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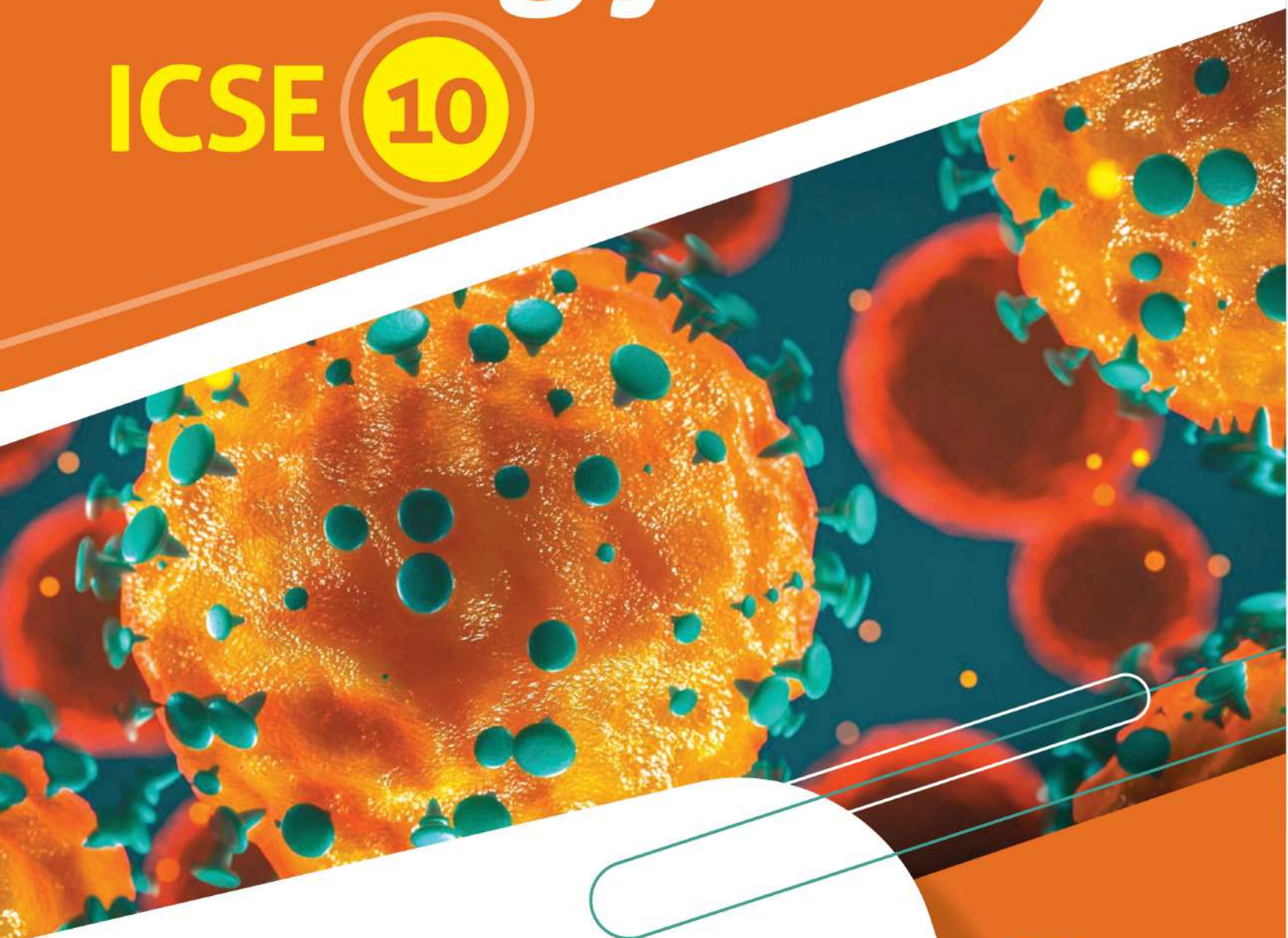


arihant

# Biology

## ICSE

## 10



Focused  
Theory

In-Text  
Exercises

Chapter  
Exercises

Past Exams'  
Questions

Sample  
Papers

Edition  
2022-23

**All in One**<sup>®</sup>  
COMPLETE STUDY | COMPLETE PRACTICE | COMPLETE ASSESSMENT

# Biology

**ICSE** **10**



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# Biology

**ICSE 10**

Focused Theory | In-Text Exercises | Chapter Exercises | Past Exams' Questions | Sample Papers

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**ARIHANT PRAKASHAN** (School Division Series)



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(School Division Series)

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# A WORD

## *With The Readers*

**All in one** ICSE Biology Class 10th has been written keeping in mind the needs of students studying in 10th ICSE. This book has been made in such a way that students will be fully guided to prepare for the exam in the most effective manner, securing higher grades.

The purpose of this book is to aid any ICSE student to achieve the best possible grade in the exam. This book will give you support during the course as well as advice you on revision and preparation for the exam itself. The material is presented in a clear & concise form and there are ample questions for practice.

## KEY FEATURES

- **Focused Theory** It contains the necessary study material well supported by Definitions, Facts, Figures, Flow Charts, etc.
- **Check Point** These are intext exercises given between the text material. These exercises have 4-5 questions based on the related concept.
- **Summary** At the end of each chapter, Summary is given. It contains crux of the chapter in pointer form that provides the quick revision of the whole chapter.
- **Exam Practice** This Exercise contains questions in that format in which these are asked in the examinations. Questions have been categorised as MCQs, Fill in the Blanks, True-False, Match the Columns, Diagram based questions, Very short answer, Short answer and Long answer type questions. All the questions given here are fully solved.
- **Chapter Exercise** It is the Assessment exercise for the complete chapter. With this exercise, students can assess their understanding of the chapter and can prepare for it accordingly.
- **Challengers** It includes some special questions based on the pattern of olympiad and other competitions to give the students a taste of the questions asked in competitions. These are not meant for school examinations.
- To make this book complete in all aspects, **Experiments** and **5 Sample Questions Papers** based on the exam pattern & Syllabus have also been given.
- At the end of book there are **Latest ICSE Specimen Paper** and **Latest ICSE Solved Paper**.

At the end it can be said that **All in one** Biology for ICSE 10th has all the material required for examination and will surely guide students to the Way to Success.

We are highly thankful to ARIHANT PRAKASHAN, MEERUT for giving us such an excellent opportunity to write this book. The role of Arihant DTP Unit and Proof Reading team is praise worthy in making of this book. Huge efforts have been made from our side to keep this book error free, but inspite of that if any error or whatsoever is skipped in the book then that is purely incidental, apology for the same, please write to us about that so that it can be corrected in the further edition of the book. Suggestions for further improvement of the book will also be welcomed.

In the end, we would like to wish **BEST OF LUCK** to our readers!

**Authors**

# PREVIEW

## CHAPTER THEORY

Contains the necessary study material well supported by Definitions, Facts, Figures, Flow charts, etc.

## CHECK POINT

There are intext exercises given between the text material. These exercises have 4-5 questions based in the related concept.

## EXAM PRACTICE

### Multiple Choice Questions

1. Among the statements given below, select the most correct option associated with a cell  
(a) The smallest entity of the living organism  
(b) The structural and functional unit of life  
(c) The macroscopic unit of life  
(d) Both (a) and (b)

Ans. (d)

2.  $G_1$ , S and  $G_2$  phases are present in which of these phases?  
(a) Anaphase (b) Interphase  
(c) Prophase (d) Metaphase

Ans. (b)

3. Synthesis phase in the cell cycle is called so, because of the synthesis of more  
(a) RNA (b) RNA and proteins  
(c) DNA (d) glucose

Ans. (c)

4. Karyokinesis and cytokinesis are the part of which phase of the cell cycle?  
(a)  $G_1$  phase (b) S phase (c) M phase (d)  $G_2$  phase

Ans. (c)

5. Cell division which helps in regeneration by keeping all somatic cells similar is  
(a) mitosis (b) meiosis  
(c) cytokinesis (d) karyokinesis

Ans. (a)

6. The nucleolus and nuclear membrane start disappearing during which phase of mitosis?  
(a) Prophase (b) Metaphase  
(c) Anaphase (d) Telophase

Ans. (a)

9. Centrioles radiate out fine microtubular fibrils called astral rays and move apart from each other towards the opposite poles. This observation is made during  
(a) prophase (b) metaphase  
(c) anaphase (d) telophase

Ans. (c)

10. Chromosomes get aligned at the centre of the cell during  
(a) anaphase (b) telophase  
(c) metaphase (d) prophase

Ans. (c)

11. A phase said to be the reverse of prophase is  
(a) anaphase (b) metaphase  
(c) telophase (d) prophase

Ans. (d)

12. The cell component visible only during cell division is  
(a) microtubule (b) chloroplast  
(c) chromosomes (d) chromatin

Ans. (d)

### Fill in the Blanks

15. Complete the following.  
(i) The process by which cell multiplies is called .....  
(ii) Mitosis forms two daughter cells and meiosis forms ..... daughter cells.  
(iii) In meiosis, the parent cell is diploid whereas the daughter cell is .....  
(iv) The division which brings the chromosome number from  $2n$  to  $n$  is .....

## SUMMARY

- Cell is the basic structural, functional and biological unit of all living organisms.
- Cell cycle involves a series of changes in a cell and cell division. It is the process of formation of new cells from the pre-existing cells.
- Cell cycle consists of two main phases: **Interphase** or non-dividing phase and **Mitotic phase** or M-phase.
- **Interphase** is further divided into three main stages on the basis of its synthetic activities. These are  $G_1$ -phase (first growth phase (synthesis of RNA and proteins)), S-phase or synthesis phase (DNA replication) and  $G_2$  phase or second growth phase (synthesis of RNA and proteins).
- The M-phase is the actual phase of division. It occurs in two steps, i.e. **Karyokinesis** and **Cytokinesis**.
- **Cell division** is the process by which life perpetuates. It is of two types: mitosis and meiosis.
- **Mitosis** leads to the production of two identical daughter cells with the same number of chromosomes.
- **Meiosis** is a special type of cell division taking place in sex cells or gametes. In this cell division, a cell undergoes two successive divisions to produce four daughter cells. Each cell contains half the number of chromosomes as compared to the parent cell.
- **Chromosomes** are highly condensed and coiled chromatin fibres. They possess genes which are responsible for the transfer of traits from one generation to the next generation.
- **Chromatids** are the thread-like form of chromosomes. These are present in nucleus during resting state of the cells.
- On the basis of the position of the centromere, chromosomes are of four types: Metacentric, Sub-metacentric, Acrocentric and Telocentric.
- **Genes** are segments of DNA.
- The DNA molecule consists of two helical strands which are unbranched and are twisted around a common axis.
- Each deoxyribonucleic acid unit consists of 3 basic molecules namely phosphate group, ribose sugar and nitrogenous base.

## CHAPTER

# 1

## Cell Cycle, Cell Division and Structure of Chromosome

The cell is the basic structural, functional and biological unit of all living organisms. Cells were first observed by **Robert Hooke** (1665) as honeycomb-like compartments in a thin slice of cork. **Anton van Leeuwenhoek** (1667) was the first to describe a living cell. **Rudolf Virchow** (1855) was the first to suggest that new cells are formed from the division of pre-existing cells.

Cell division is the fundamental characteristics of life in all living organisms. It helps in growth, development, repair and production of gametes. In this chapter, we will study about cell cycle (sequence of events occurring in a cell capable of division), cell division and structure of chromosome.

### Chapter Objective

- Cell Cycle
- Cell Division
- Mitosis
- Meiosis
- Chromosomes
- Genes
- Structure of DNA

### Cell Cycle

It is an orderly sequence of events or a set of stages by which a cell duplicates its genome, synthesises essential constituents of the cell and eventually divides into two daughter cells.

In terms of cytoplasmic increase, **cell growth** is a continuous process, while DNA synthesis occurs during a specific stage of the cell cycle. All these events occurring in a cell cycle are well-coordinated and under genetic control.

### Phases of Cell Cycle

Cell cycle consists of two main phases

1. Interphase or Non-dividing phase or Preparatory phase
2. M-phase or Division phase or Mitotic phase

### CHECK POINT 02

1. In which cell mitosis occurs?
2. .... is a longest and most complex stage of mitosis.
3. In which stage of mitosis spindle fibres get disappeared?
4. In which phase of mitosis nuclear membrane reforms?
5. What is the difference between cytokinesis in animal and plant cell?
6. Mitosis helps in the replacement of old or dead cells. True or false?

### Meiosis

In this division, the chromosome number is reduced in such a way that each daughter cell receives only half a set of chromosomes present in the parent cell. Therefore, meiosis is also called as **reductional division**. It results in the formation of four haploid cells from a diploid cell.

Meiosis is restricted to reproductive cells (germ cells) or sex cells. It results in the formation of gametes, i.e. sperms (in testes of males) and egg (in ovaries of females). In sexually

## EXAM PRACTICE

It contains questions in that format in which these are asked in the examinations, i.e., MCQs, Fill in the Blanks, True-False, Match the Columns, Diagram based questions, Very Short Answer, Short Answer & Long Answer Type Questions. All the questions are fully explained.

The explanations given here teach the students, how to write the explanations in the examinations to get full marks. Students can use these questions for practice and assess their understanding & recall of the chapter.

## SUMMARY

It contains crux of the chapter in pointer form to provide the quick revision of the whole chapter.

for ICSE 10th Examination is a complete book which can give you all; Study, Practice & Assessment. It is hoped that this book will reinforce and extend your ideas about the subject and finally will place you in the ranks of toppers.

## CHAPTER EXERCISE

At the end of the chapter, these unsolved questions are given for assessment of students. By practicing these questions, students can assess their preparation level of the chapter.

## CHAPTER EXERCISE

### Multiple Choice Questions

- At this stage of cell cycle, the cell contains 2n of DNA (chromosomes).  
(a) G<sub>1</sub>-phase  
(b) S-phase  
(c) M-phase  
(d) G<sub>2</sub>-phase
- Which phase is also referred to as pre-mitotic phase?  
(a) M-phase  
(b) S-phase  
(c) G<sub>1</sub>-phase  
(d) G<sub>2</sub>-phase
- Duplication of chromosomes is observed during  
(a) mitosis and meiosis  
(b) meiosis  
(c) mitosis  
(d) karyokinesis
- Identify the process that gives rise to daughter cells with half number of chromosomes than that of their parent cell.  
(a) Cleavage  
(b) Mitosis  
(c) Budding  
(d) Meiosis

### Fill in the Blanks

- Complete the following.  
(i) During cytokinesis, a \_\_\_\_\_ is formed in the plant cell in order to separate the two daughter cells.  
(ii) Chromosome number is halved in gametes to restore the normal number, i.e. \_\_\_\_\_ after fertilisation to form zygote.  
(iii) A \_\_\_\_\_ is the point at which the sister chromatids are held together.  
(iv) DNA replication occurs in the \_\_\_\_\_ of interphase.  
(v) In \_\_\_\_\_ stage of interphase, synthesis of RNA and proteins occur in the cell cycle.

### True-False

- State whether the statements are true/false.  
(i) Nuclear membrane in cells dividing by mitosis, remains intact upto the metaphase and disappears at telophase.  
(ii) Cell division by mitosis can be a reproductive division in living organisms.  
(iii) The nucleus in a cell has maximum size during interphase.

### Match the Columns

- Match the following columns.

Column I	Column II
A. A sequence of events occurring between the cell formation and its division.	1. G <sub>1</sub> -phase
B. It starts with karyokinesis and ends with cytokinesis after the mitotic phase.	2. G <sub>2</sub> -phase
C. Cells are metabolically active but do not proliferate.	3. M-phase
D. The pre-mitotic phase which shows increase in volume of nucleus and synthesis of RNA and proteins.	4. Cell cycle

### 1 Mark Questions

- List the events that occur during G<sub>1</sub>-phase of cell division.
- What changes do you observe during the S-phase of cell cycle?
- List any one significance of mitosis in living organisms associated with growth as a parameter.

## CHALLENGERS\*

- A cell in prophase-II of meiosis contains 12 chromosomes. How many chromosomes would be present in cell from the same organism if it were in prophase of mitosis?
- Which of the following characteristics of mitosis is not correct?  
(a) Each daughter cell formed by mitosis has the same number of chromosomes as the parent cell  
(b) During mitosis, the centromeres divide  
(c) The cells produced during mitosis possess same genetic material  
(d) During mitosis, the sister chromatids do not separate
- Cell (X) has undergone one mitotic division and cell (Y) has finished one meiotic division. How many daughter cells will be formed by X and Y? Give reason to support your answer.
- A scientist tells you that he has found a cool single-celled organism that is about to divide. He tells you that the homologous chromosomes are not paired and it does not look like any recombination has occurred. Is the organism dividing by mitosis or meiosis? Explain.
- The cells of the leaf tip of a plant contain 16 chromosomes. Each cell of the pollen tetrad of such a plant would contain  
(a) 4 chromosomes  
(b) 8 chromosomes  
(c) 16 chromosomes  
(d) 24 chromosomes

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiad, Scholarship Exams etc. For detailed explanations refer Page No. 304

## ARCHIVES\*

(Last 7 Years)

Collection of Questions Asked in Last 7 Years' (2017-2021) ICSE Class 10th Examinations

### 2017

- Choose the odd one out of the following terms given and name the category to which the others belong.  
Phosphate, RNA, Sugar, Nitrogenous base. [1]
- Synthesis phase in the cell cycle is called so, because of the synthesis of more \_\_\_\_\_ [1]  
(a) RNA  
(b) RNA and proteins  
(c) DNA  
(d) glucose
- Choose the odd one out of the following terms given and name the category to which the others belong.  
Thymine, Cytosine, Adenine, Pepsin [1]
- State the exact location of the structure : Centromere. [1]
- Differentiate between the following pairs on the basis of what is mentioned within brackets.  
Human skin cell and human ovum (number of chromosomes) [1]

### 2016

- Name the following.  
The exchange of chromatid parts between the maternal and paternal chromatids of a pair of homologous chromosomes during meiosis, [1]
- Chromosomes get aligned at the centre of the cell during  
(a) metaphase  
(b) anaphase  
(c) prophase  
(d) telophase [1]

## ICSE Examination PAPER 2019

### Biology (Fully Solved)

#### General Instructions

- You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
- The time given at the head of this paper is the time allowed for writing the answers.
- Attempt all questions from Section I and any 4 questions from Section II.
- The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

#### Section-I

[40 Marks]

Answer all questions from this section

- (a) Name the following : [16]  
(i) The layer of the eyeball that provides nourishment to the eye.  
(ii) One gaseous compound which depletes the ozone layer.  
(iii) The structure which connects the placenta and the foetus.  
(iv) A pair of corresponding chromosomes of [1]
- (b) Give suitable biological reasons for the following statements : [16]  
(i) The birth rate in India is very high.  
(ii) Carbon monoxide is dangerous when inhaled.  
(iii) Root hairs become flaccid and droop when excess fertilisers are added to the moist soil around them.  
(iv) Acid rain is harmful to the environment.  
(v) All life on earth is supported by photosynthesis. [1]

## ICSE Specimen PAPER 2019

### Biology (Fully Solved)

#### General Instructions

- You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
- The time given at the head of this paper is the time allowed for writing the answers.
- Attempt all questions from Section I and any 4 questions from Section II.
- The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

#### Section-I

[40 Marks]

- (a) Name the following : [16]  
(i) The hormone that regulates the basal metabolic rate.  
(ii) The part of the internal ear related to the static balance of the body.  
(iii) The soluble protein in blood plasma responsible for blood clotting.  
(iv) The gaseous plant hormone.  
(v) The uptake of mineral ions against the concentration gradient. [1]
- (b) Choose the correct answer from the four options given for each below : [16]  
(i) The rate of transpiration will be fastest when the day is  
A. hot, humid and windy  
B. cool, humid and windy  
C. hot, humid and still  
D. hot, dry and windy  
(ii) Cytokinins are predominantly present in  
A. permanent tissues [1]

## ARCHIVES

To have a look on the examination questions, at the end of each chapter, last 7 year's ICSE questions have been compiled, all these questions are completely covered in exam practice .

## CHALLENGERS

It includes some special questions based on the pattern of olympiad and other competitions to give the students a taste of the questions asked in competitions. These are not meant for school examinations.

## SAMPLE QUESTION PAPER and SPECIMEN PAPER

To make the students practice in the real sense, we have provided 5 Sample Question Papers, exactly based on the latest pattern, Latest Specimen Paper & 2019 Solved Paper.

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# COURSE STRUCTURE

There will be one paper of **two hours** duration of 80 marks and Internal Assessment of practical work carrying 20 marks.

The paper will be divided into **two** sections, Section I (40 marks) and Section II (40 marks).

**Section I (Compulsory)** will contain short answer questions on the entire syllabus.

**Section II** will contain **six** questions. Candidates will be required to answer any **four** of these **six** questions.

## Basic Biology

### (i) Cell Cycle and Cell Division

Cell cycle – Interphase ( $G_1$ ,  $S$ ,  $G_2$ ) and Mitotic phase.

Cell Division:

- Mitosis and its stages.
- A basic understanding of Meiosis as a reduction division (stages not required).
- A brief idea of homologous chromosomes and crossing over leading to variations.
- Significance and major differences between mitotic and meiotic division.

### (ii) Structure of Chromosome

Basic structure of chromosome with elementary understanding of terms such as chromatin, chromatid, gene structure of DNA and centromere.

### (iii) Genetics: Mendel's Laws of Inheritance and Sex Linked Inheritance of Diseases

- The three laws of Mendel.
- Monohybrid cross – phenotype and genotype.
- Dihybrid cross – Only phenotype.
- The following terms to be covered: Gene, allele, heterozygous, homozygous, dominant, recessive, mutation, variation, phenotype, genotype.
- Sex determination in human beings.  
Sex linked inheritance of diseases to include only X-linked like haemophilia and colour blindness.

## Plant Physiology

- (i) Absorption by roots, imbibition, diffusion and osmosis; Osmotic pressure, root pressure; turgidity and flaccidity; Plasmolysis and deplasmolysis; The absorption of water and minerals; Active and Passive transport (in brief); The rise of water up to the xylem; Forces responsible for ascent of sap.

- Understanding of the processes related to absorption of water by the roots.
- Characteristics of roots, which make them suitable for absorbing water.
- Structure of a single full-grown root hair.
- A general idea of Cohesive, Adhesive forces and transpirational pull.
- Experiments to show the conduction of water through the xylem.

### (ii) Transpiration - process and significance.

Ganong's potometer and its limitations. The factors affecting rate of transpiration. Experiments on transpiration. A brief idea of guttation and bleeding.

- Concept of transpiration and its importance to plants
- Experiments related to transpiration:
- (a) Loss in weight of a potted plant or a leafy shoot in a test tube as a result of transpiration.
- (b) Use of cobalt chloride paper to demonstrate unequal rate of transpiration in a dorsiventral leaf.
- Mechanism of stomatal transpiration on the basis of potassium ion exchange theory.
- Adaptations in plants to reduce transpiration.
- A brief idea of guttation and bleeding.

- (iii) Photosynthesis: The process and its importance to life in general; Experiments to show the necessity of light, carbon dioxide, chlorophyll, formation of starch and release of oxygen; Carbon cycle.

#### *The Process and Significance of Photosynthesis.*

- *The internal structure of chloroplast to be explained to give an idea of the site of light and dark reactions.*
  - *Opening and closing of stomata based on potassium ion exchange theory.*
  - *Overall balanced chemical equation to represent photosynthesis.*
  - *Introduction of the terms "Photochemical" for light phase and "Biosynthetic" for dark phases.*
  - *Light reaction - activation of chlorophyll followed by photolysis of water, release of O<sub>2</sub>, formation of ATP (photophosphorylation) and NADPH.*
  - *Dark reaction - only combination of hydrogen released by NADP with CO<sub>2</sub> to form glucose. (detailed equations are not required).*
  - *Adaptations in plants for photosynthesis.*
  - *Experiments with regard to the factors essential for photosynthesis; emphasis on destarching and the steps involved in starch test.*
  - *A diagrammatic representation of "Carbon cycle".*
- (iv) Chemical coordination in Plants:** A general study of plant growth regulators; Tropic movements in Plants.
- *A brief idea of the physiological effects of Auxins, Gibberellins, Cytokinins, Absciscic acid and Ethylene in regulating the growth of plants.*
  - *A basic understanding of the tropic movements in plants with reference to – Phototropism, Geotropism, Hydrotropism, Thigmotropism and Chemotropism (supported with suitable examples).*

## **Human Anatomy and Physiology**

- (i) Circulatory System:** Blood and lymph, the structure and working of the heart, blood vessels, circulation of blood (Only names of the main blood vessels entering and leaving the heart, liver and kidney will be required). Lymphatic system.
- *Composition of blood (Structure and functions of RBC, WBC and platelets).*
  - *Brief idea of tissue fluid and lymph.*
  - *Increase in efficiency of mammalian red blood cells due to absence of certain organelles; Reasons for the same.*

- *A brief idea of blood coagulation.*
- *Structure and working of the heart along with names of the main blood vessels entering and leaving the heart, the liver and the kidney.*
- *Concept of systole and diastole; Concept of double circulation.*
- *Brief idea of pulse and blood pressure.*
- *Blood vessels: artery, vein and capillary to be explained with the help of diagrams to bring out the relationship between their structure and function.*
- *Brief idea of the lymphatic organs: Spleen and tonsils.*
- *ABO blood group system, Rh factor.*
- *Significance of the hepatic portal system.*

- (ii) Excretory System:** A brief introduction to the excretory organs; Parts of the urinary system; Structure and function of the kidneys; Blood vessels associated with kidneys; Structure and function of nephron.

- *A brief idea of different excretory organs in the human body.*
- *External and internal structure of the kidney;*
- *Parts of the urinary system along with the blood vessels entering and leaving the kidney; Functions of various parts of the urinary system (emphasis on diagram with correct labelling). A general idea of the structure of a kidney tubule/nephron.*
- *A brief idea of ultra-filtration (emphasis on the diagram of Malpighian capsule); Selective reabsorption and tubular secretion in relation to the composition of blood plasma and urine formed.*

- (iii) Nervous system:** Structure of Neuron; central, autonomous and peripheral nervous system (in brief); brain and spinal cord; reflex action and how it differs from voluntary action.

Sense organs – Eye: Structure, functions, defects and corrective measures: Ear: Parts and functions of the ear.

- *Parts of a neuron.*
- *Various parts of the external structure of the brain and its primary parts: Medulla oblongata, cerebrum, cerebellum, thalamus, hypothalamus and pons; their functions.*
- *Reference to the distribution of white and gray matter in Brain and Spinal cord.*
- *Voluntary and involuntary actions – meaning with examples.*

- Diagrammatic explanation of the reflex arc, showing the pathway from receptor to effector.
  - A brief idea of the peripheral and autonomic nervous system in regulating body activities.
  - Differences between natural and acquired reflex.
  - External and Internal structure and functions of the eye and ear and their various parts.
  - A brief idea of stereoscopic vision, adaptation and accommodation of eye.
  - Defects of the eye (Myopia, hyperopia hypermetropia, presbiopia, astigmatism and cataract) and corrective measures (Diagrams included for myopia and hyperopia only).
  - The course of perception of sound in human ear.
  - Role of ear in maintaining balance of the body.
- (iv) Endocrine System: General study of the following glands: Adrenal, Pancreas, Thyroid and Pituitary. Endocrine and Exocrine glands.**
- Differences between Endocrine and Exocrine glands.
  - Exact location and shape of the endocrine glands in the human body.
  - Hormones secreted by the following glands: Pancreas: insulin and glucagon; Thyroid: only thyroxine; Adrenal gland: Cortical hormones and adrenaline; Pituitary: growth hormone, tropic hormones, ADH and oxytocin.
  - Effects of hypo Secretion and hyper Secretion of hormones.
  - A brief idea of feedback mechanism with reference to TSH.
- (v) The Reproductive System: Organs, fertilisation functions of placenta in the growth of the embryo Menstrual cycle.**
- Functions of male and female reproductive organs and male accessory glands. An idea of secondary sexual characters.
  - Structure and functions of the various parts of the sperm and egg.
  - Explanation of the terms: Fertilisation, implantation, placenta, gestation and parturition.
  - A brief idea of the role of placenta in nutrition, respiration and excretion of the embryo; Its endocrinal function.

- Functions of Foetal membranes and amniotic fluid.
- Menstrual cycle, outline of menstrual cycle.
- Role of Sex hormones: Testosterone, oestrogen and progesterone in reproduction.
- Identical and fraternal twins: Meaning and differences only.

## Population

Population explosion in India; need for adopting control measures - Population control.

- Main reasons for the sharp rise in human population in India and in the world.
- A brief explanation of the terms: Demography, population density, birth rate, death rate and growth rate of population.
- Problems faced due to population explosion: Unemployment, over exploitation of natural resources, low per capita income, price rise, pollution, unequal distribution of wealth.
- Methods of population control: Surgical methods – Tubectomy and vasectomy.

## Human Evolution

Basic introduction to Human evolution and Theories of evolution: Lamarck's theory of inheritance; Darwin's theory of evolution by natural selection.

- A brief idea of human ancestors – Australopithecus, Homo habilis, Homo erectus, Neanderthals, Cro-Magnon and Homo sapiens sapiens (Modern man) with reference to the following characteristics: -
  - Bipedalism
  - Increasing cranial capacity
  - Reduction of size of canine teeth
  - Forehead and brow ridges
  - Development of chin
  - Reduction in body hair
  - Height and posture
- Lamarck's theory of inheritance of acquired characteristics – with reference to use of organs (e.g. neck and forelimbs of giraffe) and disuse of organs (e.g. vestigial organs in humans like wisdom teeth, vermiform appendix, pinnae).
- Darwin's theory of Natural selection: Survival of the fittest - e.g. adaptation of peppered moth.

## Pollution

- (i) Types and sources of pollution; major pollutants.
  - *Air: Vehicular, industrial, burning garbage, brick kilns.*
  - *Water: Household detergents, sewage, industrial waste, oil spills.*
  - *Thermal pollution.*
  - *Soil: Industrial waste, urban commercial and domestic waste, chemical fertilisers.*
  - *Biomedical waste – used and discarded needles, syringes, soiled dressings, etc.*
  - *Radiation: X-rays; radioactive fallout from nuclear plants.*
  - *Noise: Motor vehicles, Industrial establishments, Construction sites, Loudspeakers, etc.*
- (ii) Biodegradable and Non-biodegradable Wastes  
*Biodegradable wastes: Meaning and example; paper, vegetable peels, etc.*  
*Non-biodegradable wastes: meaning and example; plastics, glass, styrofoam, etc. Pesticides like DDT, etc.*
- (iii) Effects of pollution on climate, environment, human health and other organisms; control measures.
  - *Brief explanation of: Greenhouse effect and Global warming, Acid rain, Ozone layer depletion.*
  - *Measures to Control Pollution:*
    - *Use of unleaded petrol / CNG in automobiles*
    - *switching of Engines at traffic signal lights*
    - *Social forestry*
    - *Setting of sewage treatment plants*
    - *Ban on polythene and plastics*
    - *Organic farming*
    - *Euro Bharat vehicular standard. (A brief idea of the above measures)*
  - *A brief mention of "Swach Bharat Abhiyan"- A National Campaign for Clean India.*

## Internal Assessment of Practical Work

*The practical work is designed to test the ability of the candidates to make an accurate observation from specimens of plants and animals.*

## Plant Life

- (i) Observation of permanent slides of stages of mitosis.
- (ii) Experiments demonstrating:
  - Diffusion: using potassium permanganate in water.
  - Osmosis: Thistle funnel experiment and potato osmoscope,
  - Absorption: using a small herbaceous plant.
- (iii) Experiments on transpiration
  - demonstration of the process using a Bell jar.
  - demonstration of unequal transpiration in a dorsiventral leaf using cobalt chloride paper.
  - demonstration of uptake of water and the rate of transpiration using Ganong's potometer.
- (iii) Experiments on Photosynthesis:
  - to show the necessity of light, carbon dioxide and chlorophyll for photosynthesis.
  - to show the release of O<sub>2</sub> during photosynthesis using hydrilla / elodea.

## Animal Life

- (i) Identification of the structures of the urinary system, heart and kidney (Internal structure) and brain (External view) through models and charts
- (ii) The identification of different types of blood cells under a microscope.
- (iii) Identification of the internal structure of the ear and eye (Through models and charts).
- (iv) Identification and location of selected endocrine glands: Adrenal, pancreas, thyroid and pituitary glands with the help of a model or chart.

# Cell Cycle, Cell Division and Structure of Chromosome

The cell is the basic structural, functional and biological unit of all living organisms. Cells were first observed by **Robert Hooke** (1665) as honeycomb-like compartments in a thin slice of cork. **Antony van Leeuwenhoek** (1667) was the first to describe a living cell. **Rudolf Virchow** (1855) was the first to suggest that new cells are formed from the division of pre-existing cells.

Cell division is the fundamental characteristics of life in all living organisms. It helps in growth, development, repair and production of gametes. In this chapter, we will study about cell cycle (sequence of events occurring in a cell capable of division), cell division and structure of chromosome.

## Cell Cycle

It is an orderly sequence of events or a set of stages by which a cell duplicates its genome, synthesises essential constituents of the cell and eventually divides into two daughter cells.

In terms of cytoplasmic increase, **cell growth** is a continuous process, while DNA synthesis occurs during a specific stage of the cell cycle. All these events occurring in a cell cycle are well-coordinated and under genetic control.

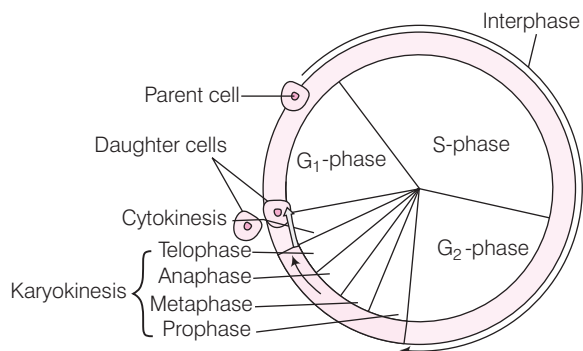
## Phases of Cell Cycle

Cell cycle consists of two main phases

1. Interphase or Non-dividing phase or Preparatory phase
2. M-phase or Division phase or Mitotic phase

## Chapter Objective

- Cell Cycle
- Cell Division
- Mitosis
- Meiosis
- Chromosomes
- Genes
- Structure of DNA



Diagrammatic view of a cell cycle indicating formation of two cells

## 1. Interphase

It is the period between two successive cell divisions. It includes the interval between the end of one cell division and the beginning of the next cell division.

It is the longest phase of cell cycle. Cells are metabolically active during this phase because of biosynthesis and multiplication of various cellular components.

Interphase is further divided into three main sub-stages depending upon its synthetic activities as described below

- (i) **G<sub>1</sub>-phase** (First growth phase) In this phase, cell grows in size and becomes metabolically active. It prepares itself for DNA replication and synthesis of RNA and proteins.

Cell organelles like mitochondria and chloroplasts contain their own DNA. It replicates in the cell for division into two daughter cells.

In the late G<sub>1</sub>-phase, cells can enter in any one of the following two pathways

- (a) Withdrawl from the cell cycle and entering into the resting phase (G<sub>0</sub>-phase).
- (b) Start preparation for the next cell division by entering the S-phase (Synthesis phase).

- (ii) **S-phase** (Synthesis phase) In this phase, actual synthesis or DNA replication takes place. Each chromosome contains two sister chromatids that remain attached to a common centromere.

The DNA content doubles from  $2n$  to  $4n$ .

- (iii) **G<sub>2</sub>-phase** (Second growth phase) This phase is comparatively shorter and is also known as **pre-mitotic phase**. During this phase, the synthesis of only RNA and proteins continues as they are required for mitosis. At the end of this stage, the cell is ready to start the next cell division and the cycle further goes on.

## 2. M-phase or Mitotic Phase

M-phase is the actual phase of division. During this phase, all components of the cell reorganise for cell division. The duplicated chromosomes and all the other cellular contents get distributed among the two daughter cells.

It occurs in two steps, i.e. **karyokinesis** (division of nucleus) and **cytokinesis** (division of cytoplasm).

### Does the cell cycle go on continuously?

The cell cycle is a continuous process. However, it stops at certain places in different cells.

The stoppage of cell cycle is temporary in some cells, while permanent in others. This cycle prepares a cell for its entry into the division phase. Those cells which are not divided more than once, do not have recurring cell cycle, like nerve cells. Some other cells like liver cells, divide only once in 1-2yrs, hence the stoppage is temporary. However, skin cells undergo continuous cell cycle and division to replace the damaged and dead cells.

A continuous cell cycle is harmful in the way, as it may cause tumours or cancers in the various parts or organs of an organism.

### CHECK POINT 01

- 1 Cell cycle consists of how many phases?
- 2 DNA replication occurs in which phase of cell cycle?
- 3 Which phase of cell cycle is known as pre-mitotic phase?
- 4 Which phase of cell cycle is actual phase of division?
- 5 Give example of cells which undergo continuous cell cycle and cell division.

## Cell Division

It is an essential process in all living organisms. The mode of cell division is fundamentally similar in all organisms. During the process of cell division, the processes like DNA replication and cell growth must take place in a sequential and coordinated manner. These processes ensure the correct division and formation of progeny cells with intact genomes.

The process of cell division in all living organisms can be either of the two types

1. Mitosis
2. Meiosis

## Mitosis

In this type of division, the chromosomes replicate themselves and get equally distributed into daughter nuclei. The chromosome number in the parental and progeny cell (diploid) remains the same. Therefore, it is also known as **equational division**.

Mitosis is also known as **somatic cell division** because it always occurs in somatic cells. Mitotic cell division occurs

in the diploid somatic cells of animals. In plants, mitotic division is seen in both haploid and diploid cells.

It is known as the phase of actual cell division. It starts with the division of nucleus, followed by the separation of daughter chromosomes, i.e. **karyokinesis** and terminates with the cytoplasmic division, i.e. **cytokinesis**.

## 1. Karyokinesis

It is the division of parent nucleus into two identical daughter nuclei with same number of chromosomes as in the parents. It is further divided into four main substages which are as follows

- (i) **Prophase** It is the longest and the most complex phase of mitosis. During this phase, condensation of the chromatin fibres takes place to form chromosomes.

The characteristics of this phase are as follows

- Each chromosome splits longitudinally forming two chromatids, joined to each other at one point called **centromere**.
- The nuclear membrane and nucleolus disappear.
- The centrosome splits into two centrioles, thus initiating the division of cell.
- Centrioles develop very fine microtubular fibrils called **astral rays**. Then they move apart from each other, towards the opposite poles.
- Between two asters very fine proteinaceous thread-like structures develop called **spindle fibres**. In plants, development of spindle fibres occurs without the involvement of centrioles.

### Mitotic Poison : Colchicine

Colchicine, an alkaloid, extracted from the corms of autumn crocus (*Colchicum autumnale*), acts as a poison for mitosis. It does not allow the formation of mitotic spindle by preventing the assembly of microtubules. It does not affect replication of chromosomes. Thus, meristematic cells treated with this chemical show doubling of chromosomes. It usually causes the arrest of metaphase stage of mitosis.

- (ii) **Metaphase** The second phase of mitosis starts with disintegration of nuclear membrane in the late prophase.

The characteristics of this phase are as follows

- Chromosomes start moving towards the equatorial plane of the spindle formed in prophase.
- Spindle fibres are extended towards the chromosome.
- Shortening and thickening of chromosomes occur.
- The chromosomes align or arrange themselves at the equator in one plane known as **metaphasic plate**.

- (iii) **Anaphase** The shortest phase amongst all phases of mitosis.

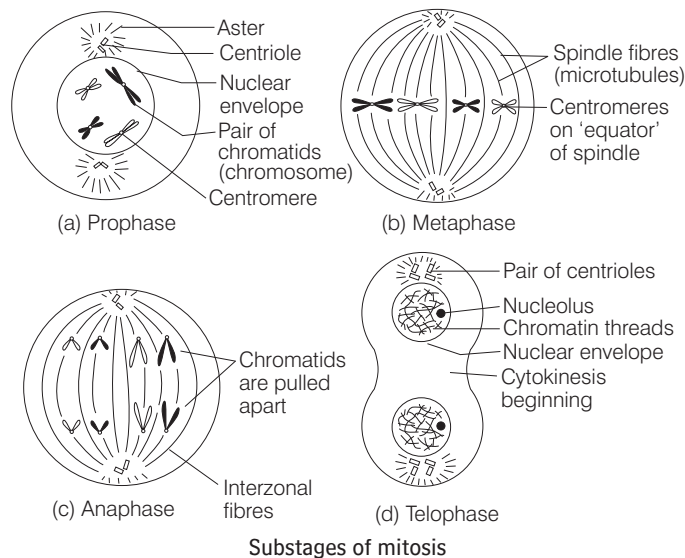
The characteristics of this phase are as follows

- The centromere of each chromosome divides.
- Two sister chromatids of each chromosome separate from each other due to the constriction of spindle fibres. They move to the opposite poles.
- The spindle fibres elongate and the cell becomes longer.

- (iv) **Telophase** It is a long and complex phase that works just opposite to the prophase.

The characteristics of this phase are as follows

- During this phase, the spindle fibres disappear.
- The chromosomes reach their respective poles and start to decondense and lose their individuality as discrete elements.
- Chromatids lengthen to become chromatin threads.
- Nuclear membrane starts reforming around each group of chromosomes. Golgi complex and nucleolus also reappear.



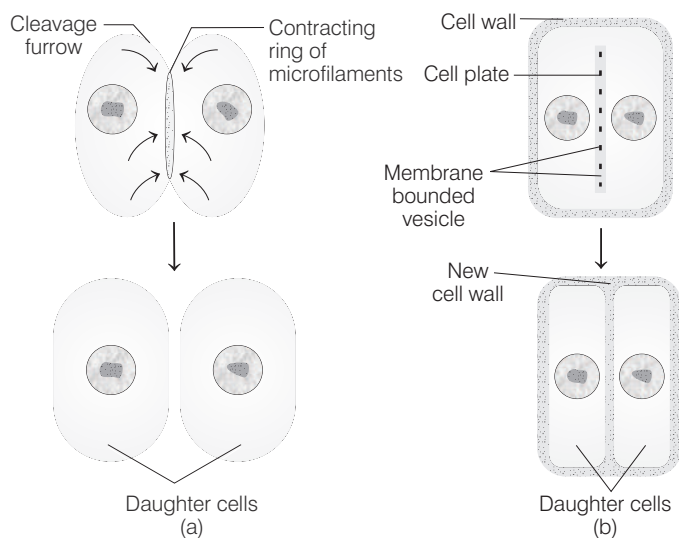
## 2. Cytokinesis

At the end of mitosis, division of cytoplasm and equal distribution of cell organelles in two daughter cells occurs by the process of cytokinesis. The process of cytokinesis occurs differently in the plant and animal cells.

Cytokinesis in animal cells takes place by furrowing method. A constriction or furrow appears in the cell membrane at the middle of the cell. This furrow deepens during telophase and splits the cell into two identical

daughter cells. Cytokinesis in plant cells takes place by cell plate method. The formation of cell plate usually begins during the late anaphase or early telophase.

The formation of a new wall in plant cells takes place at the equator of the cell. It starts growing outward towards the periphery to form two separate daughter cells.



Cytokinesis : (a) In animals, (b) In plants

## Significance of Mitosis

- (i) **Genetic stability** Mitosis helps in maintaining the number of chromosomes as that of parents.
- (ii) **Growth** Cell division leads to growth of a multicellular organism by forming clusters of cells. These later take up specific functions.
- (iii) **Repair and maintenance** The wear and tear of pre-existing cells, cellular damage due to injuries, etc., are checked by new cells formed during division.
- (iv) **Asexual reproduction** A single-celled unicellular organism like *Amoeba* reproduces by the division of cell that constitutes their body.
- (v) **Replacement** It replaces old and dead cells.

### CHECK POINT 02

- 1 In which cell mitosis occurs?
- 2 ..... is a longest and most complex stage of mitosis.
- 3 In which stage of mitosis spindle fibres get disappeared?
- 4 In which phase of mitosis nuclear membrane reforms?
- 5 What is the difference between cytokinesis in animal and plant cell?
- 6 Mitosis helps in the replacement of old or dead cells. True or false?

## Meiosis

In this division, the chromosome number is reduced in such a way that each daughter cell receives only half a set of chromosomes present in the parent cell. Therefore, meiosis is also called as **reductional division**. It results in the formation of four haploid cells from a diploid cell.

Meiosis is restricted to reproductive cells (germ cells) or sex cells. It results in the formation of gametes, i.e. sperms (in testes of males) and egg (in ovaries of females). In asexually reproducing organisms, meiosis results in the formation of asexual reproductive bodies like spores. The process of meiotic division is completed in two stages, i.e.

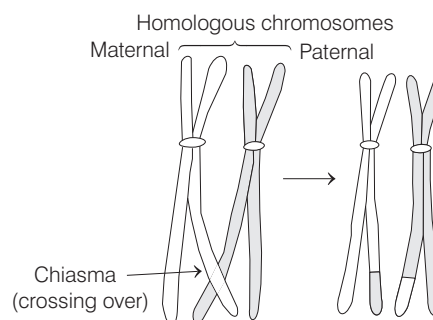
- (i) **Meiosis-I** is the heterotypic or reductional division. Here, the parental chromosomes replicate to form identical sister chromatids. The number of chromosomes reduces from diploid ( $2n$ ) to haploid ( $n$ ).
- (ii) **Meiosis-II** is a homotypic or a mitosis-like equational division. Here, the haploid nuclei divide mitotically to produce four daughter nuclei.

**Note**

- Like mitosis, both meiosis-I and II, have four stages: prophase, metaphase, anaphase and telophase.
- Meiosis-II have same stages as in mitosis.

## Significance of Meiosis

- (i) **Reproduction** It produces gametes with haploid number of chromosomes in sexually reproducing organisms.
- (ii) **Maintenance of chromosome number constant** Chromosome number is halved in gametes to maintain the normal number, i.e.  $2n$  in zygote after fertilisation. This helps in maintaining constant number of chromosomes in species.
- (iii) **Variation due to crossing over** In meiosis, a mutual exchange of corresponding parts of non-sister chromatids occurs at the **chiasmata**. It occurs between the two members of a **homologous pair** of chromosomes. It results in genetic recombination or variation.



Chromatids exchange between non-sister chromatids

**Note** Homologous chromosomes are two sets of chromosomes in a diploid cell that undergoes meiosis. These chromosomes are similar in size, shape and position of centromere.

Out of each pair of homologous chromosomes, one is shared by the female parent and the other is shared by the male parent.

- (iv) **Evolution** Meiosis acts as a source of producing genetic variations in species which lead to evolution.

#### Differences between Mitosis and Meiosis

Parameters	Mitosis	Meiosis
Occurrence	Somatic cells	Reproductive cells
Reason/ Function	For growth and development of various body parts and organism as whole.	It occurs only for the formation of gametes (male and female).
Period of occurrence	Occurs repeatedly throughout the life.	Occurs only during reproductive stage.
Number of daughter cells produced	After every mitotic division, two daughter cells are formed.	Meiotic division forms four daughter cells.
Daughter cells and number of chromosomes	Daughter cells resemble each other as well as their mother cell. A full set of chromosomes is passed to each daughter cell, i.e. a diploid (2n) set.	Daughter cells neither resemble one another nor their mother cell. Half the number of total chromosomes, i.e. a haploid (n) set is passed to each daughter cell.
Nuclear divisions	After duplication of chromosome, a single nuclear division occurs.	Two nuclear divisions occur after chromosomal duplication.
Occurrence of variations	Mitosis does not introduce variations.	Meiosis generates variations in the organism.

#### CHECK POINT 03

- Which division is also called reductional division?
- In which type of cells meiosis occurs?
- Why meiosis-II is called homotypic division?
- Name four stages similar in mitosis and meiosis.
- Give difference between mitosis and meiosis on the basis of number of daughter cells produced.

## Chromosomes

The highly condensed and coiled chromatin fibres which appear during karyokinesis are called **chromosomes**. They were first discovered by the Swiss botanist **Karl Wilhelm von Nageli** in plant cells in 1842.

Chromosomes were named so by **Waldayer** (1888) because of their feature of uptaking the colour of the stain they were treated with for various studies.

Chromosomes are the carriers of units of heredity, i.e. **genes** from one generation to the next. In our body, all the cells have a specific number of chromosomes.

## Structure of Chromosomes

Chromosomes can be observed at the metaphase stage of cell division. Each chromosome when present in the condensed form, consists of two exactly similar rod-like structures called **chromatids**.

Both chromatids are joined by a point of attachment known as **centromere** (primary constriction). It is located at a particular site in the chromosome and helps in attachment of the spindle fibres to the chromosome.

The parts of chromatids on the two sides of the centromere, are referred to as **arms**. The chromatids consist of serially arranged swellings or bead-like aggregates in them called as **chromomeres**.

Some chromosomes possess a small fragment or knob-like structure called **satellite**. Such chromosomes are known as **SAT chromosomes**. The terminal regions on either sides of the chromosomes are known as **telomeres**.

**Roger Kornberg** in 1974 reported that chromosome is made up of DNA and proteins.

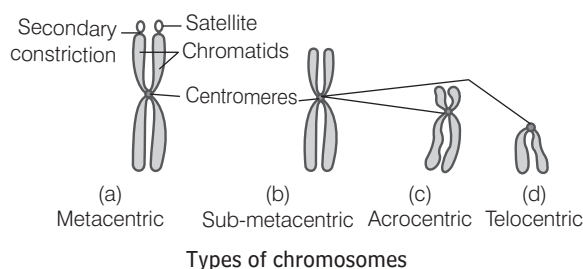
## Chromatin

It is a thread-like structure present in the resting state of nucleus in the cell. When the cell is not dividing, it is called chromatin or chromatin fibre.

## Types of Chromosomes

On the basis of the position of the centromere, chromosomes are classified into four main types

- Metacentric chromosomes** Centromere is located in the centre. Chromosome has equal arms.
- Sub-metacentric chromosomes** Centromere is present slightly away from the centre. The chromosome has one short and one long arm.
- Acrocentric chromosomes** Centromere is located near the end of the chromosome. Chromosome has one extremely short and one very long arm.
- Telocentric chromosomes** Centromere is present at the terminal or extreme end.



## Functions of Chromosomes

- (i) They direct the synthesis of particular protein, enzyme, molecule, etc.
- (ii) They control the cell division, growth, metabolism and differentiation.
- (iii) They determine the sex of an individual.
- (iv) They are responsible for evolution of species by inducing mutations, variations and crossing over.
- (v) They transfer the genetic information of an organism to the next generation.

## Genes

The segments of DNA responsible for transmission of characters from one generation to next generation is called gene.

## Structure of DNA

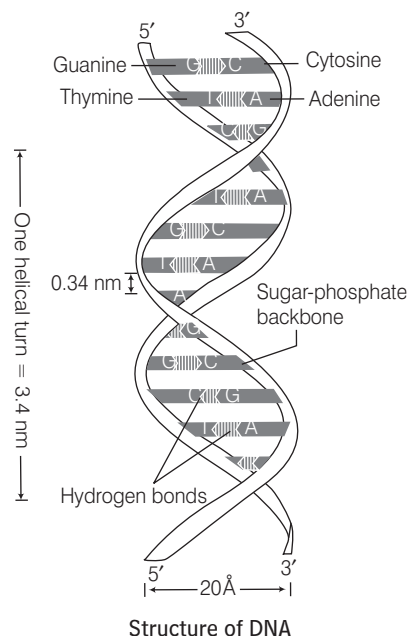
DNA or Deoxyribonucleic Acid is the chemical basis of gene which acts as a genetic material in most of the living organisms. **James Watson** and **Francis Crick** (1953) proposed the double helix model for the DNA structure on the basis of X-ray diffraction data produced by **Maurice Wilkins** and **Rosalind Franklin**.

The DNA molecule consists of two helical strands which are unbranched and are twisted around a common axis. Each deoxyribonucleotide unit consists of 3 basic molecules

- (i) Phosphate group ( $\text{PO}_4^-$ )
- (ii) 5- carbon deoxyribose and sugar ( $\text{C}_5\text{H}_{10}\text{O}_4$ )
- (iii) Nitrogenous base

Nitrogenous base may be a nine-membered, double-ringed **purine** [adenine (A) or guanine (G)] or a 6-membered, single-ringed **pyrimidine** [thymine (T) or cytosine (C)].

The backbone of DNA chain is built up of alternating deoxyribose and phosphate group.



### CHECK POINT 04

- 1 What are centromeres?
- 2 Name the thread-like structure found in a resting state of nucleus.
- 3 Name the chromosome in which centromere is present at the terminal end.
- 4 Who proposed the double helix structure of DNA?
- 5 Write the nitrogenous bases found in DNA.

# SUMMARY

- Cell is the basic structural, functional and biological unit of all living organisms.
- Cell cycle involves a series of changes in a cell and cell division. It is the process of formation of new cells from the pre-existing cells.
- Cell cycle consists of two main phases; Interphase or non-dividing phase and Mitotic phase or M-phase.
- Interphase is further divided into three main stages on the basis of its synthetic activities. These are  $G_1$ -phase first growth phase (synthesis of RNA and proteins), S-phase or synthesis phase (DNA replication) and  $G_2$ -phase or second growth phase (synthesis of RNA and proteins).
- The M-phase is the actual phase of division. It occurs in two steps; i.e. Karyokinesis and Cytokinesis.
- Cell division is the process by which life perpetuates. It is of two types; mitosis and meiosis.
- Mitosis leads to the production of two identical daughter cells with the same number of chromosomes.
- Meiosis is a special type of cell division taking place in sex cells or gametes. In this cell division, a cell undergoes two successive divisions to produce four daughter cells. Each cell contains half the number of chromosomes as compared to the parent cell.
- Chromosomes are highly condensed and coiled chromatin fibres. They possess genes which are responsible for the transfer of traits from one generation to the next generation.
- Chromatins are the thread-like form of chromosomes. These are present in nucleus during resting state of the cells.
- On the basis of the position of the centromere, chromosomes are of four types; Metacentric, Sub-metacentric, Acrocentric and Telocentric.
- Genes are segments of DNA.
- The DNA molecule consists of two helical strands which are unbranched and are twisted around a common axis.
- Each deoxyribonucleotide unit consists of 3 basic molecules namely phosphate group, ribose sugar and nitrogenous base.

# EXAM PRACTICE

## Multiple Choice Questions

1. Among the statements given below, select the most correct option associated with a cell
  - (a) The smallest entity of the living organism
  - (b) The structural and functional unit of life
  - (c) The macroscopic unit of life
  - (d) Both (a) and (b)

**Ans.** (d)
2.  $G_1$ , S and  $G_2$  -phases are present in which of these phases?
  - (a) Anaphase
  - (b) Interphase
  - (c) Prophase
  - (d) Metaphase

**Ans.** (b)
3. Synthesis phase in the cell cycle is called so, because of the synthesis of more [2017]
  - (a) RNA
  - (b) RNA and proteins
  - (c) DNA
  - (d) glucose

**Ans.** (c)
4. Karyokinesis and cytokinesis are the part of which phase of the cell cycle?
  - (a)  $G_1$  -phase
  - (b) S-phase
  - (c) M-phase
  - (d)  $G_2$  -phase

**Ans.** (c)
5. Cell division which helps in regeneration by keeping all somatic cells similar is
  - (a) mitosis
  - (b) meiosis
  - (c) cytokinesis
  - (d) diakinesis

**Ans.** (a)
6. The nucleolus and nuclear membrane start disappearing during which phase of mitosis?
  - (a) Prophase
  - (b) Metaphase
  - (c) Anaphase
  - (d) Telophase

**Ans.** (a)
7. The chromosomes are joined together at a point called
  - (a) centriole
  - (b) chromatid
  - (c) centromere
  - (d) centrosome

**Ans.** (c)
8. A chromosome when present in condensed form, consists of
  - (a) four chromatids
  - (b) two chromatids
  - (c) one chromatid
  - (d) five chromatids

**Ans.** (b)
9. Centrioles radiate out fine microtubular fibrils called astral rays and move apart from each other towards the opposite poles. This observation is made during
  - (a) prophase
  - (b) metaphase
  - (c) anaphase
  - (d) telophase

**Ans.** (c)
10. Chromosomes get aligned at the centre of the cell during [2015]
  - (a) anaphase
  - (b) telophase
  - (c) metaphase
  - (d) prophase

**Ans.** (c)
11. A phase said to be the reverse of prophase is
  - (a) interphase
  - (b) metaphase
  - (c) anaphase
  - (d) telophase

**Ans.** (d)
12. The cell component visible only during cell division is [2013]
  - (a) mitochondria
  - (b) chloroplast
  - (c) chromosomes
  - (d) chromatin

**Ans.** (d)
13. The region where crossing over in chromosome occurs is
  - (a) cell plate
  - (b) spindle fibres
  - (c) chromomere
  - (d) chiasmata

**Ans.** (d)
14. DNA is made up of sugar, mainly
  - (a) pentose
  - (b) hexose
  - (c) triose
  - (d) fructose

**Ans.** (a)

## Fill in the Blanks

15. Complete the following.
  - (i) The process by which cell multiplies is called .....
  - (ii) Mitosis forms two daughter cells and meiosis forms ..... daughter cells.
  - (iii) In meiosis, the parent cell is diploid whereas the daughter cell is .....
  - (iv) The division which brings the chromosome number from  $2n$  to  $n$  is .....

- (v) The chromosomes which are exactly similar and bear same genes at same loci are called ..... chromosomes.
- (vi) The nitrogenous bases in DNA are ..... in number.
- (vii) ..... is the phenomenon of contraction of cytoplasm from cell wall. [2011]

**Ans.** (i) cell division  
 (ii) four  
 (iii) haploid  
 (iv) meiosis  
 (v) homologous  
 (vi) four  
 (vii) Nucleosome

### True-False

- 16.** State, whether the following statements are true or false. Also rewrite the false statements.
- (i)  $G_1$  is the resting phase of cell cycle.
  - (ii) M-phase terminates with karyokinesis.
  - (iii) The longest phase of cell cycle is interphase.
  - (iv) Duplicated chromosomes remain attached at a point termed centrosome.
  - (v) Chromosomes are most thick and shortest in the telophase of mitosis.
  - (vi) Chromatin is a condensed ball of small and thick fibres.
  - (vii) Lysosome is a part of the cell in which chromosomes are present. [2011]
  - (viii) Centromere is the organelle of the cell that initiates cell division. [2011]

**Ans.** (i) False. The resting phase of cell cycle is  $G_0$ -phase.  $G_1$  is the first growth phase.  
 (ii) False. M-phase terminates with cytokinesis, i.e. division of cytoplasm.  
 (iii) True.  
 (iv) False. Duplicated chromosomes remain attached to a point called centromere.  
 (v) False. Chromosomes are the thickest and the shortest at anaphase of mitosis.  
 (vi) False. Chromatin is thread-like structure present in nucleus.  
 (vii) False. Nucleus is a part of the cell in which chromosomes are present.  
 (viii) False. Centrosome is the organelle of the cell that initiates cell division.

### Match the Columns

- 17.** Match the following columns.

Column I	Column II
A. Chromosomes become arranged in a horizontal plane at the equator	1. Anaphase
B. Daughter chromosomes move to opposite poles of the spindle	2. Prophase
C. Chromosomes become visible as fine-like long threads.	3. Telophase
D. Chromosomes lose their distinctiveness and gradually transform into chromatin network	4. Metaphase

**Ans.** A – 4, B – 1, C – 2, D – 3

- 18.** Match the following columns.

Column I	Column II
A. $G_2$ -phase	1. Unit of heredity transmission
B. Anaphase	2. Synthesis of RNA and proteins
C. S-phase	3. Shortest phase of cell division
D. Adenine	4. Duplication of DNA
E. Gene	5. Guanine

**Ans.** A – 2, B – 3, C – 4, D – 5, E – 1

### 1 Mark Questions

- 19.** Given below are the sets of five terms, rewrite the terms in a logical sequence as directed at the end of statement.

Karyokinesis, S-phase, Cytokinesis,  $G_1$ -phase,  $G_2$ -phase (cell cycle).

[2012]

**Ans.**  $G_1$ -phase, S-phase,  $G_1$ -phase, Karyokinesis, Cytokinesis.

- 20.** During which phase in cell cycle, proteins and RNA are synthesised for distribution to the daughter cells?

**Ans.** RNA and proteins are synthesised in both  $G_1$ -phase and  $G_2$ -phase.

- 21.** Given below is the group of five terms, arrange and rewrite the terms in the correct order, so as to be in a logical sequence.

Metaphase, Telophase, Prophase, Anaphase, Cytokinesis.

[2013]

**Ans.** The correct order, so as to be in a logical sequence is Prophase, metaphase, anaphase, telophase and cytokinesis.

- 22.** Name the organelle which initiates the cell division in an animal cell.

[2007]

**Ans.** Centrosome helps in the initiation of cell division in an animal cell.

- 23.** Choose the odd one out from the following terms given and name the category to which others belong.  
Centrosome, cell wall, cell membrane, large vacuoles. [2018]

**Ans.** Odd term – Centrosome  
Category – Components of plant cells

- 24.** Give the technical term for  
(i) A phase at which chromosomes are clearly outlined.  
(ii) The mode of cytoplasmic division in plant cells.  
(iii) The complex consisting of a DNA strand and a core of histones. [2018]

**Ans.** (i) Metaphase (ii) Cell plate method (iii) Nucleosome

- 25.** The chromosome number of gametes is always  $n$ . Give reason.

**Ans.** The cell division that occurs in gamete cell is meiosis, which maintains the chromosome number as  $n$  or haploid.

- 26.** Name the following.  
The exchange of chromatid parts between the maternal and the paternal chromatids of a pair of homologous chromosomes during meiosis. [2016]

**Ans.** Crossing over

- 27.** Differentiate between the following pairs on the basis of what is mentioned within brackets  
Human skin cell and human ovum (number of chromosomes) [2016]

**Ans.** Human skin cell – 46 chromosomes and  
Human ovum – 23 chromosomes.

- 28.** What is the number of chromosomes in the gametes of human beings? [2015]

**Ans.** 23

- 29.** State the exact location of the structure:  
Centromere. [2016]

**Ans.** Chromosome

- 30.** Write the number of chromosomes present in a nerve cell of a human being. [2018]

**Ans.** All the cells of the body except gamete cells contain 46 (23 pairs) of chromosome. The nerve cell of human beings are somatic cells and hence contain 46 chromosome.

- 31.** Name the structure responsible to transmit characteristics from parent to offspring. [2007]

**Ans.** The structure responsible to transmit characteristics from parent to offspring is chromosome.

- 32.** Correct the following statement by changing the underlined word.  
Nitrogen bonds are present between the complementary nitrogenous bases of DNA. [2018]

**Ans.** Hydrogen

- 33.** Expand the biological abbreviation of DNA. [2014, 07]

**Ans.** Deoxyribonucleic Acid is the full form of DNA.

- 34.** Give the biological/technical term for the following  
The repeating components of each DNA strand lengthwise. [2016]

**Or** Give technical term for repeated units of DNA molecule. [2014]

**Ans.** Nucleotides

- 35.** Choose the odd one out of the following terms given and name the category to which the others belong  
Phosphate, RNA, Sugar, Nitrogenous base [2017]

**Ans.** Odd–RNA  
Category of other three–Components of DNA.

- 36.** Choose the odd one out of the following terms given and name the category to which the others belong  
Thymine, Cytosine, Adenine, Pepsin [2016]

**Ans.** Odd–Pepsin  
Category of the other three–Nitrogenous base.

- 37.** Write the names of four nitrogenous bases in a DNA molecule. [2013]

**Or** Give an example of a nitrogenous base in DNA. [2014]

**Ans.** Adenine, guanine, cytosine and thymine.

## **b** 2 Marks Questions

- 38.** Can there be DNA replication without cell division?

**Ans.** Yes, DNA replication takes place during the synthesis stage or S-phase of interphase in the cell cycle. It is totally independent of cell division. After  $G_2$ -phase, a cell may or may not enter into the M-phase.

- 39.** Can there be mitosis without DNA replication in S-phase?

**Ans.** Mitosis cannot occur without DNA replication in S-phase because the trigger for mitosis takes place due

to the disturbance in nucleo-cytoplasmic ratio caused by DNA replication in S-phase.

**40.** Name the following

- Cell division observed to be occurring at the tip of root and shoot systems.
- The stage during which nuclear membrane and nucleolus reappear.

**Ans.** (i) Mitosis

(ii) Telophase [1 × 2]

**41.** Mention the difference between mitosis and meiosis with reference to

- Number of daughter cells formed at the end of the cell division.
- The chromosome number of daughter cells formed.

[2008]

**Ans.**

Mitosis	Meiosis
Two daughter cells are formed.	Four daughter cells are formed.
Chromosome number is 23 pairs/diploid number ( $2n$ ).	Chromosome number is 23/haploid number ( $n$ ).

[1 × 2]

**42.** Briefly explain cytokinesis in plant cells. [2013]

**Ans.** Refer to text on page 3.

**43.** A cell having 32 chromosomes undergoes mitotic divisions. What will be the chromosome number ( $n$ ) during metaphase? What would be the DNA content during anaphase?

**Ans.** The number of chromosomes during metaphase will be 32. Also the DNA content during anaphase will be same as in the parent cell. [1 × 2]

**44.** Given below are groups of terms. In each group the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis. [2017]

- Cytoplasm : Cytokinesis : : Nucleus : \_\_\_\_\_
- Adenine : Thymine : : Cytosine : \_\_\_\_\_

**Ans.** (i) Karyokinesis

(ii) Guanine [1 × 2]

### **C** 3 Marks Questions

**45.** Differentiate between  $G_1$  and  $G_2$ -phases.

**Ans.** Differences between  $G_1$  and  $G_2$ -phases are as follows

$G_1$ -phase	$G_2$ -phase
It is called first growth period.	It is post-synthetic phase.
Its duration is variable.	It lasts for 2-5 years.
Cell grows in size.	Cell prepares to go into mitotic phase.

**46.** Colchicine is known to be the mitotic poison. Why?

**Ans.** Refer to text on page 3.

**47.** Cytokinesis in plant cell is different from that in animal cell. Explain.

**Ans.** Refer to text on page 3 and 4.

**48.** Name the following

- Part of the cell associated with spindle formation
- Nucleic acid which is the main component of chromosomes.

**Ans.** (i) Centrioles (ii) DNA

### **d** 4 Marks Questions

**49.** During the cell cycle, it is observed that there is replication of DNA and synthesis of other biomolecules. Give a suitable explanation for this observation.

**Ans.** At the end of the cycle, the cellular division will start. This division results in formation of two daughter cells. During cell cycle, DNA starts replicating, i.e., it doubles its amount. This doubling is necessary in order to equally distribute the parental DNA in both the daughter cells.

DNA is the genetic material, which carries information or blueprint about the new organisms and forms the basis of their specific development. Biomolecules like RNA and proteins are also synthesised in cell as these are necessary in various functions of the body.

**50.** Give reasons.

- Gametes have a haploid number of chromosomes.
- Mitosis is called an equational division.
- Cell division is necessary for survival of a species.
- Different methods are used for cytokinesis in plant and animal cells.

**Ans.** (i) Refer to text on page 4. [1]

(ii) Refer to text on page 2. [1]

(iii) Refer to text on page 2. [1]

(iv) Refer to text on page 3 and 4. [1]

- 51.** Explain, why a pair of homologous chromosomes is genetically different, but a pair of sister chromatids is genetically identical before crossing over in meiosis?

**Ans.** A pair of homologous chromosomes is genetically different because in a set of homologous chromosomes, one of the chromosome belongs to the male parent and the other to the female parent. Therefore, one of a pair will contain paternal genes and the other will contain maternal genes.

However, a pair of sister chromatids is genetically identical before crossing over as the chromatids are formed from the replication of DNA during the S-phase of interphase. DNA replication ensures that the DNA content is doubled with identical genes being copied from the original DNA.

Therefore, there is no genetic variation because there is no exchange of genetic material between sister chromatids. If crossing over occurs, then it would be possible for some genes to be exchanged between the chromatids of homologous chromosomes that have chiasmata, thus leading to genetic variation.

- 52.** State the main function of following

- DNA
- SAT chromosome.

**Ans.** (i) **DNA** (Deoxyribonucleic Acid) is the carrier of genetic blueprint of an organism. [2]

- (ii) **SAT chromosome** Knob-like structures formed of non-staining regions of secondary constrictions in a chromosome. [2]

- 53.** Name the following.

- Two symmetrical structures present in a chromosome.
- The bead-like accumulation of chromatin material.
- The complex formed by histones and DNA together.
- Nitrogenous bases of the DNA.

**Ans.** (i) Chromatids  
(ii) Chromomeres  
(iii) Nucleosomes  
(iv) Adenine, Thymine, Cytosine and Guanine [1 × 4]

## **e** 5 Marks Questions

- 54.** Answer the following questions.

- What is meant by cell cycle?
- The cellular organelles to be distributed to daughter cells, are duplicated at which stage?
- The phase in which the actual cell division starts.

- (iv) Increase in cell size is observed during certain phase of cell cycle.

- Identify this phase.
- Give reason for this observation.

**Ans.** (i) Cell cycle refers to the sequence of events, by which a cell duplicates its genome, synthesises other constituents of the cell and ultimately divides into two daughter cells by cell division process. [1]

- (ii) G<sub>1</sub>-phase. [1]

- (iii) M-phase involves the initiation of actual cell division. [1]

- (iv) (a) G<sub>1</sub>-phase. [1]

- (b) Increase in size is observed because the cellular contents are doubling up for equal division among two daughter cells. Due to this increase in the cellular content, the overall size of a cell is increased. [1]

- 55.** Describe the events taking place during interphase.

**Ans.** Refer to text on page 2.

- 56.** Write the significance of meiosis.

**Ans.** Refer to text on page 4.

- 57.** Briefly describe the significance of cell division.

**Ans.** Refer to text on page 4.

- 58.** List the differences between mitosis occurring in animal and plant cells.

**Ans.** Differences between mitosis of plant and animal cell are as follows

Animal cell	Plant cell
Asters are formed.	Asters are not formed.
Occurs nearly in all tissues.	Occurs mainly at meristem.
Centrioles are present at spindle poles.	Centrioles are absent at spindle poles.
Cytokinesis is by cell furrowing.	Cytokinesis is by the formation of cell plate.
Cells become rounded and the cytoplasm becomes more viscous.	Cells do not change their form or nature.

- 59.** What are the functions of chromosomes?

**Ans.** Refer to text on page 6.

- 60.** Differentiate between

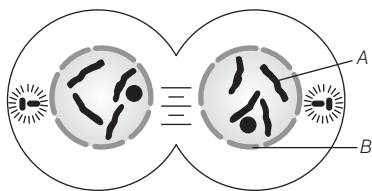
- Chromosome and Genes
- Metacentric and Telocentric
- Karyokinesis and Cytokinesis
- Centrosome and Centromere
- Purine base and Pyrimidine base.

**Ans.** (i)

Chromosome	Genes
The highly condensed fibres of chromatin.	The unit of chromosomes responsible for heredity.
[1]	
Metacentric	Telocentric
The chromosome with centromere in the middle.	The chromosome having a terminal centromere.
[1]	
Karyokinesis	Cytokinesis
It is the division of nucleus that occurs during cell division.	It is the division of cytoplasm that takes place soon after karyokinesis.
[1]	
Centrosome	Centromere
It helps in initiation of cell division in animal cells.	A part of chromosome that holds two sister chromatids together.
[1]	
Purines	Pyrimidines
The bases having double ring structure, e.g. adenine, guanine.	The bases having a single ring structure, e.g. cytosine, thymine.
[1]	

## Diagram Based Questions

- 61.** Study the given diagram which represents a stage during the mitotic cell division and answer the questions that follows [2017]

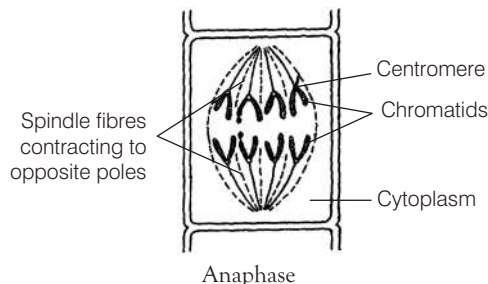


- Identify the stage giving suitable reasons.
- Name the parts labelled A and B.
- What is the technical term for the division of nucleus?
- Mention the stage that comes before the stage shown in the diagram. Draw a neat labelled diagram of the stage mentioned.
- Which is the cell division that results in half the number of chromosomes in daughter cells?

**Ans.** (i) In the given figure, the two sets of daughter chromosomes have reached to opposite poles as

well as reformation of nuclear membrane has also started. Therefore, it is telophase of mitotic division.

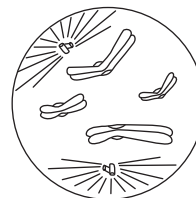
- A—Chromosome  
B—Nuclear membrane (appearing)
- Karyokinesis is the technical term which is used for the division of nucleus.
- Telophase is preceded by anaphase. A diagram of anaphase is given below



Anaphase

- During meiosis, the chromosome number is reduced in such a way that each daughter cell receives only half the number of chromosomes present in the parent cell.

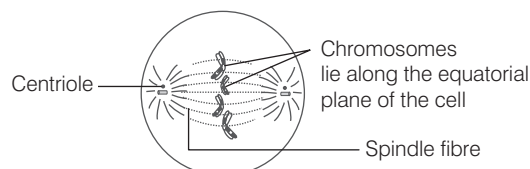
- 62.** The given diagram shows a stage during mitotic division in an animal cell. [2016]



- Identify the stage. Give a reason to support your answer.
- Draw a neat labelled diagram of the cell as it would appear in the next stage. Name the stage.
- How the mitotic division in an animal cell is different from the mitotic division in a plant cell?
- Name the type of cell division that occurs during
  - growth of a shoot
  - formation of pollen grains.

**Ans.** (i) **Late prophase** Chromosomes start coming in the centre of the cell. Nuclear membrane, nucleolus disappear and centriole appears which reaches at opposite pole of the cell.

- Metaphase**



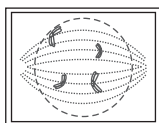
- (iii) In animal cell, the two daughter cells separate by growing furrow while the plant cells separate by cell plate formation.

(iv) (a) Mitosis (b) Meiosis

**63.** Given below is a diagram representing a stage during mitotic cell division. Study it carefully and answer the questions that follows. [2014]

(i) Is it a plant cell or an animal cell?

Give a reason to support your answer.



(ii) Identify the stage shown.

(iii) Name the stage that follows the one shown here. How is that stage identified?

(iv) How will you differentiate between mitosis and meiosis on the basis of the chromosome number in the daughter cells?

- Ans.** (i) It is a plant cell because cell wall is present and centrioles are absent.  
 (ii) The stage shown is prophase.  
 (iii) The stage that follows the one shown here, i.e. prophase is metaphase. It is identified by the position of chromosomes that are arranged at the equator attached to the spindle fibre.  
 (iv) In mitosis, the chromosome number in daughter cell is same as that of the mother cell, i.e. diploid parent cell gives rise to two diploid ( $2n$ ) daughter cells. In meiosis, the chromosome number is halved in the daughter cell, i.e. the diploid mother cell gives rise to four haploid ( $n$ ) daughter cells.

**64.** The diagram given below represents a stage during cell division.

Study the same and answer the questions that follows

[2018]

(i) Identify whether it is a plant cell or an animal cell.

Give a reason in support of your answer.

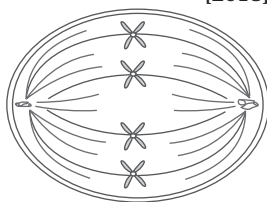
(ii) Name the stage depicted in the diagram.

What is the unique feature observed in this stage?

(iii) Name the type of cell division that occurs during  
 1. replacement of old leaves by new ones.  
 2. formation of gametes.

(iv) What is the stage that comes before the stage shown in the diagram?

(v) Draw a neat, labelled diagram of the stage mentioned in (iv) above, keeping the chromosome number constant.



**Ans.** (i) The given cell is an animal cell as it contains centrosome.

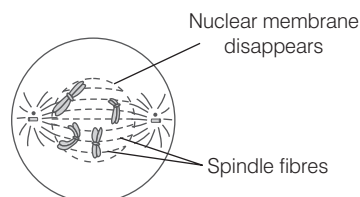
(ii) Metaphase

Chromosomes are aligned on equatorial region.

(iii) (1) Mitosis (2) Meiosis

(iv) Late prophase

(v)



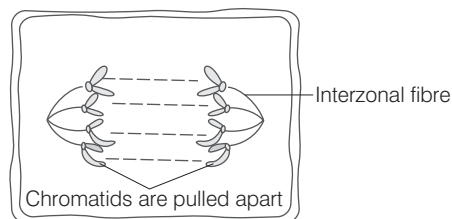
Late prophase

**65.** Draw a well-labelled diagram to show the metaphase stage of mitosis in an animal cell having four chromosomes. [2012]

**Ans.** Refer to figure on page 3.

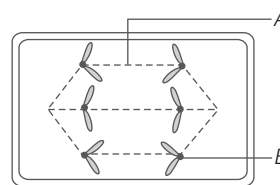
**66.** Draw a well-labelled diagram to show the anaphase stage of mitosis in a plant cell having four chromosomes. [2013]

**Ans.**



Anaphase stage in plant cell

**67.** The diagram given below represents a certain stage of mitosis.



(i) Identify the stage of cell division.

(ii) Name the parts labelled A and B.

(iii) What is the unique feature observed in this stage?

(iv) How many daughter cells are formed from this type of cell division? [2015]

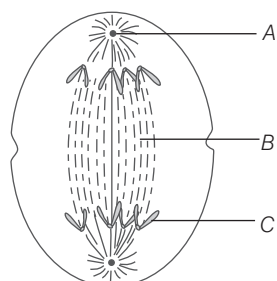
**Ans.** (i) Late anaphase

(ii) A—Spindle fibre, B—Centromere

(iii) Unique feature of this stage is that the chromosome gets divided into sister chromatids that move towards the opposite poles.

(iv) Two daughter cells are formed from this kind of cell division.

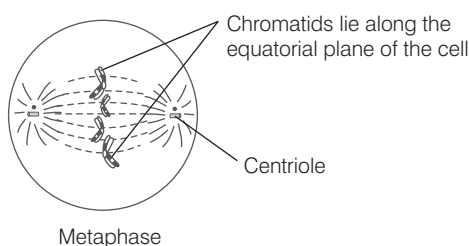
- 68.** The diagram represents a stage during cell division. Study the same and then answer the questions that follows



- Name the parts labelled *A*, *B* and *C*.
- Identify the above stage and give a reason to support your answer.
- Mention where in the body this type of cell division occurs.
- Name the stage prior to this stage and draw a diagram to represent the same. [2011]

**Ans.** Different parts can be labelled as

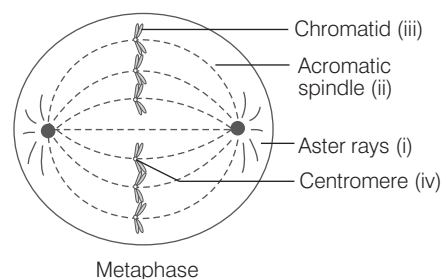
- A* – Centriole  
*B* – Spindle fibres  
*C* – Chromatid
- The above stage is anaphase because sister chromatids are seen at the poles.
- This type of cell division occurs in the somatic cells of the body.
- The stage prior to anaphase is metaphase.



- 69.** Draw a diagram of the nucleus of a cell, having chromosome number 6, as it would appear in the metaphase stage of mitosis and label the following parts

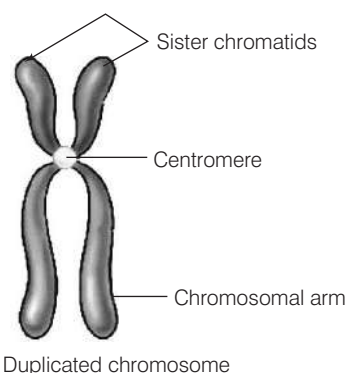
- Aster rays
- Acromatic spindle
- Chromatid
- Centromere

**Ans.** Diagram showing metaphase stage of mitosis in the nucleus of a cell having chromosome number 6 is given below

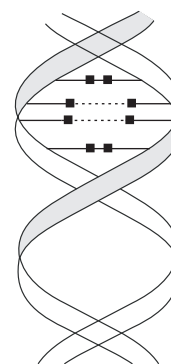


- 70.** Draw a duplicated chromosome and label its parts. [2014]

**Ans.**



- 71.** There is a diagram of double helical structure of DNA.



- Name the type of DNA shown in the figure.
- Give the full form of DNA.
- Name the unit of heredity. [2010]

**Ans.** (i) Double-stranded DNA.  
(ii) The full form of DNA is Deoxyribonucleic Acid.  
(iii) Genes are the unit of heredity.

# CHAPTER EXERCISE

## Multiple Choice Questions

- At this stage of cell cycle, the cell contains  $2n$  of DNA (chromosomes).  
(a)  $G_2$ -phase  
(b) S-phase  
(c) M-phase  
(d)  $G_1$ -phase
- Which phase is also referred to as pre-mitotic phase?  
(a) M-phase  
(b) S-phase  
(c)  $G_2$ -phase  
(d)  $G_1$ -phase
- Duplication of chromosomes is observed during  
(a) mitosis and meiosis  
(b) meiosis  
(c) mitosis  
(d) karyokinesis
- Identify the process that gives rise to daughter cells with half number of chromosomes than that of their parent cell.  
(a) Cleavage  
(b) Mitosis  
(c) Budding  
(d) Meiosis
- The cell division occurring in germ cells is  
(a) diakinesis  
(b) karyokinesis  
(c) mitosis  
(d) meiosis
- Haploid chromosome number in a cell will be  
(a)  $2n$   
(b)  $n$   
(c)  $4n - 1$   
(d)  $2n + 1$

**Ans.** 1. (b) 2. (b) 3. (c) 4. (d) 5. (d) 6. (b)

## Fill in the Blanks

- Complete the following.
  - During cytokinesis, a ..... is formed in the plant cell in order to separate the two daughter cells.
  - Chromosome number is halved in gametes to restore the normal number, i.e. .... after fertilisation to form zygote.
  - A ..... is the point at which the sister chromatids are held together.
  - DNA replication occurs in the ..... of interphase.
  - In ..... stage of interphase, synthesis of RNA and proteins occur in the cell cycle.

## True-False

- State whether the statements are true/false.
  - Nuclear membrane in cells dividing by mitosis, remains intact upto the metaphase and disappears at telophase.
  - Cell division by mitosis can be a reproductive division in living organisms.
  - The nucleus in a cell has maximum size during interphase.
  - Crossing over is an event occurring during meiosis.
  - M-phase starts with cytoplasmic division and terminates with division of nucleus.
  - Interphase is the period between two successive cell divisions of a cell.

## Match the Columns

- Match the following columns.

Column I	Column II
A. A sequence of events occurring between the cell formation and its division.	1. $G_0$ -phase
B. It starts with karyokinesis and ends with cytokinesis after the resting phase.	2. $G_2$ -phase
C. Cells are metabolically active but do not proliferate.	3. M-phase
D. The pre-mitotic phase which shows increase in volume of nucleus and synthesis of RNA and proteins.	4. Cell cycle

## 1 Mark Questions

- List the events that occur during  $G_1$ -phase of cell division.
- What changes do you observe during the S-phase of cell cycle?
- List any one significance of mitosis in living organisms associated with growth as a parameter.
- If two daughter cells are formed during mitosis, how are DNA and chromosomes distributed?

## 2 Marks Questions

14. Give the names of following.
  - (i) The stage at which the sister chromosomes separate from their paired condition.
  - (ii) The factors or units of chromosome that transmit the heritable traits through generations.
15. The M-phase initiates and terminates with which processes?
16. Answer in one or two words.
  - (i) The stage of mitotic division, where condensation of chromatin material into chromosomes occurs.
  - (ii) A cell division process occurring in two parts.
17. Rewrite the sentences after correcting the underlined words.
  - (i) Chromosomes were first observed by Strasburger.
  - (ii) A chromatid is a duplicate chromosome.
  - (iii) Centromere is a part of ribosomes.
  - (iv) When the centromere is present at one end, the chromosome is sub-metacentric.

## 3 Marks Questions

18. During cell cycle, cell enters the interphase before it undergoes another cycle of division. Why?
19. Cell cycle is an important cycle of events necessary for survival. Give reason.
20. A cell with chromosome number 16 is undergoing meiotic cell division. What will be the number of chromosomes in daughter cells formed? Give reason.
21. In the meiotic division, the second division is mitosis-like. How many daughter cells will be produced with what chromosome number after second meiotic division?
22. Distinguish between the following on the basis of what is given in the brackets.
  - (i) Mitosis and meiosis (mode, occurrence and significance).
  - (ii) Karyokinesis and cytokinesis (purpose of occurrence).
  - (iii) Mitosis in animal and plant cell (occurrence).

## 4 Marks Question

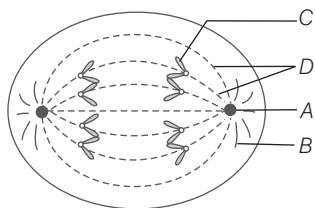
23. Explain the various stages of mitosis with reference to how chromosomes change their pattern from prophase to the end of the telophase.

## 5 Marks Questions

24. Give reasons.
  - (i) Cells require resting phase before entering cell division.
  - (ii) Cell cycle is essential for perpetuation of a species.
  - (iii) Interphase is the longest phase of cell cycle.
  - (iv) Cell is a basic structural and functional unit of all organisms.
  - (v)  $G_1$ , S,  $G_2$ -phases are called as preparatory phases.
25.
  - (i) List the features of a cell as it enters the M-phase from the interphase.
  - (ii) M-phase is said to be the phase of actual division. Why?
26. Select the correct word from two options provided in brackets with regards to the statements.
  - (i) DNA does not occur in (ribosomes/nucleus).
  - (ii) When centromere in a chromosome is present in centre (holocentric/metacentric).
  - (iii) The carriers of hereditary unit. (DNA/chromosomes).
  - (iv) Each deoxyribonucleotide unit consists of (phosphate group/phosphite group).
  - (v) A nitrogenous base present in DNA (adenine/uracil).
27. Given below are certain biological terms. Write a single collecting term for each group.
  - (i) Interphase,  $G_1$ , S,  $G_2$ , M-phase.
  - (ii) Adenine, thymine, cytosine and guanine.
  - (iii) Genes, chromosomes, DNA
  - (iv) Prophase, metaphase, anaphase, telophase.
  - (v) Sub-metacentric, telocentric, acrocentric

## Diagram Based Questions

- 28.** Draw a well-labelled diagram of cell cycle and explain all the phases occurring during it.
- 29.** There is a diagram representing a stage during mitotic cell division in an animal cell.

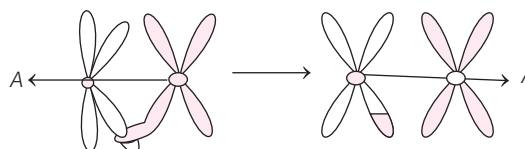


- Identify the above stage. Give a reason to support your answer.
- Name the parts labelled *A*, *B*, *C* and *D*.
- What is the function of part *C*?

- Name the stage that comes just after the stage shown in the diagram. Draw a well-labelled diagram of this stage. [2010]

- 30.** Draw a well-labelled diagram for double-helix DNA.

- 31.** Observe the figure given below and answer the following questions.



- Identify the process.
- What is the purpose of this process?
- Differentiate between chromosome and chromatid.
- What is the part *A* between the chromatids?

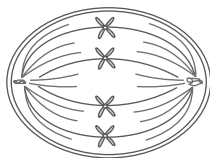
# ARCHIVES\*

## (Last 7 Years)

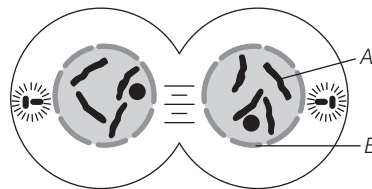
Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

- Name the following.  
The number of chromosomes present in a nerve cell of a human being. [1]
- Write the following statement by changing the underlined word.  
Nitrogen bonds are present between the complementary nitrogenous bases of DNA. [1]
- Choose the odd one out from the following terms given and name the category to which others belong.  
Centrosome, cell wall, cell membrane, large vacuoles. [1]
- Give appropriate biological or technical term for the following.  
The complex consisting of a DNA strand and a core of histones. [1]
- The diagram given below represents a stage during cell division.  
Study the same and answer the questions that follows
  - Identify whether it is a plant cell or an animal cell. Give a reason in support of your answer.
  - Name the stage depicted in the diagram.  
What is the unique feature observed in this stage?
  - Name the type of cell division that occurs during
    - replacement of old leaves by new ones.
    - formation of gametes.
  - What is the stage that comes before the stage shown in the diagram?
  - Draw a neat, labelled diagram of the stage mentioned in (iv) above, keeping the chromosome number constant. [5]



- Given below are group of terms. In group, the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis.
  - Cytoplasm : Cytokinesis : Nucleus : ..... [1]
  - Adenine : Thymine :: Cytosine : ..... [1 × 2]
- Study the given diagram which represents a stage during the mitotic cell division and answer the questions that follows



- Identify the stage giving suitable reasons.
- Name the parts labelled A and B.
- What is the technical term for the division of nucleus?
- Mention the stage that comes before the stage shown in the diagram. Draw a neat labelled diagram of stage mentioned.
- Which is the cell division that results in half the number of chromosomes in daughter cells? [5]

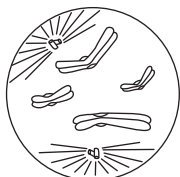
### 2016

- Name the following.  
The exchange of chromatid parts between the maternal and paternal chromatids of a pair of homologous chromosomes during meiosis. [1]
- Choose the odd one out of the following terms given and name the category to which the others belong  
Thymine, Cytosine, Adenine, Pepsin [1]
- State the exact location of the structure : Centromere. [1]
- Differentiate between the following pairs on the basis of what is mentioned within brackets.  
Human skin cell and human ovum (number of chromosome) [1]
- Give the biological/technical term for the following  
The repeating components of each DNA strand lengthwise. [1]

### 2017

- Choose the odd one out of the following terms given and name the category to which the others belong.  
Phosphate, RNA, Sugar, Nitrogenous base [1]
- Synthesis phase in the cell cycle is called so, because of the synthesis of more [1]
  - RNA
  - RNA and proteins
  - DNA
  - glucose

15. The given diagram shows a stage during mitotic division in an animal cell.



- Identify the stage. Give a reason to support your answer.
- Draw a neat labelled diagram of the cell as it would appear in the next stage. Name the stage.
- How the mitotic division in an animal cell is different from the mitotic division in a plant cell?
- Name the type of cell division that occurs during
  - growth of a shoot
  - formation of pollen grains.

[5]

- Is it a plant cell or an animal cell? Give a reason to support your answer.
- Identify the stage shown.
- Name the stage that follows the one shown here. How is that stage identified?
- How will you differentiate between mitosis and meiosis on the basis of the chromosome number in the daughter cells?

[5]

20. Draw a duplicated chromosome and label its parts.

[5]

21. Give an example of a nitrogenous base in DNA.

[1]

22. Expand the biological abbreviation of DNA.

[1]

23. Give technical term for repeated units of DNA molecule.

[1]

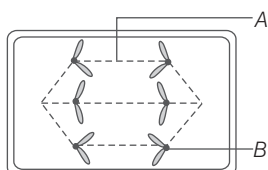
## 2015

16. Chromosomes get aligned at the centre of the cell during

- metaphase
- anaphase
- prophase
- telophase

[1]

17. The diagram given below represents a certain stage of mitosis.



- Identify the stage of cell division.
- Name the parts labelled A and B.
- What is the unique feature observed in this stage?
- How many daughter cells are formed from this type of cell division?

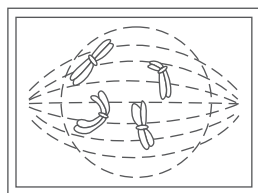
[5]

18. What is the number of chromosomes in the gametes of human beings?

[1]

## 2014

19. Given below is a diagram representing a stage during mitotic cell division. Study it carefully and answer the questions that follows



## 2013

24. The cell component visible only during cell division is

- mitochondria
- chloroplast
- chromosome
- chromatin

[1]

25. Given below is the group of five terms, arrange and rewrite the terms in the correct order, so as to be in a logical sequence.

Metaphase, Telophase, Prophase, Anaphase, Cytokinesis.

[1]

26. Briefly explain the term cytokinesis in plant cells.

[1 × 2]

27. Draw a well-labelled diagram to show the anaphase stage of mitosis in a plant cell having four chromosomes.

[5]

28. Write the names of four nitrogenous bases in a DNA molecule.

[1]

## 2012

29. Given below are the sets of five terms, rewrite the terms in a logical sequence as directed at the end of the statement.

Karyokinesis, S-phase, Cytokinesis, G<sub>1</sub>-phase, G<sub>2</sub>-phase (cell cycle).

[1]

30. Draw a well-labelled diagram to show the metaphase stage of mitosis in an animal cell having four chromosomes.

[5]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

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- 1** A cell in prophase-II of meiosis contains 12 chromosomes. How many chromosomes would be present in cell from the same organism if it were in prophase of mitosis?
- 2** Which of the following characteristics of mitosis is not correct?
  - (a) Each daughter cell formed by mitosis has the same number of chromosomes as the parent cell
  - (b) During mitosis, the centromeres divide
  - (c) The cells produced during mitosis possess same genetic material
  - (d) During mitosis, the sister chromatids do not separate
- 3** Cell (X) has undergone one mitotic division and cell (Y) has finished one meiotic division. How many daughter cells will be formed by X and Y? Give reason to support your answer.
- 4** A scientist tells you that he has found a cool single-celled organism that is about to divide. He tells you that the homologous chromosomes are not paired and it does not look like any recombination has occurred. Is the organism dividing by mitosis or meiosis? Explain.
- 5** The cells of the leaf tip of a plant contain 16 chromosomes. Each cell of the pollen tetrad of such a plant would contain
  - (a) 4 chromosomes
  - (b) 8 chromosomes
  - (c) 16 chromosomes
  - (d) 24 chromosomes
- 6** A certain species has three pairs of chromosomes— an acrocentric pair and two metacentric pairs. Draw a cell of this species as it would appear in metaphase of mitosis.

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 304.

# Genetics

Genetics is the study of transmission of body features (both similarities and dissimilarities) from parents to offsprings. These body features are coded in the form of genetic material. The term '**genetics**' was first used by **W Bateson** in 1905. It can be defined as the branch of science that deals with the mechanism of heredity and variation in living organisms.

**Heredity** is the transmission of genetic characters from one generation to the next generation.

**Variation** may be defined as the degree of differences in characteristics among the individuals of a species. The greatest advantage of variation in species is that they increase the chance of survival in a changing environment.

## Some Important Genetic Terms

A list of important terms used to study genetics is given below

1. **Unit factor** (Gene) The determinant of a characteristic pertaining to a particular organism. **Mendel** used the word unit factor or pair factor for controlling units of various traits. Later **Johannsen** replaced the word factor with gene. A **gene** is a unit of inheritance. It is a piece of DNA that carries the information needed to make a specific protein.
2. **Character** The feature or characteristic of an individual like height, colour, shape, etc.
3. **Trait** An inherited character, i.e. the feature, which is normally inherited and has its detectable variant too. Here, tall and dwarf are traits of a character, i.e. height.
4. **Gene locus** It is a particular position of a gene on a chromosome. Various alleles of the gene will occur on the same locus on similar or homologous chromosomes.

## Chapter Objective

- Some Important Genetic Terms
- Mendelian Inheritance
- Mendel's Experiments
- Mendel's Laws of Inheritance
- Sex-Determination in Human Beings















5. **Alleles or Allelomorphs** The alternate forms or varieties of genes in a particular gene pair. They occupy same locus (position) on homologous pair of chromosome. This term was given by Bateson.
6. **Homozygous** When a gene pair (alleles) in an organism contains two identical genes controlling similar trait of a character then the organism is considered as homozygous for that particular character.
7. **Heterozygous** When a gene pair (alleles) contains two different genes controlling different traits of a character in an organism then the organism is considered as heterozygous for that particular character.
8. **Phenotype** The physical appearance of an individual.
9. **Genotype** The complete genetic constitution of an individual.
10. **Gamete** A mature reproductive cell, which is specialised for amphimixis (fusion).
11. **Hybrid** The literary meaning of this word is mixture. In genetics, we define it as an offspring, which is obtained from a cross between two genetically different parents.
12. **F<sub>1</sub>-generation** First filial (filial=offspring) generation, i.e. the generation of hybrids, which are obtained from a cross between two genetically different parents.
13. **F<sub>2</sub>-generation** Second filial generation, i.e. individuals normally obtained after self-crossing the individuals of F<sub>1</sub>-generation.
14. **Dominant allele** An allele which expresses itself externally whether present in homozygous or in heterozygous conditions.
15. **Recessive allele** An allele which expresses itself externally when present in homozygous condition, but remains suppressed in heterozygous condition.

## Mendelian Inheritance

**Gregor Johann Mendel** (1822-1884), an Austrian Monk is known as the **Father of Genetics**. Mendel was able to formulate the laws to explain the pattern of inheritance of characters in garden pea (*Pisum sativum*).

## Mendel's Experiments

Mendel worked with the common garden pea plant (*Pisum sativum*). In his experiments, he chose to follow seven visible characters represented by two contrasting forms or traits as shown below

Character	Contrasting traits	Dominant/ Recessive
Shape of the seeds	 ×  Round      Wrinkled	Round/wrinkled
Colour of the seeds	 ×  Yellow      Green	Yellow/green
Shape of the pods	 ×  Inflated      Constricted	Inflated/constricted
Colour of the pods	 ×  Green      Yellow	Green/yellow
Colour of the flowers	 ×  Violet      White	Violet/white
Position of the pods	 ×  Axial      Terminal	Axial/terminal
Height of the stem	 ×  Tall      Dwarf	Tall/dwarf

Mendel selected garden pea for his experiments due to the following reasons

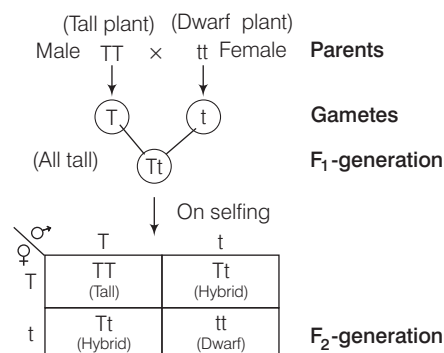
- (i) Varieties were available in pure forms.
- (ii) Many varieties were available having contrasting characters.
- (iii) Being bisexual, pea plants can be self-pollinated and cross-pollinated.
- (iv) These are annual plants with short life cycle. So, several generations could be studied within a short period.
- (v) Pea plants were readily available on large scale.
- (vi) Pea plants could easily be handled, raised and maintained.

Through the selective growing of common pea plants over many generations, he discovered that certain traits appear in offspring plants without any blending of parental characteristics.

Mendel conducted his experiments for seven years (1856-1863) on garden pea, first, by taking only one character at a time (monohybrid cross) and then, by taking two characters together (dihybrid cross). These crosses are discussed in detail below

## Monohybrid Cross

This cross is performed by taking only one pair of contrasting character or one feature at a time, e.g. when a cross between pure tall plant (TT) and pure dwarf plant (tt) was done, only dominant feature expressed itself in the first filial generation ( $F_1$ ), i.e. all tall plants were produced, masking the effect of recessive feature. After self-pollination in second filial generation ( $F_2$ ), both the traits, i.e. tallness and dwarfness were expressed in the ratio 3 : 1.



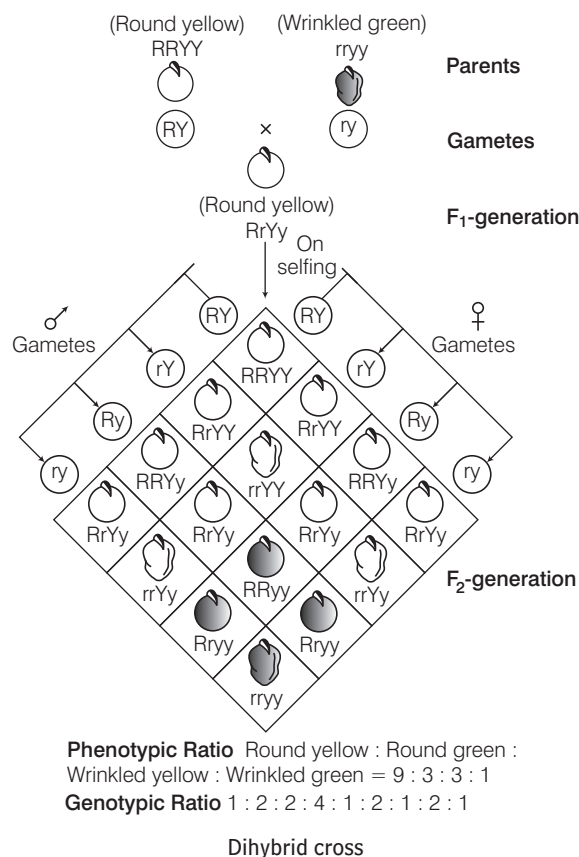
**Phenotypic ratio** Tall : dwarf = 3 : 1

**Genotypic ratio** 1 : 2 : 1 (TT : Tt : tt)

Monohybrid cross

## Dihybrid Cross

This type of cross is performed by taking two pairs of contrasting characters at a time, e.g. when a cross between a plant having round, yellow seeds (RRYY) and a plant having wrinkled, green seeds (rryy) was done, only round, yellow seeds were produced in  $F_1$ -generation (as round, yellow were dominant alleles). Further, when  $F_1$  were self-pollinated, four different types of seed combinations were obtained in  $F_2$ -generation.



**Phenotypic Ratio** Round yellow : Round green : Wrinkled yellow : Wrinkled green = 9 : 3 : 3 : 1  
**Genotypic Ratio** 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1

Dihybrid cross

**Note** The square used in the above crosses to show the cross of gametes in  $F_2$ -generation is called **Punnett square**. It is used to calculate the probability of all possible genotypes of offsprings in a genetic cross.

## CHECK POINT 01

- 1 Name the unit of heredity.
- 2 Define alleles or allelomorphs.
- 3 Who is known as father of genetics?
- 4 Give any two dominant traits in pea plant.
- 5 What was the ratio of tallness and dwarfness in monohybrid cross?
- 6 Mention the phenotypic ratio of dihybrid cross in  $F_2$ -generation.

## Mendel's Laws of Inheritance

On the basis of the inferences of monohybrid crosses, Mendel proposed two general rules to consolidate his understanding of inheritance in monohybrid crosses. This includes law of dominance and law of segregation. Law of independent assortment was proposed on the basis of observation of dihybrid crosses. Altogether, these three laws are called **Mendel's Principles of Inheritance** or **Mendelism**.

## Law of Dominance (First Law)

This law states that 'when two alternative forms of traits or character are present in an organism, only one factor expresses itself in  $F_1$ -progeny'.

The factor that expresses itself is called **dominant factor**, while the other factor which remains hidden is called **recessive factor**. It explains the expression of a gene in a cross and the ratio obtained in  $F_2$ -generation is 3 : 1.

## Law of Segregation (Second Law)

This law states that 'the two factors or alleles controlling one character segregate without influencing each other during the formation of gametes, so that each gamete receives one factor for each character'.

Due to this, the gametes are pure for a character. Though, the parents contain two alleles during gamete formation, the factors or alleles of a pair segregate from each other such that a gamete receives only one of the two factors. The gametes then, combine during zygote formation. This is also called **law of purity of gametes**.

## Law of Independent Assortment (Third Law)

This law states that 'when two pairs of contrasting characters are combined in a hybrid, segregation of one pair of character is independent of the other pair of character at the time of gamete formation'.

It also gets randomly rearranged in the offsprings producing both parental and new combination of characters. Exception to this phenomenon was discovered due to **linkage** (tendency of the genes to remain in their parental combination). Linkage is opposite to the phenomenon of **crossing over** (exchange of chromatid segments between the homologous chromosome).

## Sex-Determination in Human Beings

The establishment of sex through differential development in an individual at the time of zygote formation is called **sex-determination**. In humans, XX-XY type of sex determination is observed.

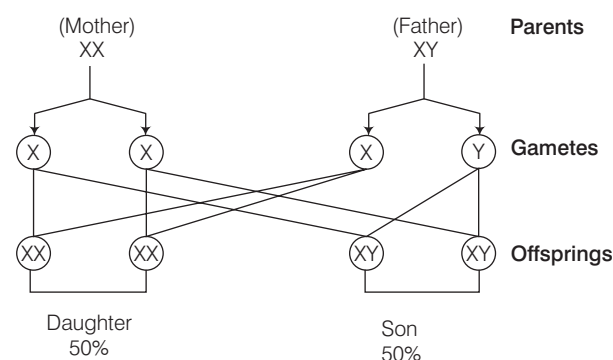
There are 46 chromosomes (23 pairs) present in human body which can be classified into two main types

- (i) **Autosomes** These are exactly similar chromosomes in both males and females (22 pairs). These are found in somatic cells.

- (ii) **Sex-chromosome or Allosomes** These chromosomes determine the sex of a person. There are two types of sex chromosomes, i.e. X-chromosome and Y-chromosome. These are designated as 23rd pair of chromosome. Allosomes always occur in pair. In males, it is XY and in females it is XX.

In human beings, male gamete (sperm) contains either X or Y-chromosome, while female gamete (egg) contains only X-chromosome. Since, female produces only one type of gametes, the male gamete determines the sex of progeny. In other words, sex of a child depends upon the kind of sperm that fertilises the egg during the process of fertilisation. In case, the sperm carrying X chromosome fertilises the egg (X) then, the resulting child will be female (XX) and if the sperm carrying Y chromosome fertilises the egg (X), then the resulting child will be male (XY).

This can be shown by the following cross



There are 50% chances of having either a male or female child in each pregnancy. Thus, it is the phenomenon occurring by chance. So, women should not be blamed for giving birth to a girl child.

### CHECK POINT 02

- 1 State the law of dominance proposed by Mendel.
- 2 Which law of inheritance is called law of purity of gametes?
- 3 What is crossing over?
- 4 Name the types of chromosomes which do not take part in sex-determination.
- 5 Write the number of chromosomes present in human body.

## Sex-linked Inheritance

It is the appearance of a trait due to the presence of an allele located exclusively on X-chromosome or Y-chromosome.

## Types of Sex-linked Inheritance

In XX-XY type organisms including humans, sex-linked inheritance can be classified into the following types

### 1. X-linked

This type of inheritance is controlled by recessive genes which are localised on X-chromosome and that have no corresponding allele on Y-chromosome. Examples of X-linked inheritance include haemophilia and colour blindness.

- (i) **Haemophilia** It is a sex-linked recessive disease, which is transmitted from an unaffected carrier female to some of the male offsprings. Due to this disease, patient continues to bleed even on a minor injury because of defective blood coagulation mechanism.

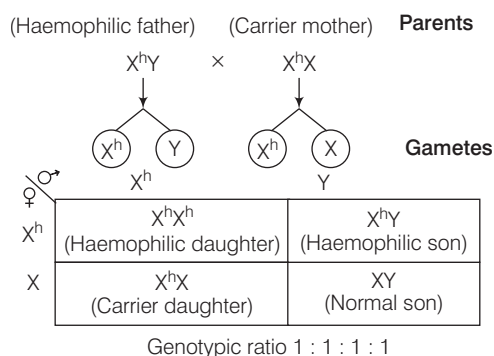
The blood of haemophilic person does not contain anti-haemophilic globulin (haemophilia-A) or plasma thromboplastin (haemophilia-B) essential for blood clotting. The genes for haemophilia are located on the X-chromosome.

The possibility of a female becoming haemophilic is extremely rare. For being haemophilic, mother of such a female has to be at least carrier and father should be haemophilic.

Females suffer from this disease only in homozygous condition, i.e.  $X^hX^h$ . Since, it is a recessive character, a woman may carry the disease and would transmit the disease to 50% of her sons, even if the father is normal.

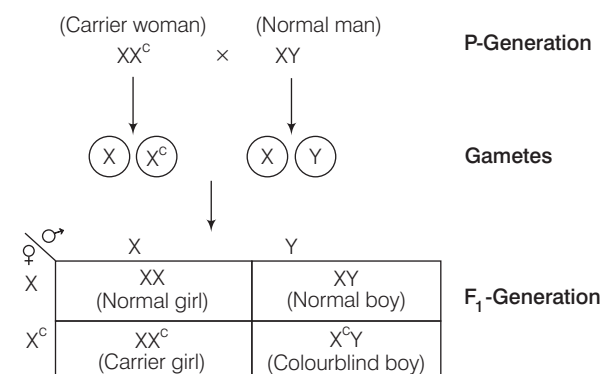
The family pedigree of **Queen Victoria**, who was a carrier of haemophilia shows a number of haemophilic individuals.

The following cross explains the inheritance of haemophilia in human when mother is a carrier and father is haemophilic.



- (ii) **Colour blindness** It is a sex-linked recessive disorder, which results in the visualisation defect of either red or green colour. It does not mean inability of seeing these colours at all. In fact, it leads to the failure in discrimination between red and green colour.

The gene for colour blindness is present on X-chromosome. The disease is more common in males ( $X^cY$ ) because of the presence of only one X-chromosome as compared to two X chromosomes in females. The cross between carrier woman and normal man explains the inheritance of colour blindness as follows



A heterozygous female has normal vision, but a carrier passes on the disorder to some of her sons. Colour blindness shows *criss-cross inheritance*.

- Note**
- X-linked characters are expressed more commonly in males than in females because males express the character in hemizygous condition.
  - X-linked genes are never passed from father to son. The Y-chromosome is the only sex chromosome that passes from father to son.
  - The phenomenon of transmission of sex-linked gene from mother to son and from father to daughter is called *criss-cross inheritance*.

### 2. Y-linked

This type of inheritance is determined by genes located on the non-homologous region of Y-chromosome. They have no alleles on X-chromosomes. Y-linked genes are commonly called as **holandric genes**.

The Y-chromosome linked traits (characters) occur in males but not in females, e.g. traits such as **hypertrichosis of ears** (hair growing out of ears) and **pattern baldness**. This is because the dominant genes of such traits are found only on 'Y'-chromosome.

## Mutation

It is a sudden, inheritable change in the nucleotide sequences of the genome of an individual which ultimately changes the genotype of an organism.

These mutations may or may not induce any phenotypic characteristics of an organism.

The agents which cause mutation are called **mutagens**. They can be physical and chemical factors, e.g. ultraviolet (UV) radiation, certain chemicals, etc.

The mutation can be of two main types

- (i) **Chromosomal mutation** Change in the number of arrangement of the chromosome.
- (ii) **Gene mutation** Change in the sequence of DNA.

### CHECK POINT 03

- 1 Which of the following is an example of sex-linked disease? Diabetes, haemophilia, leukaemia, AIDS.
- 2 The gene for colour blindness located on which chromosome?
- 3 Name a disorder inherited through Y-chromosomes.
- 4 What are mutagens?
- 5 Name the types of mutations.

## SUMMARY

- Genetics is the branch of biology, which deals with the inheritance, as well as variation of characters from parents to offsprings.
- Gregor Johann Mendel for the first time conducted experiments to understand the pattern of inheritance and variations in living beings. He is also known as Father of Genetics.
- Trait/character refers to the expression of genes in the form of visible physical properties, e.g. colour of flower, height of plant, shape of leaf, etc.
- Gene is a unit of inheritance, a sequence of DNA that codes for a specific polypeptide. One gene can have slightly different forms.
- Alleles are the alternate forms of genes in a particular gene pair, e.g. gene which codes for the colour of eyes. One of its forms codes for brown and another codes for blue colour.
- Genotype refers to the genetic constitution of an individual; a single gene pair or sum total of all the genes.
- Phenotype refers to observable traits or characters that result from expression of genes.
- Homozygous condition means having a pair of identical alleles (forms of gene) at a gene location (locus) on a pair of chromosomes. Heterozygous condition means having a pair of non-identical alleles at a gene locus on a pair of chromosomes.
- Mendel's Laws of Inheritance Mendel selected garden pea (*Pisum sativum*) as an experimental material and conducted hybridisation experiments for seven years and proposed the laws of inheritance in living organisms.
  - (i) Law of dominance (First law) states that, when two alternate forms of a trait or character (genes) are present in an organism only one factor expresses itself in  $F_1$  progeny, i.e. dominant one.
  - (ii) Law of segregation (Second law) states that the alleles do not show any blending and both the characters are recovered as such in the  $F_2$ -generation. The factors or alleles of a pair segregate from each other in a way that a gamete receives only one of the two factors.
  - (iii) Law of independent assortment (Third law) states that when two pairs of traits are combined in a hybrid, segregation of one pair of character is independent of the other pair of characters at the time of gamete formation. This law was based on the result of dihybrid cross. It shows phenotypic ratio of 9 : 3 : 3 : 1 and genotypic ratio of 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1
- Sex-determination in human beings Males have two types of gametes, i.e. X and Y, while females have only one type of gamete, i.e. X. If an ovum gets fertilised with a sperm carrying X-chromosome, the zygote develops into a female (XX) and if an ovum gets fertilised with a sperm carrying Y-chromosome, the zygote develops into a male. Hence, the type of sperm, which fertilises the ovum determines the sex of a child.
- Sex-linked inheritance It is the appearance of a trait or a character due to the presence of an allele either on the X or Y-chromosome. Certain disorders in human beings are transferred to the next generation because they are associated with the inheritance of changed or altered genes or chromosomes. These are called genetic disorders. These disorders when occur due to change in sex-chromosomes are known as sex-linked inherited diseases.
- Mutations are sudden inheritable changes in the genome that alter the genotype of an individual.
- Mutations are of two types, i.e. chromosomal mutation and gene mutation.

# EXAM PRACTICE

## Multiple Choice Questions

1. The discipline which deals with the study of transmission of characters from parents to offsprings is called

(a) evolution (b) genetics  
(c) variation (d) similarity

Ans. (b)

2. Transfer of characters from parents to their offsprings is called

(a) heredity (b) variations  
(c) genetics (d) cytology

Ans. (a)

3. The morphological differences between parents and offsprings are called

(a) heredity (b) morphology  
(c) variations (d) taxonomy

Ans. (c)

4. Which of the following terms represents alternate forms of a gene?

(a) Alleles (b) Phenotype  
(c) Heterozygous (d) Genetics

Ans. (a)

5. The recessive gene is one that expresses itself in [2013]

(a) heterozygous condition (b) homozygous condition  
(c)  $F_2$ -generation (d) Y-linked inheritance

Ans. (b)

6. Who among the following is the 'Father of Genetics'?

(a) Khorana (b) Morgan  
(c) Kornberg (d) Mendel

Ans. (d)

7. What is a monohybrid cross?

(a) In which only one character of an allele is studied  
(b) In which both the characters of alleles are studied  
(c) In which all the characters are studied  
(d) In which more than two characters are studied

Ans. (a)

8. After mitotic cell division, a female human cell will have [2014]

(a) 44 + XX-chromosome (b) 44 + XY-chromosome  
(c) 22 + X-chromosome (d) 22 + Y-chromosome

Ans. (a)

9. Which one of the following conditions would lead to the birth of normal human female child?

(a) Two X-chromosomes  
(b) Only one Y-chromosome  
(c) Only one X-chromosome  
(d) One X and one Y-chromosomes

Ans. (a)

10. If a colourblind woman marries a normal visioned man their sons will be

(a) all colourblind  
(b) all normal visioned  
(c) one-half colourblind and one-half normal  
(d) three-fourth colourblind and one-fourth normal

Ans. (a)

## Fill in the Blanks

11. Fill in the blanks to complete the following statements.

(i) Law of independent assortment was proposed on the basis of observations of ..... cross.  
(ii) Phenotype is the observable characteristic which is ..... controlled. [2011]  
(iii) ..... is the scientific name of garden pea, which Mendel used for his experiments. [2015]  
(iv) Mendel studied a total of ..... traits in peas, each trait occurring in ..... different forms.  
(v) ..... is the phenotypic ratio of dihybrid cross.  
(vi) Haemophilia is caused due to ..... genes.

Ans. (i) dihybrid (ii) genetically  
(iii) *Pisum sativum* (iv) seven, two  
(v) 9 : 3 : 3 : 1 (vi) recessive

## True-False

12. State whether the given statements are true or false.

(i) Chromosomes other than the pair of sex chromosomes are called alleles.  
(ii) Human males are homogametic.  
(iii) Eggs produced by human female contain only X-chromosome.  
(iv) When both the alleles are identical they are said to be homozygous.

- (v) The genetic make up of an organism is called phenotype.  
 (vi) The plant used by Mendel was sweet pea.  
 (vii) Genetics and heredity are the same thing.

**Ans.** (i) False (ii) False  
 (iii) True (iv) True  
 (v) False (vi) True  
 (vii) False

## Match the Columns

**13.** Match the following columns.

Column I	Column II
A. Genetics	1. Chromosomes similar in size and shape.
B. Recessive gene	2. Study of laws of inheritance of characters.
C. Autosomes	3. A gene that can express only when in a similar pair.
D. Homologous chromosomes	4. Chromosomes other than the pair of sex chromosomes.

**Ans.** A–2, B–3, C–4, D–1

## **a** 1 Mark Questions

**14.** Briefly explain the term gene. [2013]

**Ans.** Gene is a portion (or sequence) of DNA that codes for a known cellular function or process. These are also called as the unit of inheritance containing the information required to express a trait.

**15.** Name the pair of genes responsible for a particular characteristics in an individual. [2007]

*Or* Briefly explain the term allele. [2012]

**Ans.** The pair of genes responsible for a particular characteristics in an individual are called alleles.

**16.** Name the physical expression of genes in an individual. [2013]

**Ans.** Phenotype is the physical expression of genes in an individual.

**17.** What is a phenotype?

**Ans.** The observable characteristic of an organism that is genetically controlled is called a phenotype.

**18.** Give appropriate biological or technical term for the following

The condition in which a pair of chromosome carries similar alleles of a particular character.

[2018]

**Ans.** Homozygous condition

**19.** Give the biological term for the suppressed allele of a gene. [2012]

*Or* Name the type of gene which in the presence of contrasting allele is not expressed. [2014]

**Ans.** Recessive factor in an allelic pair of a gene is unable to express itself in a heterozygote and remains suppressed.

**20.** Explain the term monohybrid cross. [2014]

**Ans.** Monohybrid cross It is performed by taking only one pair of contrasting character or one feature at a time.

**21.** Name the cross between two parents having one pair of contrasting characters. [2015]

**Ans.** Monohybrid cross.

**22.** Given below is a group of terms. In the group the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis.

TT : Homozygous :: Tt : ..... [2017]

**Ans.** Heterozygous

**23.** What is a dihybrid ratio?

**Ans.** The ratio of each phenotype (or appearance) of the seeds in the F<sub>2</sub>-generation obtained in a dihybrid cross is called dihybrid ratio, i.e. 9 : 3 : 3 : 1.

**24.** Write down the difference between the following pair as indicated within the bracket. Monohybrid and dihybrid cross (phenotypic ratio). [2011]

**Ans.** Phenotypic ratio in F<sub>2</sub>-generation of monohybrid cross is 3 : 1, while the phenotypic ratio in F<sub>2</sub>-generation of dihybrid cross is 9 : 3 : 3 : 1.

**25.** State Mendel's law of dominance. [2015]

**Ans.** Law of dominance (First law) states that when two alternative forms of a trait or character are present in an organism, only one factor expresses itself in F<sub>1</sub>-progeny. This factor is called dominant factor, while the other factor which remains hidden is called recessive factor.

**26.** State Mendel's law of segregation. [2014]

**Ans.** This is the second law of inheritance. It states that during gamete formation, the alleles for each gene segregate from each other so that each gamete carries only one allele for each gene.

**27.** What are autosomes?

**Ans.** Autosomes are chromosomes that are not allosome, i.e. not sex chromosomes. There are similar number of chromosomes in both males and females (22 pairs).

**28.** Name the two sex-linked diseases in humans.

[2009]

**Ans.** Colour blindness and haemophilia are the two sex-linked diseases in humans.

**29.** Write the genotype of haemophilic son and carrier daughter.

**Ans.**  $X^hY$ —Haemophilic son  
 $X^hX$ —Carrier daughter

**30.** The son of a haemophilic man may not get this genetic disorder. Mention the reason.

**Ans.** The gene responsible for haemophilia is located on X-chromosome and males have only single copy of X-chromosome with no alternative normal allele. That's why the son of a haemophilic man may not get this genetic disorder.

**31.** A haemophilic man marries a normal homozygous woman. What is the probability that their daughter will be haemophilic?

**Ans.** The possibility of a female becoming a haemophilic is extremely rare because mother of such a female has to be at least carrier and father should be haemophilic.

**32.** Give scientific reason for the following statement. Colour blindness is more common in men than in women.

[2016]

**Ans.** Colour blindness is a sex-linked disease. Its gene is located on X-chromosomes not on Y-chromosomes. Females are carriers of the disease. The male will be affected by the disease if this character is carried by its X-chromosomes.

**33.** Given below is set with four terms. In the set, a term is an odd one that cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong. Haemophilia, colour blindness, albinism, night blindness.

**Ans.** The difference between set, odd one and category are given below

Set	Odd one	Category
Haemophilia, colour blindness, albinism, night blindness	Night blindness (It is caused due to nutritional deficiency)	Sex-linked diseases

**34.** In the set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd

term and name the category to which the remaining three belong.

Typhoid, haemophilia, albinism, colour blindness

[2016]

**Ans.** Odd term—Typhoid (bacterial disease)

Rest three belong to genetic disorders (disease).

**35.** Why the pattern of baldness is found only in males?

**Ans.** Pattern of baldness is Y-linked disease. Due to the presence of Y-chromosomes only in male, it is found only in them.

**36.** Give the biological/technical term for the following.

An alteration in the genetic material that can be inherited.

[2016]

*Or* Give technical term for sudden, heritable change in the gene.

[2014]

**Ans.** Mutation.

**37.** Name one factor that can cause mutation.

**Ans.** Ultraviolet (UV) radiation.

**38.** What is gene mutation?

**Ans.** Gene mutation is the change in sequence of DNA.

## **b** 2 Marks Questions

**39.** Give appropriate biological/technical terms for the following

[2017]

- The suppressed allele of a gene.
- A pair of corresponding chromosomes of the same size and shape, one from each parent.

**Ans.** (i) Recessive allele

(ii) Homologous chromosome

[1 × 2]

**40.** List any three features of garden pea with their dominant and recessive traits.

<b>Ans.</b>	<b>Character</b>	<b>Dominant</b>	<b>Recessive</b>
	Stem height	Tall	Short
	Colour of seed	Yellow	Green
	Shape of seed	Round	Wrinkled

**41.** Briefly explain the sex-linked inheritance.

**Ans.** Sex-linked inheritance is the appearance of a trait which is due to the presence of an allele exclusively located on X-chromosome or Y-chromosome. This can be classified into two types X-linked inheritance and Y-linked inheritance.

**42.** A couple got only four daughters in a row and no son. Do you agree that it is because the husband does not produce Y-bearing sperms? Justify.

**Ans.** No, the above situation does not mean that the husband does not produce Y-bearing sperms. It only means that in four consecutive pregnancies, the X-bearing sperms could fertilise the eggs which resulted in the birth of female children.

### c 3 Marks Questions

**43.** Choose the correct alternatives from those given in brackets

- One of the example of X-linked inherited disease is (diabetes, haemophilia, AIDS, baldness).
- Which of the following is inherited through Y-chromosomes? (Colourblindness, baldness, haemophilia, anaemia).
- Sudden changes in the genetic constitution of an individual is known as (genotype, phenotype, mutation, inheritance)

**Ans.** (i) Haemophilia

(ii) Baldness

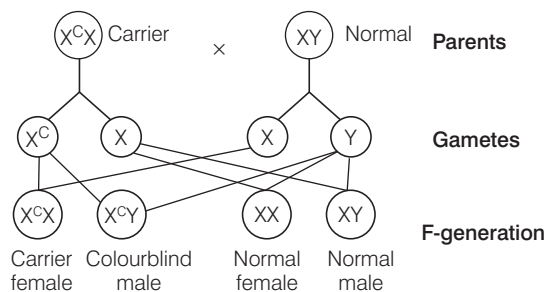
(iii) Mutation

[1 × 3]

**44.** A colourblind child is born to a normal couple. Work out a cross to show how it is possible. Mention the sex of this child.

**Ans.** Colour blindness is a sex-linked disease. The gene for this disorder is present on the X-chromosome. Hence, it is carried by normal females not expressing the disease.

If a colourblind child is born to a normal couple, then the mother could be the carrier of the disease. The cross below shows the inheritance of the disorder



The sex of the child would be males.

**45.** Generally, the male child only suffers from colour blindness and not the female. Explain.

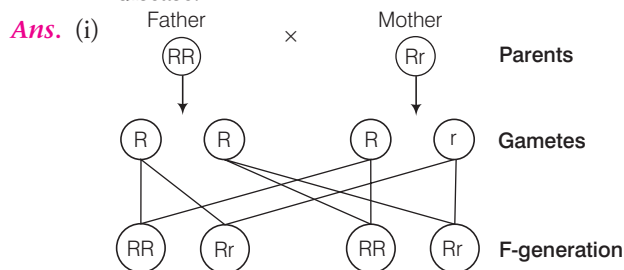
**Ans.** The genes that produce photopigments are carried by the X-chromosomes. In case of a male child, if the X gene carries the trait of colour blindness then it would be expressed in the male child. In case of a female child, two X chromosomes are present.

So, if one has carrier gene for colour blindness, the other X will have gene for the necessary photopigments. Thus, it will not produce a colourblind female child.

### d 4 Marks Question

**46.** A genetic disease is caused by a recessive allele (r). The mother is a carrier of the disease, while the father has normal alleles. The normal condition is dominant allele (R).

- Draw the cross showing children of this couple.
- Will any of their children suffer from this genetic disease?



[2]

- As there is no homozygous pair of recessive genes, so none of the children would suffer from this genetic disease.

[2]

### e 5 Marks Questions

**47.** Differentiate between the following

- Dominance and recessive
- Homozygous and heterozygous

**Ans.** (i) Differences between dominance and recessive are as follows

Dominance	Recessive
When an allele expresses itself in the presence of its recessive allele, it is called dominant trait.	It can only express in the absence of its dominant allele and remains masked in its presence.
Dominant allele forms a complete functional enzyme due to which complete polypeptide is formed to express.	Recessive allele forms incomplete polypeptide enzyme due to which non-functional polypeptide is formed and fails to express completely.

- | <b>Homozygous</b>  | <b>Heterozygous</b>  |
|--|--|
| It is a condition when both alleles of a gene are similar. | It is a condition when both alleles of a gene are dissimilar.  |
| The genotype is expressed as TT or tt.                     | The genotype is expressed as Tt (dominant and recessive allele).   |
| They are true breeding leading to purelines.               | They are not true breeding.  |
| The gametes produced by them are similar in genotype.      | The gametes produced by them are of two types, one with dominant allele and other with recessive allele. |

- (i) Give the phenotype and genotype of the  $F_1$ -generation.  
Which type of pollination has occurred to produce  $F_2$ -generation?
- (ii) Write the phenotypic ratio of the  $F_2$ -generation.
- (iii) Write the possible combinations of the gametes that can be obtained if two  $F_1$ -hybrid plants are crossed.
- (iv) State Mendel's law of 'segregation of gametes'.
- (v) What is the scientific name of the plant which Mendel used for his experiments on inheritance?

(i) Give the genotype and phenotype of the plants of  $F_1$ -generation.

- [2016]**

Tall and red coloured flower (TTRR) X Dwarf and white coloured flower (tt rr)

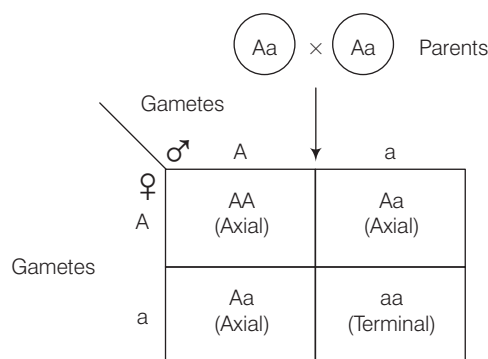
↓

TtRr

- $[1 \times 5]$

- (i) What is the phenotype and genotype of the  $F_1$ -generation if a plant bearing pure axial flowers is crossed with a plant bearing pure terminal flowers?
- (ii) Draw a Punnett square board to show the gametes and offsprings when both the parent plants are heterozygous for axial flowers.
- (iii) What is the phenotypic ratio and genotypic ratio of the above cross shown in (ii)?
- (iv) State the Mendel's law associated with this cross.
- (v) Name two genetic disorders commonly seen in human males.

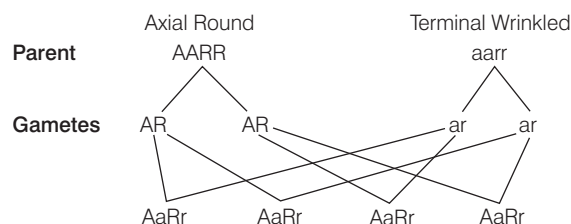
- Ans.** (i) If a plant bearing pure axial flowers (AA) is crossed with a plant bearing pure terminal flowers (aa), the phenotype of flowers of  $F_1$ -generation will be axial flowers while the genotype will be Aa.
- (ii) The Punnett square representing the given cross is as follows



- (iii) **Phenotypic ratio** – 3(axial) : 1 (terminal)  
**Genotypic ratio** – 1(AA) : 2(Aa) : 1(aa)
- (iv) **Law of dominance** (First law) Refer to Ans 25 (1 Mark Questions)
- (v) Colour blindness and haemophilia are the two genetic disorders commonly seen in human males. [1 × 5]

## Diagram Based Questions

- 51.** Given below is a schematic diagram showing Mendel's experiment on sweet pea plants having axial flowers with round seeds (AARR) and terminal flowers with wrinkled seeds (aarr). Study the same and answer the questions that follows



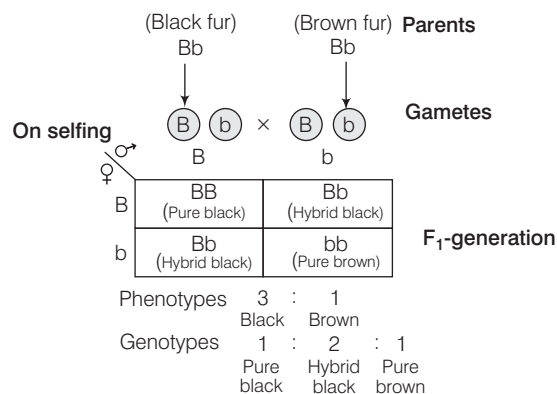
- (i) Give the phenotype of  $F_1$  progeny.
- (ii) Give the phenotypes of  $F_2$  progeny produced by the self-pollination of  $F_1$  progeny.
- (iii) Give the phenotypic ratio of  $F_2$  progeny.
- (iv) Name and explain the law introduced by Mendel on the basis of the above observation. [2013]

- Ans.** (i) Phenotype of  $F_1$  progeny is axial flowers with round seeds.
- (ii) Phenotype of  $F_2$  progeny are axial round (9), axial wrinkled (3), terminal round (3) and terminal wrinkled (1).
- (iii) Phenotypic ratio of  $F_2$  progeny is 9 : 3 : 3 : 1.
- (iv) Mendel introduced the law of independent assortment on the basis of above observation. Refer to text on page 25.

- 52.** In a certain species of animals, black fur (B) is dominant over brown fur (b).

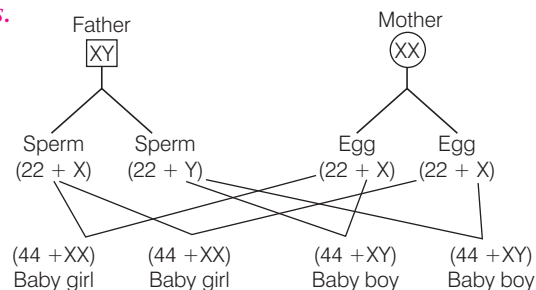
Predict a genotype and phenotype of the offspring when both parents are Bb or have heterozygous black fur. [2014]

**Ans.**



- 53.** Show the mechanism of sex-determination of children in human being in a chart form.

**Ans.**



The males produce two types of gametes (22 + X) and (22 + Y), while females produce only one type of gamete (22 + X).

During fertilisation, when one of the male gamete (22 + X) fertilises female gamete (22 + X), the result will be a baby girl. When male gamete (22 + Y) fertilises the female gamete (22 + X), baby boy will be born.

# CHAPTER TEST

## Multiple Choice Questions

1. Mendel crossed pure breeding varieties, first by taking only one feature at a time. It was termed as,  
(a) monohybrid cross  
(b) dihybrid cross  
(c) test cross  
(d) back cross
2. The Mendel's law which explains the dihybrid ratio is  
(a) law of purity of gametes  
(b) law of dominance  
(c) law of segregation  
(d) law of independent assortment
3. X-linked genes can never pass from  
(a) father to daughter  
(b) mother to son  
(c) mother to daughter  
(d) father to son

4. The possibility of a female becoming haemophilic is  
(a) most (b) 50% (c) rare (d) 25%

Ans. 1. (a) 2. (d) 3. (d) 4. (c)

## Fill in the Blanks

5. (i) The fundamental physical and functional unit of heredity is known as .....  
(ii) An organism with two copies of the same allele is ..... for that trait.  
(iii) ..... is the ratio of dihybrid cross.  
(iv) In humans, ..... type of sex chromosomes are present.  
(v) The family pedigree of queen Victoria was a carrier of .....

## True-False

6. State whether the statements are true or false.  
(i) The ovum contains XX chromosomes.  
(ii) There is one sex chromosome in human.  
(iii) Mendel selected only one contrasting trait during his experiments.  
(iv) Variations are produced due to mutation.

## Match the Columns

7. Match the following columns.

Column I	Column II
A. Homozygous	1. It is the condition in which both the alleles are different
B. Heterozygous	2. It is the condition in which both the alleles are identical
C. Phenotype	3. It is the genetic make up of an organism
D. Genotype	4. The characters which are visible from outside

## 1 Mark Questions

8. Define variations.
9. Name the type of gene, which in the presence of a contrasting allele is not expressed.
10. Mention one reason why Mendel selected garden pea for his experiments.
11. Name the following.  
(i) The dominant and recessive traits for the position of flower in pea plant on which Mendel worked.  
(ii) The common name of Y-linked gene.

## 2/3 Marks Questions

12. Draw a suitable cross to demonstrate Mendel's first law. [2]
13. A pea plant with pure yellow (YY) round (RR) seeds were crossed with a plant having pure green (yy) wrinkled (rr) seeds.  
(i) What would be the nature of the offsprings in the  $F_1$ -generation?  
(ii) If the offsprings of the  $F_1$ -generation are self-pollinated, what would be the phenotypic ratio in  $F_2$ -generation?  
(iii) On which law, part (ii) is based? [3]
14. What is sex-linked inheritance? Give two examples. [2]

## 4/5 Marks Questions

15. A homozygous tall plant (T) bearing red coloured (R) flowers is crossed with a homozygous dwarf plant (t) bearing white flowers (r)

- Give the genotypes and phenotypes of the  $F_1$ -generation.
- Give the possible combinations of the gametes that can be obtained from the  $F_1$ -hybrid.
- Give the dihybrid ratio and the phenotype of the offspring of the  $F_2$ -generation when two plants of the  $F_1$ -generation above are crossed. [5]

16. Explain the process of dihybrid cross. [4]

17. (i) State the Mendel's law of independent assortment.

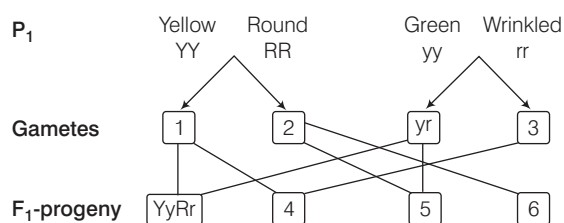
- A homozygous tall plant (T) bearing red coloured (R) flowers is crossed with a homozygous dwarf plant (t) bearing white flowers (r).
  - Give the genotype and phenotype of the  $F_1$ -generation.
  - Give the possible combinations of the gametes that can be obtained from the  $F_1$ -hybrid.
  - Give the dihybrid ratio and the phenotype of the offsprings of the  $F_2$ -generation, when two plants of the  $F_1$ -generation are crossed. [5]

18. Elaborate the different types of sex-linked inheritance. [5]

19. What is the type of genetic inheritance of colour blindness? Is colour blindness more frequent in men or in women? What is the physiological explanation for colour blindness? [5]

## Diagram Based Question

20. Given below is a schematic diagram showing Mendel's experiment on sweet pea plants with yellow round seeds (YYRR) and green wrinkled seeds (yyrr). Answer the questions that follows



- Complete the diagram by filling in the blanks numbered 1-6.
- Give the phenotype of  $F_1$  progeny.
- Name the phenotypes produced in  $F_1$  progeny by self-pollination of  $F_1$  progeny.
- Name the law deduced by Mendel on the basis of above observations.

# ARCHIVES\*

## (Last 8 Years)

Collection of Questions Asked in Last 8 Years' (2018-2011) ICSE Class 10th Examinations

### 2018

1. Give appropriate biological or technical term for the following  
The condition in which a pair of chromosome carries similar alleles of a particular character. [1]
2. Answer the following questions
  - (i) Give the phenotype and genotype of the  $F_1$ -generation.  
Which type of pollination has occurred to produce  $F_1$ -generation?
  - (ii) Write the phenotypic ratio of the  $F_2$ -generation.
  - (iii) Write the possible combinations of the gametes that can be obtained if two  $F_1$ -hybrid plants are crossed.
  - (iv) State Mendel's law of 'segregation of gametes'.
  - (v) What is the scientific name of the plant which Mendel used for his experiments on inheritance? [5]

### 2017

3. Given below is a group of terms. In the group, the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis.  
TT : Homozygous :: Tt : ..... [1]
4. Give appropriate biological/technical terms for the following
  - (i) The suppressed allele of a gene.
  - (ii) A pair of corresponding chromosomes of the same size and shape, one from each parent. [1×2]
5. In a homozygous pea plant, axial flowers (A) are dominant over terminal flowers (a). [5]
  - (i) What is the phenotype and genotype of the  $F_1$ -generation if a plant bearing pure axial flowers is crossed with a plant bearing pure terminal flowers?
  - (ii) Draw a Punnett square board to show the gametes and offsprings when both the parent plants are heterozygous for axial flowers.
  - (iii) What is the phenotypic ratio and genotypic ratio of the above cross shown in (ii)?
  - (iv) State the Mendel's law of dominance.

- (v) Name two genetic disorders commonly seen in human males. [5]

### 2016

6. Give scientific reason for the following statement.  
Colour blindness is more common in men than in women. [1]
7. In the set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term in the set and name the category to which the remaining three belong.  
Typhoid, haemophilia, albinism, colour blindness [1]
8. Give the biological/technical term for the following.  
An alteration in the genetic material that can be inherited. [1]
9. A homozygous tall plant (T) bearing red coloured (R) flowers is crossed with a homozygous dwarf (t) plant bearing white (r) flowers.
  - (i) Give the genotype and phenotype of the plants of  $F_1$ -generation.
  - (ii) Mention the possible combinations of the gametes that can be obtained from the  $F_1$  hybrid plant.
  - (iii) State the Mendel's law of independent assortment.
  - (iv) Mention the phenotypes of the offsprings obtained in  $F_2$ -generation.
  - (v) What is the phenotypic ratio obtained in  $F_2$ -generation? [5]

### 2015

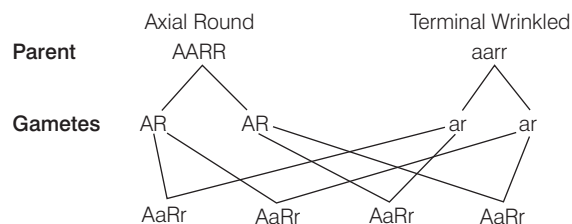
10. Name the cross between two parents having one pair of contrasting characters. [1]
11. Rewrite and complete the following sentence by inserting the correct word in the space indicated. [1]  
..... is the scientific name of garden pea, which Mendel used for his experiments.
12. State Mendel's law of dominance. [1]

**2014**

13. Name the type of gene, which in the presence of contrasting allele is not expressed. [1]
14. Explain the term monohybrid cross. [1]
15. State Mendel's law of segregation. [1]
16. After mitotic cell division, a female human cell will have  
 (a) 44 + XX-chromosome  
 (b) 44 + XY-chromosome  
 (c) 22 + X-chromosome  
 (d) 22 + Y-chromosome [1]
17. Give the technical term for sudden, heritable change in the gene. [1]
18. In a certain species of animals, black fur (B) is dominant over brown fur (b). Predict a genotype and phenotype of the offspring, when both parents are Bb or have heterozygous black fur. [5]

**2013**

19. Name the physical expression of genes in an individual. [1]
20. The recessive gene is one that express itself in  
 (a) heterozygous condition  
 (b) homozygous condition  
 (c)  $F_2$ -generation  
 (d) Y-linked inheritance [1]
21. Briefly explain the term gene. [2]
22. Given below is a schematic diagram showing Mendel's experiment on sweet pea plants having axial flowers with round seeds (AARR) and terminal flowers with wrinkled seeds (aarr). Study the same and answer the questions that follows



- (i) Give the phenotype of  $F_1$  progeny.  
 (ii) Give the phenotypes of  $F_2$  progeny produced upon by the self-pollination of  $F_1$  progeny.  
 (iii) Give the phenotypic ratio of  $F_2$  progeny.  
 (iv) Name and explain the law introduced by Mendel on the basis of the above observation. [5]

**2012**

23. Briefly explain the term allele. [1]
24. Given below is set with four terms. In the set, a term is an odd one that cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong.  
 Haemophilia, colour blindness, albinism, night blindness. [1]
25. Give the biological term for the suppressed allele of a gene. [1]

**2011**

26. Rewrite and complete the following sentence by inserting the correct word in the space indicated.  
 Phenotype is the observable characteristic which is ..... controlled. [1]
27. Write down the difference between the following pair as indicated within the bracket.  
 Monohybrid and dihybrid cross (phenotypic ratio). [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

---

- 1** Sex-linked genetically inherited traits
  - (a) can appear in both males and females
  - (b) are only found in males
  - (c) are only found in females
  - (d) result from pre-marital sexual intercourse
- 2** Two heterozygous plants are crossed.  
What is the ratio of homozygous genotype to heterozygous genotype among the offsprings?  
Homozygous genotype : Heterozygous genotype
  - (a) 1 : 1
  - (b) 1 : 2
  - (c) 1 : 3
  - (d) 3 : 1
- 3** In humans, the sex ratio is very close to 50 : 50. The best genetic explanation for this is
  - (a) crossing over
  - (b) linkage
  - (c) transformation
  - (d) segregation
- 4** In a cross between a pure breed, red-eyed female fruitfly and a white-eyed male, what percentage of the male offsprings will have white eyes?  
(White eyes are X-linked, recessive).
- 5** How many alleles of genes for X-linked traits are present in female and male individuals, respectively?
- 6** If a father and son are both defective in red-green colour vision is it likely that the son inherited the trait from his father? Comment.

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 304.

# Absorption By Roots

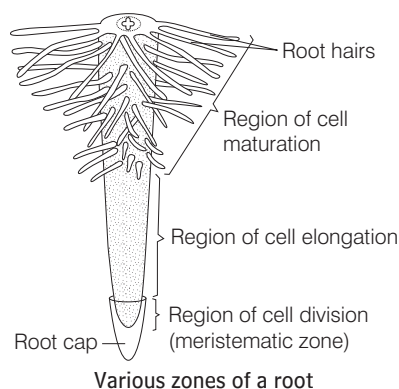
Water acts as an excellent solvent and is required by plants for all their cellular activities. It is the major source of protoplasm. Without the constant supply of water and nutrients, the plant could not carry on any of its physiological activities.

The absorption of water and minerals from the soil takes place *via* roots of plants which is further conducted to all parts of the plant body through xylem.

This constitutes the circulatory system of plants. It is necessary for their survival, growth and development. In this chapter, we will explore the term root and thereafter its functions to show how water and minerals are carried by them from the soil.

## Roots

The roots are branched parts at the lower end of a plant. They fix the plant in the soil (anchorage). They also help the plants to absorb mineral and water from the soil. The structure of a typical root shows different zones as shown in the figure. The major absorption of water occurs in the root hair zone.



## Characteristics of Roots for Absorbing

There are following characteristics of roots for absorbing

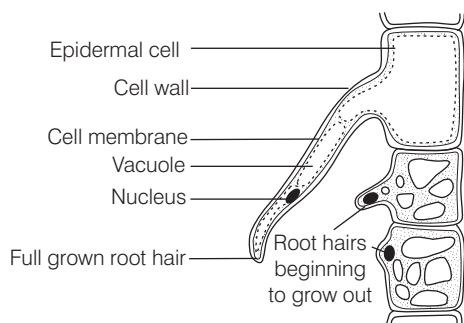
- (i) **Extensive root hair with rapid growth** Plants have extensive root system which grows rapidly in soil.

## Chapter Objective

- Roots
- Processes Involved in Absorption
- Absorption of Water and Minerals in Plants
- Ascent of Sap
- Forces Responsible for Ascent of Sap
- Experiments Related to Absorption and Conduction of Water

For example, in 4-month old rye, the total length of the root system is estimated to be 620 km with a daily increase of 5 km.

- (ii) **Large surface area** Surface area of roots is enormous because of the presence of root hairs. If the root hairs of plant are laid from one end to another, a significant length in kilometres is covered. This increases the area of absorption of water.
- (iii) **Thin walls of root hairs** Root hairs present at the tip of root are thin-walled extensions of the outer walls of the epidermal cells of roots. Root hairs have vacuoles filled with cell sap (a liquid material). They are also surrounded by two layers, i.e. cell wall and cell membrane.



Root hair showing various parts

The **cell wall** is thin and freely permeable, i.e. permits free movement of water and dissolved substances to and from the cell. The **cell membrane** is very thin but semipermeable, i.e. it permits passage of water but with selected dissolved molecules.

- (iv) **High concentrated solution** In root hair vacuole, some salts are dissolved in it therefore, root hair cells have high concentrated cell sap than the surrounding water.

This character is important requirement to draw in water from outside by a process called **osmosis**. That is why water diffuses from outside into the root cells.

### CHECK POINT 01

- 1 In which zone of a root, the root hairs are present?
- 2 Name the four characteristics of roots for absorbing.
- 3 Which structure helps to increase the surface area of roots?
- 4 Name the organelle in roots which is filled with cell sap.

## Processes Involved in Absorption

The entire process of absorption is the result of some important processes such as imbibition, diffusion, osmosis, plasmolysis, etc.

### 1. Imbibition

It is a special phenomenon by which water or any other liquid is adsorbed by the solid particles of a substance, i.e. the living or dead cells by surface attraction.

The solid particles which imbibe water or any other liquid are called **imbibants**, while the liquid which is imbibed is called **imbibate**. The hydrophilic (or water loving) substances have the tendency to imbibe water or moisture which causes them to swell up, e.g. swelling up of dry seeds, swelling and jamming of wooden doors, etc., on exposure to moist air/water.

### Imbibition Pressure

Pressure developed by solid particles which absorb water or other liquid, when submerged in pure imbibing liquid is called **imbibition pressure**. It is due to this pressure that seeds filled in a closed container can break open it.

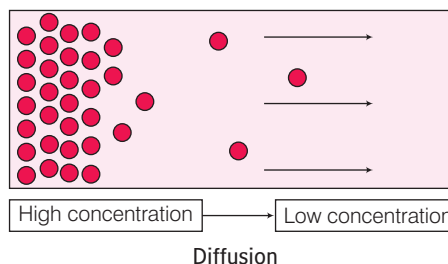
### Significance of Imbibition

Imbibition plays following major roles

- (i) It helps the seed to germinate by breaking the seed coats.
- (ii) It helps in the movement of water from cell to cell in the plant body.
- (iii) It is dominant in the initial stage of water absorption by roots.
- (iv) It helps in ascent of sap *via* root hairs.

### 2. Diffusion

It is the movement of molecules or ions in a random fashion from the region of their higher concentration to the region of their lower concentration. Molecules can be of a gas, liquid or solid. Diffusion is a physical process in which passive transport of solvent molecules or solute ions occurs without the expenditure of energy. It is a slow process and is independent of living system.



## Diffusion Pressure

The diffusing particles in a medium exert a pressure which is directly proportional to their concentration. This pressure is known as **diffusion pressure**.

Higher the concentration of diffusing particles, greater will be their diffusion pressure.

## Significance of Diffusion

- (i) It is a mean of transport of gases in plants.
- (ii) Transpiration of water from stomata occurs by diffusion.
- (iii) It distributes ions and molecules into the protoplasm.

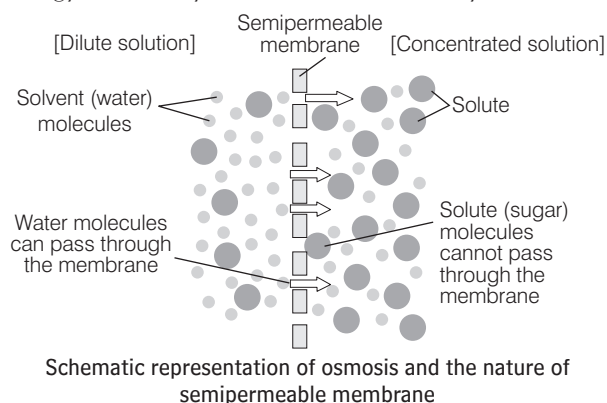
### Differences between Imbibition and Diffusion

Imbibition	Diffusion
In this, the absorption of solvent or water takes place by a solid substance.	It is the movement of substances from the region of their high concentration to a region of low concentration.
The molecules of water or any other liquid are absorbed by the surface of hydrophilic colloids (e.g. cellulose, starch, proteins, polypeptides, etc).	The diffusing particles/molecules get distributed uniformly throughout the available space.
The imbibant swells up but the swelling is less than volume of imbibate.	No overall change in volume is seen.

## 3. Osmosis

It is defined as the movement of water molecules from the region of their higher concentration to a region of lower concentration through a semipermeable membrane (i.e. a membrane that allows only certain molecules to pass through it, e.g. egg membrane, etc).

Osmosis takes place spontaneously in response to a driving force. It is a passive process, i.e. does not require any input of energy. Discovery of osmosis was done by **Pfeffer**.



Osmosis can be of following two types depending upon the concentration of solute inside the cell and the surrounding medium.

- (i) **Exosmosis** It is the **outward movement** of water molecules through the semipermeable membrane when the medium surrounding the cell is more concentrated (hypertonic). In this condition, cell shrinks and becomes **flaccid**.
- (ii) **Endosmosis** It is the **inward movement** of water molecules through the semipermeable membrane when the medium surrounding the cell is less concentrated (hypotonic) or diluted than the medium inside the cell. In this condition, cell swells up and becomes **turgid**.

## Types of Membranes

Depending upon the permeability of various solutes and solvents, the membranes are classified into four types

- (i) **Impermeable membrane** It does not permit the passage of either a solvent or a solute molecules, e.g. cutinised or suberised cell walls.
- (ii) **Permeable membrane** It allows the passage of both the solute and solvent across it, e.g. cellulosic cell wall, lignified cell walls.
- (iii) **Semipermeable membrane** It allows free movement of solvent but only few selected solute molecules can pass through it, e.g. membranes of parchment paper and copper ferrocyanide, etc.
- (iv) **Differentially permeable membrane** It allows useful substances to diffuse in and harmful substances to diffuse out, e.g. all biological membranes.

## Osmotic Pressure

Osmotic pressure of a solution is the pressure which must be applied to the solution in order to prevent the passage of solvent into the solution through a semipermeable membrane. It is measured using an instrument called **osmometer**.

The osmotic pressure of a solution largely depends upon the ratio between the number of solute and solvent particles present in a given solution. In other words, osmotic pressure is the measure of the tendency to take up the water by osmosis.

## Reverse Osmosis

It is the process of expulsion of pure water from a solution through a semipermeable membrane under the influence of pressure higher than the osmotic pressure of the solution.

## Tonicity

Osmosis gets affected by the environment in which it takes place, i.e. the tonicity of a solution. It is the amount of tension developed in a system on account of solute particles in it.

## Types of Solutions Based on Tonicity

Based on the tonicity, solutions are divided into three main types

- (i) **Hypotonic solution** It is the solution having lower solute concentration (outside the cell) than the fluid inside the cell.  
In this case, endosmosis takes place, i.e. water moves into the cell and cell swells up to become **turgid**.
- (ii) **Isotonic solution** It is the solution in which the relative concentration of water molecules and the solute on either sides is equal, i.e. inside and outside of the cell membrane. In this case, size of cell remains the same.
- (iii) **Hypertonic solution** It is the solution having higher solute concentration (outside the cell) than the fluids inside the cell. In this case, exosmosis takes place, i.e. water moves out of the cell and cell shrinks.

## Significance of Osmosis

Osmosis is helpful in many ways as given below

- (i) It helps in the maintenance of cell turgidity.
- (ii) It plays a vital role in stomatal movement during transpiration.
- (iii) It helps in the movement of liquids across biological membranes.
- (iv) Absorption of water from soil by root hairs is due to osmosis.
- (v) It regulates the opening and closing of stomata.
- (vi) It plays a key role in growth of radicle and plumule during germination of seeds.

### Differences between Diffusion and Osmosis

Diffusion	Osmosis
It is the movement of molecules or ions from a zone of high to low concentration or from a zone of lower free energy, until they are evenly spread in the medium.	It is the movement of solvent (water) molecules from a zone of higher free energy to a zone of lower free energy through a semipermeable membrane.
It can occur in any type of medium-solid, liquid or gaseous.	It occurs only in liquid medium.
Semipermeable membrane is not involved.	Semipermeable membrane is involved.

## CHECK POINT 02

- 1 The solid particles which imbibe water are called ....., while the liquid which is imbibed is called .....
- 2 Which process is the mean of transport of gases in plants?
- 3 Give an example of a semipermeable membrane.
- 4 Which membrane allows the movement of both solvent and solute across it?
- 5 How is osmotic pressure measured?
- 6 What is an isotonic solution?
- 7 Mention one significance of osmosis?

## 4. Turgidity

It is a condition of a cell in which it becomes distended or bulged out due to the entry of water by endosmosis. The cell is said to be turgid when it cannot accommodate more water in it. Such a cell is known as **turgid cell**, e.g. reversal of wilting when plant cell gets water.

A turgid cell has its walls stretched because of the pressure from inside. The cell in turn presses the cellular contents toward the centre of the cell.

Two kinds of pressures are generated by a turgid cell, namely turgor pressure and wall pressure.

- (i) **Turgor Pressure (TP)** It is the pressure exerted by the protoplasm against the cell wall in the cell.
- (ii) **Wall Pressure (WP)** It is the back pressure exerted by the cell wall against the protoplasm of a fully turgid cell. Normally, wall pressure is equal and opposite to turgor pressure.

## Significance of Turgidity

- (i) It provides rigidity to soft tissues like leaves in a plant and maintains proper shape.
- (ii) It helps the roots to push through the hard grounds.
- (iii) The opening and closing of stomata is regulated by turgidity.
- (iv) It develops root pressure in root cells.
- (v) Turgor movements are observed in leguminous plants, leaflets of *Oxalis* and *Mimosa pudica*.

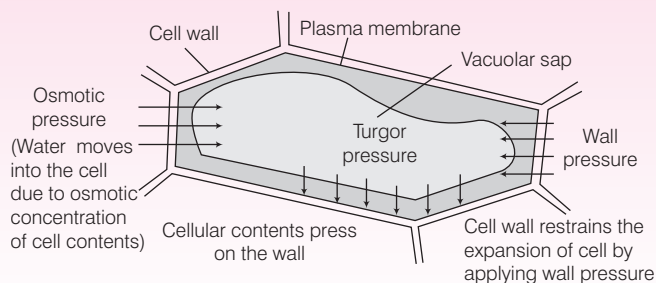
## 5. Flaccidity

It is the condition in which a cell loses water from its cytoplasm due to exosmosis. Such a cell is known as **flaccid cell**, e.g. wilting property of leaves when plant is exposed to the sun. It is basically a reverse process of turgidity.

### Relation between Turgor Pressure, Wall Pressure and Osmotic Pressure

When a cell is in a turgid state, it is said to be in equilibrium, as no more water enters or gets out of the cell.

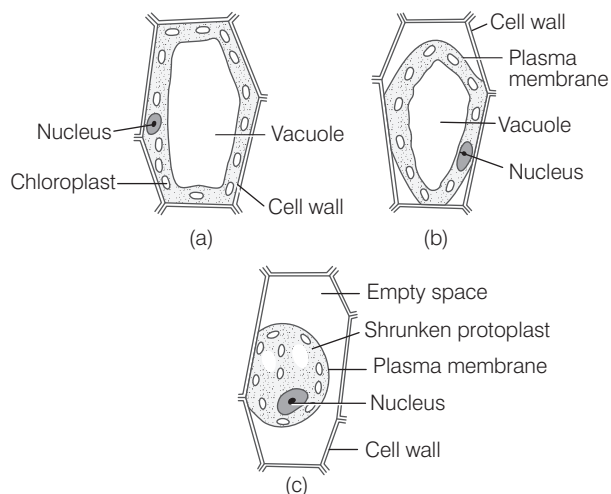
Turgor pressure balances the wall pressure and osmotic pressure, as there is no absorption of water even when concentration of solutes inside cell may be greater than outside.



Relationship between the osmotic, turgor and wall pressure

## 6. Plasmolysis

It occurs when water moves out of the cell when placed in a hypertonic solution due to osmosis. Due to plasmolysis, plant cell loses its original appearance, i.e. protoplasm shrinks and plasma membrane is pulled away from the cell wall. This makes cell look flaccid in appearance.



Diagrammatic representation of plasmolysis

### Significance of Plasmolysis

- (i) It is used in killing bacteria that grow on or contaminate food items, such as meat, jams, pickles, etc., by adding large amount of salt or sugar in it. In such conditions, the bacteria dies due to the loss of water (plasmolysis) from their cell body.

- (ii) It can also be used to kill weeds which are grown in playgrounds, gardens, etc. This is achieved by sprinkling large amount of salt at their base.

## 7. Deplasmolysis

It is exactly the reverse of plasmolysis in which the protoplasm of the cell returns to its original position when favourable conditions are provided, e.g. when the cell is placed in pure water or hypotonic solution. This again makes the cell normal (turgid) and it attains the original shape and size.

For example, if a plant cell is placed in salt solution, it becomes plasmolysed but if the same cell is placed in tap water, its original state will reappear, i.e. it will become deplasmolysed.

### Differences between Plasmolysis and Deplasmolysis

Plasmolysis	Deplasmolysis
It occurs when tissue cell is placed in hypertonic solution.	It occurs when tissue cell is placed in hypotonic solution.
It is a result of exosmosis.	It is a result of endosmosis.
It is not reversible after a long period of time.	It is reversible even after a long period of time.

### CHECK POINT 03

- 1 How are wall pressure and turgor pressure related ?
- 2 What is the relationship among turgor, wall and osmotic pressure?
- 3 Give the biological reason of adding extra salt in pickles and sugar in jams.
- 4 Which process of osmosis is involved in case of plasmolysis and deplasmolysis?
- 5 How can we deplasmolyse the cell?

## Absorption of Water and Minerals in Plants

In plants, a complex movement of materials takes place in different directions. The water taken up by the roots, the absorbed minerals and the food manufactured by leaves, all needs to be distributed to various parts of a plant.

The short distance transportation is carried out by the processes like diffusion and osmosis as discussed earlier in this chapter.

However, for long distance transport, special vascular tissues are present in plants. These are

- (i) **Xylem** This is mainly responsible for the transport of water and minerals from roots to aerial parts of the plant.
- (ii) **Phloem** This is mainly responsible for the transport of organic and inorganic substances such as food, etc., from leaves to other parts of the plant.

## Types of Absorption

Absorption of water or minerals by roots takes place by the following two processes

- (i) **Passive absorption or Passive transport** It is the mechanism of movement of substances into root cells simply by diffusion, i.e. without the expenditure of energy from the region of higher concentration to the region of lower concentration.
- (ii) **Active absorption or Active transport** It is the mechanism of transport of molecules (ions) against a concentration gradient, i.e., from the region of lower concentration to the higher concentration with the help of energy in the form of ATP.

Direction of molecules in active transport is just opposite to that of diffusion. Nutrient molecules such as potassium, zinc, nitrates, sulphates, etc., do not pass through the cell membrane because of their higher concentration inside the root cells. Thus, these molecules are forcibly carried inside the cell, against their concentration gradient.

### Differences between Active and Passive Absorption

Active absorption	Passive absorption
It takes place from the region of lower to higher concentration	It takes place from the region of higher to lower concentration
Expenditure of energy in the form of ATP is required	Energy is not required
It requires carriers for transport of ions across the cell membrane	It does not require carriers for the transport of ions

## Ascent of Sap (Water Movement up a Plant)

It is the upward movement of water along with minerals from roots to upper parts of the plant (such as leaves and other growing points) by the stems. It occurs through the tracheary elements of xylem.

Path followed by water during transport is given below

Root hair → Cortex cells → Endodermis → Passage cells → Xylem vessels.

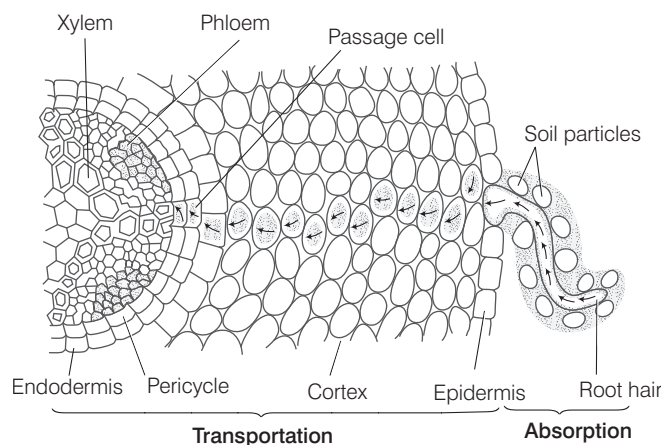


Diagram showing cross-section of a part of a root indicating cell-to-cell conduction of water from a root hair to xylem by arrows

## Forces Responsible for Ascent of Sap

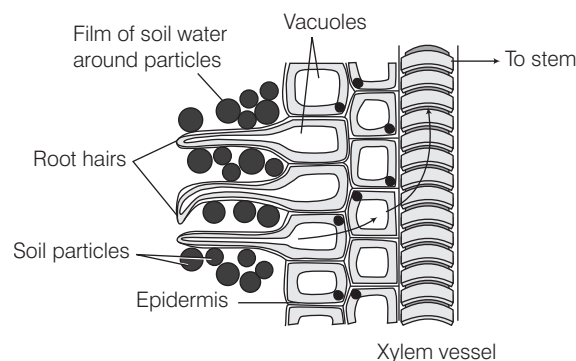
The upward movement of water is brought about by the virtue of four main forces. These are

### 1. Root Pressure

It is the pressure that develops in the xylem of roots mainly in cortical cells due to inflow of water. It pushes the water and minerals in the upward direction. Root pressure develops largely due to osmotic phenomenon.

The root pressure is maximum during early morning of spring and rainy season when the level of evaporation is low. It is measured by an instrument called **manometer**.

But it fails to play a role in water movement in tall trees like gymnosperms, etc.



Root pressure builds up due to osmosis and turgidity of root cells and up into the xylem vessels

## 2. Capillarity Action

It is one of the forces contributing to ascent of sap having narrow diameter. It causes the water from a lower level to rise and fill up the vacuum created by the loss of water due to transpiration from the leaves.

Narrower the diameter of a tube, greater will be the height of water rising in it exerting a force called **capillary force**.

## 3. Adhesion of Water

The molecules of water stick to the walls of xylem vessels due to adhesive property of water to cell wall material. This is called **adhesive force**.

This draws more water from below when leaf cells lose water during transpiration.

## 4. Transpirational Pull

This is a force developed due to transpiration. Water is lost from the leaf cells (mesophyll) to the intercellular space, as a result of transpiration and develops a strong negative water potential.

This negative pressure exerts an upward pull over the water column. This pull is due to the tendency of water molecules to remain joined (**cohesion**) during transpiration. The tendency of water molecules to remain joined is due to the **cohesive force**.

## Descent of Sap

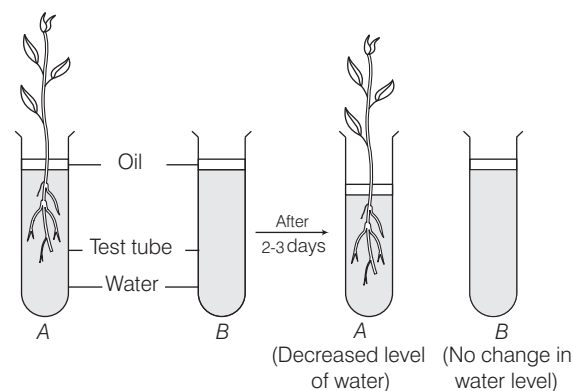
The downward movement of sap is relatively simple. The manufactured food in leaves gets dissolved in water and flows down due to the force of gravity.

## Experiments Related to Absorption and Conduction of Water

### Experiment 1

✓ *Experiment to demonstrate the absorption of water by plant roots.*

■ **Procedure** Take two test tubes and fill both of them with water. In the first tube A, insert a freshly plucked plant (like balsam) with intact roots dipped in water. Add a few drops of oil to reduce water loss by evaporation. Prepare a similar set-up with test tube B without the plant.



Demonstration of water by plant roots

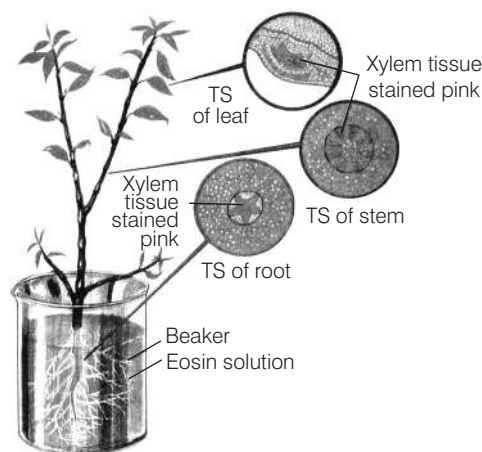
Mark the level of water in both the tubes. Leave the set-up for a day or two and observe.

**Observations** The level of water in the test tube A decreases while no change is observed in test tube B. This indicates that the water is lost in test tube A and was absorbed by the roots.

### Experiment 2

✓ *To show that xylem tissues conduct water in a plant.*

■ **Procedure** Take a young medium-sized balsam plant. Wash it and place it in a beaker containing an eosin dye solution (pink) in water. It is to be noted that the roots should be completely submerged in the solution.



Experiment to show that water is conducted upwards through xylem

The set-up is allowed to stand for about 3-4 hrs. After the period of 3-4 hrs, take the plant out of the solution and wash it in tap water. Cut and make a Transverse Section (TS) of the stem, leaves or roots. Examine them under a microscope. You will observe that the xylem vessels are distinctly visible as they have taken the stain indicating that the solution moved through the xylem.

## Experiment 3

- ✓ *To demonstrate the conduction of water through xylem by ringing experiment.*

■ **Procedure** Take two balsam plants and cut them under water in order to prevent bubbles from entering in roots.

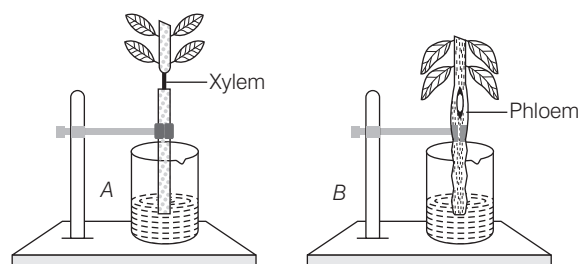
Keep the cut ends of the plants dipped in water. In set-up A, remove about 3 cm long outer ring of stem (phloem) without disturbing the central part.

In set-up B, remove an equal length of the central part, keeping the peripheral part intact.

The shoots are fixed on stands with their cut ends in water and left for two days.

**Observation** The leaves in set-up A remain turgid and stand out almost normally, while in set-up B leaves get wilted and drop downwards.

The experiment verifies that water is conducted upward in a plant through xylem.



Experiment to demonstrate conduction of water upwards through xylem

### CHECK POINT 04

- 1 How does long distance transport of water and minerals in plants take place?
- 2 Name the four main forces responsible for ascent of sap.
- 3 ..... fails to play a role in water movement in tall trees.
- 4 Conduction of food in plants takes place through .....
- 5 What is the colour of eosin dye solution?
- 6 Which process in plants is demonstrated using ringing experiment?

## SUMMARY

- Absorption of water and minerals in plants takes place with the help of xylem and phloem. It is necessary for survival, growth and development of plant.
- Water is the most important component required by plant for all its activities such as transportation, transpiration, photosynthesis, mechanical support, etc.
- Mineral nutrients are required by plants for growth and cellular activities.
- Roots form the major organ for absorption of water from soil and root hairs play a distinct role in absorption.
- Imbibition is a process of adsorption of water by solid particles of a substance without forming a solution.
- Diffusion is a process of movement of molecules from a region of higher concentration to a region of lower concentration. It does not require energy.
- Osmosis is the process of movement of water molecules from a less concentrated solution to a more concentrated solution when the two are separated via a semipermeable membrane.
- Osmotic pressure is the potential of water molecules to move from a less concentrated solution to a more concentrated solution across a semipermeable membrane.
- Tonicity is the amount of tension developed in a system on account of occurrence of solute particles in it. Solutions may be isotonic, hypertonic or hypotonic when the tonicity of two solutions is compared.
- Turgidity is the condition of a cell in which it cannot accommodate more water.
- Turgor pressure The pressure exerted by the protoplasm against the cell wall is called turgor pressure or pressure potential.
- Plasmolysis is the shrinkage of protoplast and its movement away from the cell wall due to exosmosis. It occurs when a cell is placed in hypertonic solution. Reversal of plasmolysis is deplasmolysis.
- Water absorption in plants occurs mainly by two mechanisms, i.e. active absorption and passive absorption.
- Passive absorption is the movement of substances into root cells by simple diffusion without using energy.
- Active absorption is the uptake of substances against the concentration gradient by using energy stored in ATP molecules.
- Ascent of sap is the long distance transport of water via xylem tissue. It is due to many forces such as root pressure, cohesion and adhesion, transpiration pull and capillarity.
- Root pressure is the positive hydrostatic pressure developed in the roots due to excess of water absorption.

# EXAM PRACTICE

## Multiple Choice Questions

1. A component common in both the processes, i.e. absorption of water and transportation of minerals in plants is

(a) air (b) water  
(c) soil (d) light

Ans. (b)

2. Root hairs are surrounded by two layers, among these which one is selectively permeable to certain specific substances only

(a) cell wall  
(b) cell membrane  
(c) cytoplasm  
(d) None of the above

Ans. (b)

3. Marine fish when placed in tap water bursts because of [2017]

(a) endosmosis (b) exosmosis  
(c) diffusion (d) plasmolysis

Ans. (a)

4. A cell is placed in a solution and shrinkage of this cell is observed in the medium. This solution is

(a) hypertonic (b) isotonic  
(c) hypotonic (d) None of these

Ans. (a)

5. A plant *Mimosa pudica* shows folding of its leaves within 2-3 sec when touched. This happens due to the presence of

(a) flaccid movements (b) turgor movements  
(c) plasmolysis (d) osmosis

Ans. (b)

6. A plant cell may burst when  
(a) turgor pressure equalises wall pressure  
(b) turgor pressure exceeds wall pressure  
(c) wall pressure exceeds turgor pressure  
(d) None of the above [2016]

Ans. (a)

7. Plants require water and minerals for their growth and development. A mineral required for maintenance of osmotic balance in a cell is

(a)  $\text{Ca}^{2+}$  (b)  $\text{PO}_4^{2-}$   
(c)  $\text{Mg}^{2+}$  (d)  $\text{K}^+$

Ans. (d)

8. The shrunken condition of a cell is brought about by which of the following processes?

(a) Plasmolysis (b) Diffusion  
(c) Osmosis (d) None of these

Ans. (a)

9. Water absorption by roots occurs when

(a) solute concentration is high in cell sap  
(b) solute concentration in soil is high  
(c) there is no light  
(d) the plant is respiring rapidly

Ans. (a)

10. The space between the cell wall and plasma membrane in plasmolysed cell is filled with

(a) isotonic solution (b) hypotonic solution  
(c) hypertonic solution (d) water

Ans. (c)

11. For absorption of water and minerals, the most effective process is

(a) diffusion (b) osmosis  
(c) ionic exchange (d) All of these

Ans. (d)

12. The transport of water and dissolved minerals occurs through

(a) phloem (b) xylem  
(c) ionic exchange (d) None of these

Ans. (b)

13. The root pressure is inhibited by

(a) decreased aeration (b) fluctuating temperature  
(c) increased evaporation (d) All of these

Ans. (d)

## Fill in the Blanks

14. Fill in the blanks with suitable words

- The first process by which water enters into the seed coat when a seed is placed in suitable situation for germination is.....
- Root pressure can be measured by .....
- Water potential of a cell is lowered by the addition of .....
- Metabolic energy of the cell is utilised in ..... absorption of water.
- The concentration of the cell sap ..... as plasmolysis takes place.

- (vi) When plants absorb water from the soil, the water potential of root cell is ..... than the soil.
- (vii) The solution which has the same concentration of dissolved particles as inside the cell is called ...
- (viii) The condition opposite to turgid is .....
- (ix) Root hair is an extension of .....
- (x) ..... does not require an energy input to operate.
- (xi) Wooden doors swell up in rainy season due to .....
- (xii) ..... is the phenomenon of contraction of the cytoplasm from the cell wall. [2011]

- Ans.** (i) imbibition (ii) manometer  
 (iii) solutes (iv) active  
 (v) increases (vi) lower  
 (vii) isotonic (viii) flaccid  
 (ix) epidermal cell (x) Passive transport  
 (xi) imbibition (xii) Plasmolysis

## True-False

- 15.** Mention whether the following statements are true or false. Also rewrite the false statement correctly.
- (i) The plasma membrane is semipermeable.
  - (ii) Deplasmolysis occurs when a cell is placed in water.
  - (iii) Wall pressure is the pressure exerted by the cell wall over the cell content.
  - (iv) Passive absorption requires energy.
  - (v) Phloem is responsible for ascent of sap.
  - (vi) The fully expanded state of a cell is called turgid.
  - (vii) By exosmosis, water enters into the cell.
  - (viii) The hydrostatic pressure developed due to osmosis is osmotic pressure.
  - (ix) An egg membrane allows only the solvent parts to pass through it.
  - (x) The upward movement of water through xylem is guttation.

- Ans.** (i) True  
 (ii) True  
 (iii) True  
 (iv) False. Active absorption requires energy.  
 (v) False. Xylem is responsible for ascent of sap.  
 (vi) True  
 (vii) False. By endosmosis, water enters into the cell.

- (viii) True
- (ix) True
- (x) False. The upward movement of water through xylem is ascent of sap.

## Match the Columns

- 16.** Match the following columns.

Column I	Column II
A. Xylem	1. semipermeable
B. Phloem	2. permeable
C. Cell membrane	3. downward flow of sap
D. Root pressure	4. upward flow of water
E. Cell wall	5. manometer

- Ans.** A – 4, B – 3, C – 1, D – 6, E – 2

- 17.** Match the following columns.

Column I	Column II
A. Plasmolysis	1. Active transport
B. Absorption of ions from soil against concentration gradient	2. Exerted by cell sap on cell wall
C. Turgor pressure	3. Hypertonic medium
D. Phloem	4. Adsorption of water by living or dead cells of plants.
E. Imbibition	5. Translocation of food

- Ans.** A – 3, B – 1, C – 2, D – 5, E – 4

## a 1 Mark Questions

- 18.** Name the phenomenon by which living or dead plant cells absorb water by surface attraction. [2012]

- Ans.** Imbibition is the phenomenon by which living or dead plant cells or cell material adsorb water by surface attraction.

- 19.** Give biological reason. Why wooden frames of doors get jammed during the monsoon season? [2013]

- Ans.** Wooden doors swell up in rainy season due to imbibition.

- 20.** Briefly explain the term osmosis. [2012]

- Ans.** **Osmosis** The diffusion of water (solvent) from its region of higher concentration to its lower concentration through a semipermeable membrane.

- 21.** Name the process by which root hairs absorb water from the soil. [2017]

- Ans.** Root hairs absorb water with the help of osmosis.

- 22.** Differentiate between diffusion and osmosis (definition). [2015]

**Ans.** Difference between diffusion and osmosis is as follows

Diffusion	Osmosis
Movement of molecules of substance from the region of higher concentration to lower one when two are in direct contact.	Diffusion of water (solvent) from the region of higher concentration to lower one through semipermeable membrane.

- 23.** Give the biological term for a membrane which allows the passage of molecules selectively. [2012]

**Ans.** Plasma or the cell membrane is selectively permeable membrane which allows the passage of molecules selectively.

- 24.** Give the biological term for a solution in which the relative concentration of water molecules and solute on either sides of cell membrane is the same. [2013]

**Ans.** Isotonic solution

- 25.** Differentiate between the following pair on the basis of what is indicated in brackets. Hypotonic solution and hypertonic solution (condition of a plant cell when placed in them). [2018]

**Ans.** When a plant cell is placed in hypotonic solution, it becomes turgid due to endosmosis. While, when it is placed in hypertonic solution, it becomes flaccid or deplasmolysed due to exosmosis.

- 26.** Correct the following statements by changing the underlined words.

(i) The cell sap of root hair is hypotonic. [2018]

(ii) Xylem transports starch from the leaves to all parts of the plant body. [2018]

**Ans.** (i) Hypertonic (ii) Phloem

- 27.** Give appropriate biological or technical term for the following.

Movement of molecules of a substance from their higher concentration to lower concentration when they are in direct contact. [2018]

**Ans.** Diffusion

- 28.** The statement given below is incorrect. Rewrite the correct statement by changing the underlined words of the statements.

Free movement of solutes in and out of the cell takes place across the cell membrane. [2017]

**Ans.** Free movement of solutes in and out of the cell takes place across the cell wall.

- 29.** Give reasons for the following  
Potato cubes when placed in water become firm and increase in size. [2011]

**Ans.** Endosmosis takes place when potato cubes were placed in water that acts as a hypotonic medium. The cells of potato become turgid and potato cubes become firm. Thus, they increase in size.

- 30.** Name the pressure exerted by cell contents on a plant cell wall.

**Or** Explain the term turgor pressure. [2015]

**Ans.** Turgor pressure is the pressure exerted by cell contents on a plant cell wall.

- 31.** Differentiate between turgor pressure and wall pressure. [2014]

**Ans.** Difference between turgor pressure and wall pressure is as follows

Turgor pressure	Wall pressure
Pressure exerted by the protoplasm against the cell wall.	Back pressure exerted by the cell wall on the protoplasm.

- 32.** Name the process of uptake of mineral ions against the concentration gradient using energy from the cell. [2016, 15]

**Ans.** Active transport.

- 33.** The transpirational pull theory involves two forces. Identify these forces.

**Ans.** (i) **Cohesion** The attraction among water molecules  
(ii) **Adhesion** The attraction between water and walls of xylem molecules. [ $\frac{1}{2} \times 2$ ]

- 34.** How does most of the water move within the root?

**Ans.** By transpiration pull, cohesion and adhesion property of water molecules.

- 35.** Differentiate between active transport and diffusion (significance in plants). [2017]

**Ans.** Difference between active transport and diffusion is as follows

Active transport	Diffusion
Uptake of mineral ions into root cells occurs through active transport.	Exchange of gases between the plant interior and outside occurs through diffusion.

- 36.** Give biological explanation for the following.  
Plants growing in fertilised soil are often found to wilt if the soil is not adequately watered. [2018]

**Ans.** If the soil is fertilised and not well-watered, the concentration of the soil solution will be very high and water begins to move from the root hair cells to soil due to exosmosis. If this process continues for a long time, plasmolysis takes place and it leads to wilting of plants.

## b 2 Marks Questions

**37.** List any two importance of diffusion in plants.

**Ans.** Two importance of diffusion in plants are as follows

(i) Gaseous exchange with the atmosphere through stomata.

(ii) The ions are absorbed by the simple diffusion during passive salt intake. [1 × 2]

**38.** State any two functions of turgor pressure.

**Ans.** Two functions of turgor pressure are as follows

(i) It helps in movement of plants.

(ii) It also aids in cell enlargement. [1 × 2]

**39.** Name the following.

(i) The tissue which is responsible for the transport of organic and inorganic substances.

(ii) The root hairs are the extension of which cells?

**Ans.** (i) Phloem (ii) Epidermal cells. [1 × 2]

**40.** Give one reason for the following.

Wilted lettuce leaves if kept in cold water become crisp.

**Ans.** Leaves of wilted lettuce are flaccid in nature due to the loss of water. When these leaves are kept in cold water, the water enters the cells making them turgid. Hence, they become crisp.

**41.** When separated by a semipermeable membrane, water enters the sugar solution. What would we call the sugar solution, osmotically active or inactive? Why?

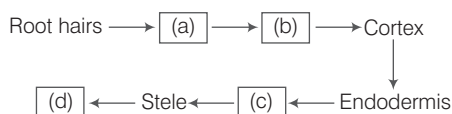
**Ans.** The sugar solution is osmotically active because it possesses lower water potential and can cause osmotic entry of water into it.

**42.** Answer the following briefly.

Plants growing in fertilised soil are often found to wilt if the soil is not adequately watered, why?

**Ans.** If the soil is fertilised and not well-watered, the concentration of the soil solution will be very high and water begins to move from the root hair cells to soil due to exosmosis. If this process continues for a long time, plasmolysis takes place and leads to wilting of plants.

**43.** Complete the pathway of water absorption in roots.



**Ans.** (a) Epidermal cells (b) Hypodermis  
(c) Pericycle (d) Xylem [½ × 4]

**44.** Why is there a need of long distance transport system in plants?

**Ans.** The long distance transport system is needed in plants because substances have to be moved across very long distances like flowers, roots, leaves, etc., for which diffusion and active transport are not sufficient.

## c 3 Marks Questions

**45.** The statements given below need correction for the underlined word. Rewrite the statements after correcting the word.

(i) The first process by which water gets into the seed coat during germination is osmosis.

(ii) Osmosis is an active transport of molecules in cells.

(iii) The plasma membrane present in plant cell is completely impermeable to solutes.

**Ans.** (i) Imbibition (ii) Passive  
(iii) Semipermeable [1 × 3]

**46.** Define the term active transport giving one example.

**Ans.** Active transport is the movement of molecules (or ions) from lower concentration to higher concentration against a concentration gradient using energy in the form of ATP (Adenosine Triphosphate), e.g. uptake of mineral ions into root cells.

**47.** What role does root pressure play in water movement in plants?

**Ans.** Root pressure is responsible for pushing up water to small height in the stem. The greatest contribution of root pressure may be to re-establish the continuous chain of water molecules in the xylem, which often break under the enormous tensions created by transpiration. Root pressure does not account for the majority of water transport. Most plants meet their water need by transpiratory pull.

**48.** Will the ascent of sap be possible without the cohesion and adhesion of water molecules? Explain.

**Ans.** The cohesion and adhesion of water molecules alone creates pressure of about 350 atm, which is responsible for conducting water to great height in tall trees without breaking the water column. On the other hand, all forces such as imbibition pressure and root pressure have been found to create pressure of only 50 atm. So, ascent of sap is not possible without cohesion and adhesion of water molecules.

**d 4 Marks Questions****49.** Name the following.

- (i) A major component of all the cells, i.e a universal medium in which all substances can be dissolved.
- (ii) A mineral required for the synthesis of chlorophyll in plants.
- (iii) A process that helps in ascent of sap *via* root hairs.
- (iv) The process in which molecules of a substance move in a random fashion to region of lower concentration.

- Ans.** (i) Water [1]  
 (ii) Magnesium ( $Mg^{2+}$ ) [1]  
 (iii) Imbibition [1]  
 (iv) Diffusion [1]

**50.** Give reasons for the following.

- (i) A closed can of dried seeds bursts open if water somehow enters the can.
- (ii) A normal osmotic concentration of blood is maintained in our body.
- (iii) The fishes living in freshwater cannot survive in sea water.
- (iv) Microorganisms like bacteria and fungi do not grow in pickles, jams and squashes, etc.

- Ans.** (i) The dried seeds absorb the water by imbibition and swell up. The swelling creates pressure and exerts it on the walls. This can cause the seeds to burst open.  
 (ii) Osmotic concentration is maintained in order to prevent dehydration of cells which leads to their shrinkage.  
 (iii) As compared to freshwater, the sea water is saline and is hypertonic for freshwater fishes. It causes plasmolysis of cells in the fish due to which they die.  
 (iv) Pickles, jams, squashes, etc., are preserved with hypertonic solution of sugar or salt which causes plasmolysis of microbial cells. [1 × 4]

**51.** Describe briefly the three physical properties of water which help in ascent of sap in xylem.

- Ans.** The three physical properties of water which help in ascent of sap in xylem are cohesion, adhesion and capillarity. Refer to text on page 44 and 45.

**52.** Answer the following questions briefly.

- (i) How does most of the water move within the roots?
- (ii) Keep some freshly cut flowers in a solution of food colour. Wait for some time for the dye to rise in the flower, when the stem of the flower is held up in

light, coloured strand can be seen inside. Can this experiment demonstrate which tissue is conducting water up the stem?

- (iii) Name any one factor responsible for ascent of sap.
- (iv) Name the instrument used to measure root pressure.

- Ans.** (i) Most of the water moves by transpiration pull, cohesion and adhesion property of water molecules within the root.  
 (ii) Yes, it shows that xylem tissues conduct water in the stem.  
 (iii) Capillary action.  
 (iv) Manometer. [1 × 4]

**e 5 Marks Questions****53.** Given below are certain structures. Fill in the blanks with their suitable functions.

- (i) Root hairs ..... [2015]
- (ii) Xylem ..... [1]
- (iii) Active absorption ..... [1]
- (iv) Phloem ..... [1]
- (v) Turgidity ..... [1]

- Ans.** (i) Water absorption  
 (ii) Upward water transport in plants  
 (iii) Movement against concentration gradient  
 (iv) Translocation of food molecules  
 (v) Strengthens soft parts of plants [1 × 5]

**54.** Name the following.

- (i) The outward movement of water molecules causing the cell to become flaccid.
- (ii) A solution which causes water to move into the cell and swelling up.
- (iii) Back pressure exerted by the cell wall against the protoplasm.
- (iv) The force that forms continuous water column in xylem.
- (v) The process which causes raisins to swell, when kept in water.

- Ans.** (i) Exosmosis (ii) Hypotonic (iii) Wall pressure  
 (iv) Cohesion (v) Endosmosis [1 × 5]

**55.** Differentiate between the following

- (i) Osmotic pressure and turgor pressure
- (ii) Endosmosis and exosmosis
- (iii) Flaccid condition and turgid condition
- (iv) Osmosis and plasmolysis
- (v) Hypertonic solution and hypotonic solution

**Ans.** (i) Differences between osmotic pressure and turgor pressure are as follows

Osmotic pressure	Turgor pressure
It develops due to osmotic entry of water in a cell.	It is the pressure exerted by the cell contents on the cell wall.
It helps in the absorption of water.	It helps in keeping the plant erect.

(ii) Differences between endosmosis and exosmosis are as follows

Endosmosis	Exosmosis
It occurs when a cell is placed in a hypotonic solution.	It occurs when a cell is placed in a hypertonic solution.
Water moves into the cell.	Water moves out of the cell.

(iii) Differences between flaccid condition and turgid condition are as follows

Flaccid condition	Turgid condition
It is a condition when cell is placed in a hypertonic solution.	It happens when a cell is placed in hypotonic solution.
Water is lost from the plant due to exosmosis.	Water enters into a cell due to endosmosis.

(iv) Difference between osmosis and plasmolysis is as follows

Osmosis	Plasmolysis
It is the movement of water from its region of higher concentration to its region of lower concentration through a semipermeable membrane.	It is the shrinkage of protoplasm when a cell is placed in a hypertonic solution.

(v) Differences between hypertonic solution and hypotonic solution are as follows

Hypertonic solution	Hypotonic solution
A solution whose concentration is more than the cell sap.	A solution whose concentration is less than the cell sap.
Its osmotic pressure is more.	Its osmotic pressure is less.

[1 × 5]

**56.** The following paragraph is related to absorption of water from the soil. Copy and complete the following paragraph by selecting the correct word from those given in the box. You may use the term only once.

exosmosis, hypertonic, osmosis, isotonic, hypotonic, cortical, endosmosis

Water enters the root hair from the soil by the process of ..... . This is because the solution in the soil is ....., whereas the cell sap in the root hair cell is ..... . The water then passes through the ..... cells by cell to cell ..... and reaches the xylem of the root.

[2014]

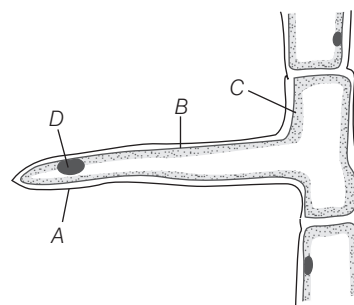
**Ans.** Water enters the root hair from the soil by the process of **endosmosis**. This is because the solution in the soil is **hypotonic**, whereas the cell sap in the root hair cell is **hypertonic**.

The water then passes through the **cortical** cells by cell to cell **osmosis** and reaches the xylem of the root.

## Diagram Based Questions

**57.** The diagram given below represents a layer of epidermal cells showing a fully grown root hair. Study the diagram and answer the questions that follows

[2011]



- Name the parts labelled *A*, *B*, *C* and *D*.
- The root hair cell is in a turgid state. Name and explain the process that caused this state.
- Mention one distinct difference between the parts labelled *A* and *B*.

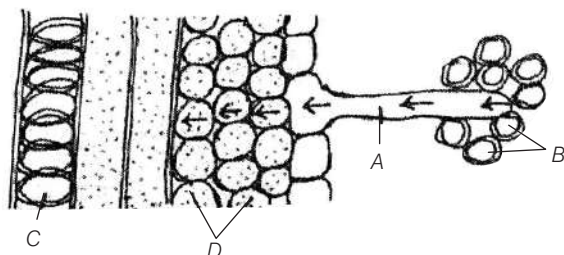
**Ans.** (i) Different parts can be labelled as

- A* – Cell wall of root hair
- B* – Cell membrane of root hair
- C* – Cytoplasm
- D* – Nucleus

(ii) The soil medium is hypotonic, thus endosmosis would have occurred, due to which the root hair cell became turgid.

(iii) *A* (cell wall) is freely permeable whereas, *B* (cell membrane) is semipermeable

- 58.** The figure given below is diagrammatic representation of a part of the cross-section of the root hair zone. Study the same and then answer the questions that follows [2016]



- Name the parts indicated by the guidelines A-D.
- Which is the process that enables the passage of water from the soil into the root hair?
- Name the pressure that is responsible for the movement of water in the direction indicated by the arrows. Define it.
- Due to an excess of this pressure sometimes drops of water are found along the leaf margins of some plants especially in the early morning. What is the phenomenon called?
- Draw a well-labelled diagram of the root hair cell as it would appear if an excess of fertiliser is added to the soil close to it.

- Ans.** (i) A – Root hair                      B – Water molecules  
C – Xylem                              D – Cortex
- Endosmosis
  - Osmotic pressure. It is the potential of water molecules to move from a less concentrated solution to a more concentrated solution across a semipermeable membrane.
  - Guttation
  - Due to addition of excess of fertiliser, the root hair will appear shrunk.

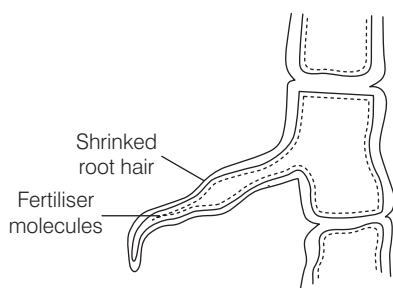
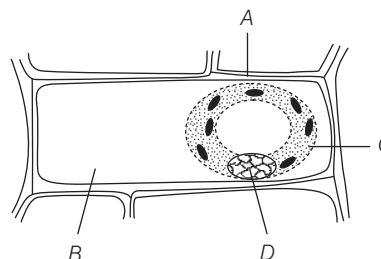


Diagram showing shrinking/loosening/flaccid condition

- 59.** The diagram given below represents a plant cell after being placed in a strong sugar solution. Study the diagram and answer the questions that follows

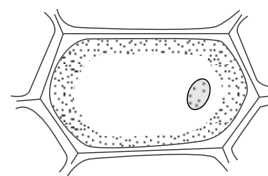


- What is the state of the cell shown in the diagram?
- Name the structure that acts as a selectively permeable membrane.
- Label the parts labelled A-D in the diagram.
- How can the above cell be brought back to its original condition? Mention the scientific term for the recovery of the cell.
- State any two features of the above plant cell which is not present in animal cell. [2017]

- Ans.** (i) The cell shown in the figure is plasmolysed.
- Plasma membrane acts as a selectively permeable membrane.
  - A – Cell wall                      B – Hypertonic solution  
C – Plasma membrane      D – Nucleus
  - The cell can be returned back to its original condition, if it will be placed in a hypotonic medium or pure water for some time. Scientific term for the recovery of the cell is deplasmolysis.
  - The two features of the given plant cell which are not present in animal cells are
    - presence of cell wall
    - presence of chloroplast

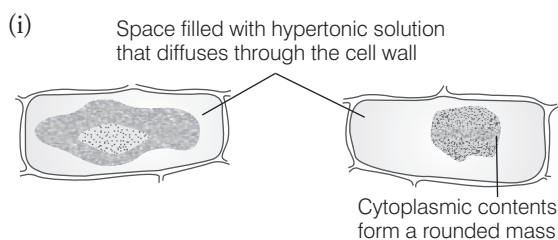
[1 × 5]

- 60.** The figure given below shows the epidermal cells of an onion bulb. This cell was then transferred to a drop of sugar solution.



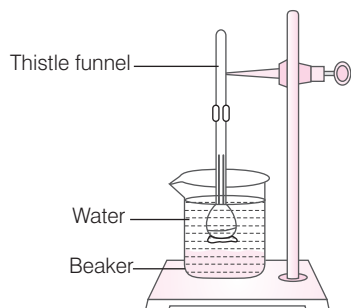
- (i) Draw a well-labelled diagram of the epidermal cell as it would appear after immersion in a strong sugar solution.
- (ii) What scientific term is used for the changes as shown in (i) above?
- (iii) What should be done to restore the cell back to its original condition?
- (iv) Give the scientific term for the recovery of the cell as a result of the step taken in (iii) above.
- (v) Define the term osmosis. [2013]

Ans.



- (ii) The scientific term used for the above change shown in figures is plasmolysis.
- (iii) To restore the cell back to its original condition, it must be placed in hypotonic solution immediately after it gets plasmolysed.
- (iv) The scientific term used for the recovery of the cell as a result of the step taken in (iii) above is deplasmolysis.
- (v) Refer to text on page 41.

61. Given below is the diagram of an apparatus set-up to study a very important physiological process.

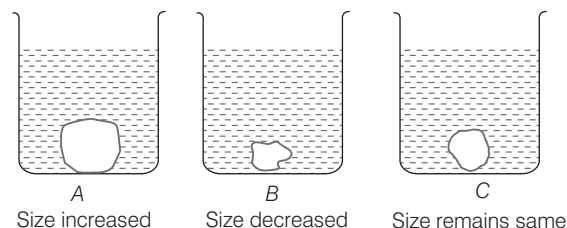


- (i) Name the process being studied.
- (ii) Explain the process.
- (iii) What change would you observe in the thistle funnel containing sugar solution after about 10 minutes?
- (iv) Is sugar solution hypertonic or hypotonic?
- (v) Name the part of the plant cell which is represented by the sugar solution.

Ans.

- (i) Osmosis
- (ii) Osmosis is a process of diffusion of water molecules from the region of higher concentration to that of lower concentration through semipermeable membrane.
- (iii) After about 10 minutes, the sugar solution in the thistle funnel will rise up.
- (iv) Sugar solution is hypertonic in nature as it is more concentrated than water.
- (v) Cell sap of the root hair.

62. A candidate in order to study the process of osmosis has taken 3 potato cubes and put them in 3 different beakers containing 3 different solutions. After 24 hours, in the first beaker the potato cube increased in size, in the second beaker the potato cube decreased in size and in the third beaker there was no change in the size of the potato cube. The following diagrams show the result of the same experiment.



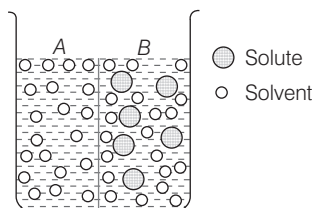
- (i) Give the technical terms of the solutions used in beakers A, B and C.
- (ii) In beaker C, the size of the potato cube remains the same. Explain the reason in brief.
- (iii) Write the specific feature of the cell sap of root hairs which helps in absorption of water.
- (iv) What is osmosis?
- (v) How do a cell wall and a cell membrane differ in their permeability? [2014]

Ans.

- (i) The technical terms of the solution used in beakers (A), (B) and (C) are  
A – Hypotonic solution  
B – Hypertonic solution  
C – Isotonic solution
- (ii) In beaker C, the concentration of water and solute is same in solution as the potato cube. Due to which no osmosis occurs and the size of potato cube remains same.
- (iii) The concentration of cell sap is higher in the root hair as compared to soil water. Thus, endosmosis takes place facilitating absorption of water.

- (iv) Refer to text on page 41.
- (v) Cell wall is freely permeable, while cell membrane is semipermeable.

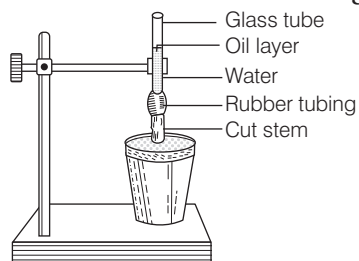
**63.** Observe the figure given below and answer the following questions.



- (i) What are your observations regarding the pore size of the semipermeable membrane after observing the distribution of solute and solvent across the membrane.
- (ii) What will be the direction of solvent movement? Give reason.
- (iii) List any two conditions that affect this process.
- (iv) In which direction will the net movement of solvent molecules be?

- Ans.** (i) Since, no solute particle is observed in A, the pore size of membrane is large enough to allow solvent particles but not the solute particles.
- (ii) Solvent molecules move both ways across the membrane.
- (iii) Temperature and tonicity of the solution.
- (iv) The net movement of solvent molecules will be from its higher concentration to its lower concentration.

**64.** Observe the figure demonstrating root pressure given below and answer the following questions.



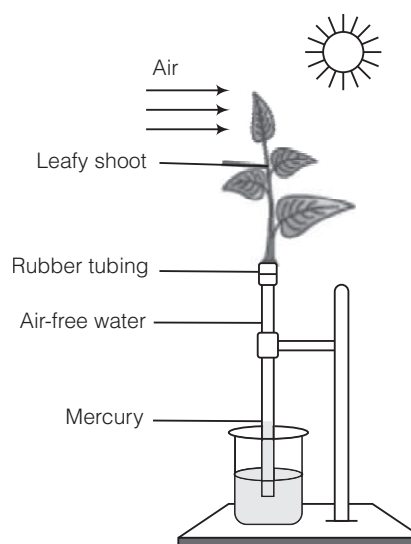
- (i) What is root pressure?
- (ii) List your observation regarding the water level after some time.

- (iii) Oil layer has been added over the water. Why?
- (iv) How does root pressure help the stem in the given set-up?

**Ans.** (i) Refer to text on page 44.

- (ii) The water level increases after some time.
- (iii) Oil prevents the evaporation of water from the tube by inhibiting the contact between tube and its surrounding.
- (iv) The root pressure is forcing the water to move upward in the stem.

**65.** Comment on the experimental set-up.



- (i) What does the set-up demonstrate?
- (ii) What will happen to the level of water, if a blower is placed close to set-up?
- (iii) Will the mercury level fluctuate (go up/down) if phenyl mercuric acetate is sprayed on leaves?

- Ans.** (i) This set-up demonstrates transpiration pull.
- (ii) Water will rise up due to activity of blowers, the rate of transpiration increases.
- (iii) The mercury level goes down, if phenyl mercuric acetate is sprayed on the leaves. When mercuric acid is sprayed on the leaves, the stomata get blocked and rate of transpiration decreases.

# CHAPTER EXERCISE

## Multiple Choice Questions

- The force developed due to osmosis is  
(a) turgor pressure (b) flaccidity  
(c) osmotic pressure (d) imbibition pressure
- Movement of molecules from the region of their higher concentration to the lower concentration region without the involvement of a semipermeable membrane is  
(a) active transport (b) diffusion  
(c) osmosis (d) None of these
- When a plant wilts, the sequence of events should be  
(a) exosmosis, plasmolysis, deplasmolysis, temporary wilting  
(b) exosmosis, plasmolysis, temporary and permanent wilting  
(c) Either (a) or (b)  
(d) Neither (a) nor (b)
- Transport of food molecules from the source to all the parts is an  
(a) active process (b) passive process  
(c) imbibing process (d) None of these
- In which type of mineral absorption theory, the ATP is required?  
(a) Active mineral absorption  
(b) Passive mineral absorption  
(c) Both (a) and (b)  
(d) None of the above
- A shoot from a balsam plant is kept in eosin solution (pink in colour) for 3-4 hours. The pink colour is most likely to be observed in  
(a) cortex (b) epidermal cells  
(c) phloem tissue (d) xylem tissue

Ans. 1. (c) 2. (b) 3. (b) 4. (a) 5. (a) 6. (d)

## Fill in the Blanks

- Fill in the blanks by using appropriate words.  
(i) ..... serves as the medium for transport of inorganic salts and food molecules throughout the plant.  
(ii) Absorption of water by the plant cells through surface attraction is called .....

- A plasmolysed cell becomes turgid when placed in solution that is .....
  - Osmometer measures ..... pressure.
- Complete the following statements by choosing the correct alternative out of those given in brackets.  
(i) Approximately 98% of the water is absorbed by plants through ..... (passive absorption/active absorption/plasmolysis).  
(ii) The force exerted by the ..... is essential for conduction of water specially in herbaceous plants (transpirational pull/root hairs).  
(iii) The loss of xylem in a plant will lead a plant to loose its ..... (flaccidity/turgidity/osmotic capability).

## True-False

- State whether the following statements are true/false. Rewrite the false statements after correction.  
(i) The conduction of absorbed minerals in a plant occurs by xylem against the concentration gradient.  
(ii) The food molecules move upward through the phloem tissue.  
(iii) Diffusion is the exit of water from the cells to their outer environment.  
(iv) Osmosis is the process by which molecules of a solute spread uniformly across a medium.  
(v) Opening and closing of stomata is due to turgidity.

## Match the Columns

- Match the following columns.

Column I	Column II
A. Diffusion	1. Energy
B. Active absorption	2. Mixing of molecules
C. Root pressure	3. Exosmosis
D. Hypertonic solution	4. Unicellular
E. Root hair	5. Cortical cells

11. Match the following columns.

Column I	Column II
A. Xylem	1. Conduction of food molecules
B. Transpiration pull	2. Water absorption
C. Root pressure	3. Ascent of sap
D. Phloem	4. Cohesion-adhesion forces

## 1 Mark Question

12. Identify the part of the cell which permits easy movement of water but only selectively permits the solute molecules.
13. What are imbibates?
14. Name the following.  
Movement against the concentration gradient.
15. Name the vascular tissue which helps in active mineral absorption.
16. Differentiate between modes of transport of water and food molecules.

## 2 Marks Questions

17. Differentiate between  
(i) Osmosis and diffusion (ii) Imbibition and diffusion
18. Name the following.  
(i) A condition of cell in shrunken state.  
(ii) Transport process where movement of molecules occurs in reverse of passive process coupled with ATP.
19. State the conditions necessary for imbibition to take place.
20. Enumerate the importance of osmosis in the life of the plants.
21. List any two factors controlling the osmosis.
22. How does transpirational pull help in the absorption of water by the plants?

## 3 Marks Questions

23. Name the following.  
(i) The solution outside a cell having low solute concentration than fluids.  
(ii) The process by which wilting or drooping of leaves occurs.  
(iii) Pressure exerted by the protoplasm against the cell wall in the cell.

24. Answer the following questions in brief.

- (i) Explain the role of root pressure in water movement in plants.
- (ii) Mention atleast two conditions, when it occurs.
- (iii) What is the consequence of excessive root pressure?

25. What is the relation between permeability and osmosis?

## 4 Marks Questions

26. Answer the following questions in brief.

- (i) Give atleast three uses of water in plants.
- (ii) How are the root hairs of a plant adapted for absorption of water from the soil?
- (iii) List any two advantages of plasmolysis.
- (iv) How is turgidity important to plants?

27. Explain tonicity. How solutions are classified on the basis of tonicity?

28. Name the following.

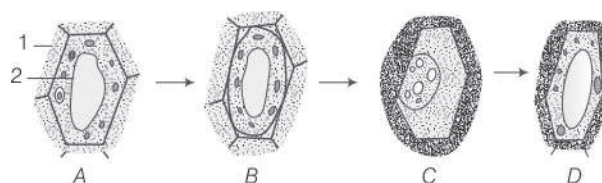
- (i) In tall trees, the ascent of sap occurs through this process.
- (ii) Absorption of water by the roots occurs by this means.
- (iii) Force between water molecules.
- (iv) The structure through which thin, delicate root hairs extend.

## 5 Marks Questions

29. How can you experimentally verify the occurrence of imbibition process in daily life?
30. With an experimental set-up, explain the absorption of water by the roots in a plant.
31. Demonstrate the root pressure in plants with the help of manometer.

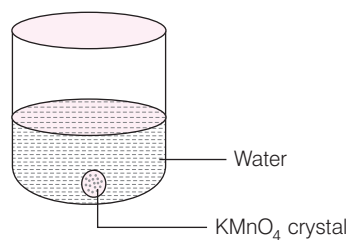
## Diagram Based Questions

32. Observe the figure given below and answer the following questions.



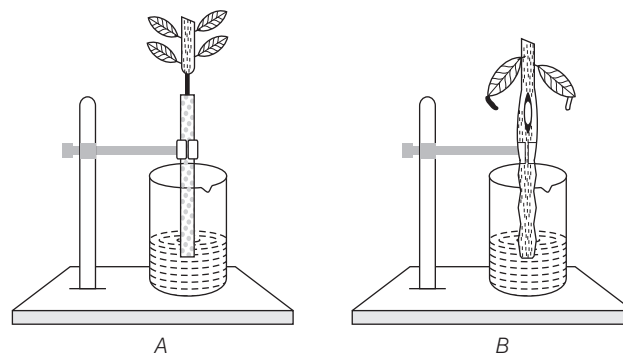
- (i) State the nature of solution marked (1).
- (ii) What process has been depicted in figures C-D?
- (iii) What will be present in the space marked as (2)?
- (iv) In which figures turgor pressure will be zero?
- (v) In which figures wall pressure will be positive?

**33.** The figure given below shows an experimental process.



- (i) Name the process.
- (ii) Define the process shown in the figure.
- (iii) What will you observe after some time?
- (iv) Give one importance of this process to plants.

**34.** Observe the diagram given below and answer the following questions.



- (i) Identify the aim of the experiment.
- (ii) Some parts of the stem in both the shoots have been removed. Name the conducting tissue in shoot A and in shoot B, that have been removed.
- (iii) What will you observe at the end of this experiment?

# ARCHIVES\*

## (Last 7 Years)

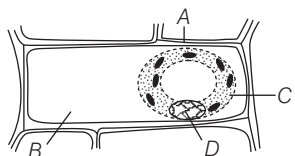
Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

- Correct the following statements by changing the underlined words.
  - The cell sap of root hair is hypotonic.
  - Xylem transports starch from the leaves to all parts of the plant body. [1]
- Give appropriate biological or technical term for the following.  
Movement of molecules of substance from their higher concentration to lower concentration when they are in direct contact. [1]
- Differentiate between the following pair on the basis of what is indicated in brackets.  
Hypotonic solution and hypertonic solution (condition of a plant cell when placed in them). [1]
- Give biological explanation for the following.  
Plants growing in fertilised soil are often found to wilt if the soil is not adequately watered. [1]

### 2017

- The statement given below is incorrect. Rewrite the correct statement by changing the underlined words of the statement. Free movement of solutes in and out of the cell takes place across the cell membrane. [1]
- Marine fish when placed in tap water bursts because of [1]
  - endosmosis
  - exosmosis
  - diffusion
  - plasmolysis
- Name the process by which root hairs absorb water from the soil. [1]
- Give difference between active transport and diffusion (significance in plants). [1]
- The diagram given below represents a plant cell after being placed in a strong sugar solution. Study the diagram and answer the questions that follows [5]



- What is the state of the cell shown in the diagram?
- Name the structure that acts as a selectively permeable membrane.
- Label the parts labelled A-D in the diagram.
- How can the above cell be brought back to its original condition? Mention the scientific term for the recovery of the cell.
- State any two features of the above plant cell which are not present in animal cell.

### 2016

- Choose the correct answer from each of the four options given below [1]
 

A plant cell may burst when

  - turgor pressure equalises wall pressure
  - turgor pressure exceeds wall pressure
  - wall pressure exceeds turgor pressure
  - None of the above
- Name the process of uptake of mineral ions against the concentration gradient using energy from the cell. [1]
- The figure given below is a diagrammatic representation of a part of the cross-section of the root in the root hair zone. Study the same and then answer the questions that follows [5]
  - Name the parts indicated by the guidelines A-D.
  - Which is the process that enables the passage of water from the soil into the root hair?
  - Name the pressure that is responsible for the movement of water in the direction indicated by the arrows. Define it.
  - Due to an excess of this pressure sometimes drops of water are found along the leaf margins of some plants especially in the early morning. What is the phenomenon called?
  - Draw a well-labelled diagram of the root hair cell as it would appear if an excess of fertiliser is added to the soil close to it.

**2015**

13. Name the process of uptake of mineral ions against the concentration gradient using energy from cell. [1]
14. Given below is a certain structure. Fill the blank with its suitable function.  
Xylem and ..... [1]
15. Differentiate between diffusion and osmosis (definition). [1]
16. Explain the term turgor pressure. [2]

**2014**

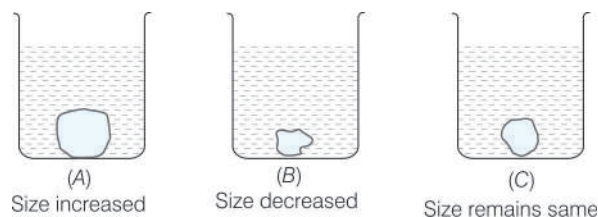
17. Differentiate between the following pairs on the basis of what is mentioned within bracket.  
Turgor pressure and wall pressure (explain). [1]
18. The following paragraph is related to absorption of water from the soil. Complete the following paragraph by selecting the correct word from those given in the box. You may use the term only once.

exosmosis, hypertonic, osmosis, isotonic, hypotonic, cortical, endosmosis

Water enters the root hair from the soil by the process of ..... This is because the solution in the soil is ....., whereas the cell sap in the root hair cell is ..... The water then passes through the ..... cells by cell to cell ..... and reaches the xylem of the root. [5]

19. A candidate in order to study the process of osmosis has taken 3 potato cubes and put them in 3 different beakers containing 3 different solutions. After 24 hours, in the first beaker the potato cube increased in size, in the second beaker the potato cube decreased in size and in the third beaker there was no change in the size of the potato cube.

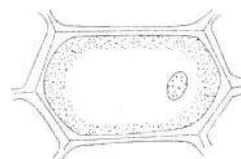
The following diagram shows the result of the same experiment.



- (i) Give the technical term of the solutions used in beakers A, B and C.
- (ii) In beaker C the size of the potato cube remains the same. Explain the reason in brief.
- (iii) Write the specific feature of the cell sap of root hairs which helps in absorption of water.
- (iv) What is osmosis?
- (v) How do a cell wall and a cell membrane differ in their permeability? [5]

**2013**

20. Rewrite the correct terms in the correct order so, as to be in a logical sequence.  
Endodermis, cortex, soil water, xylem, root hair. [1]
21. Give the biological term for a solution in which the relative concentration of water molecules and solute on either sides of the cell membrane is the same. [1]
22. Give biological reason, why wooden frames of doors get jammed during the monsoon season. [1]
23. The figure given below shows the epidermal cell of an onion bulb. This cell was then transferred to a drop of sugar solution.



- (i) Draw a well-labelled diagram of the epidermal cell as it would appear after immersion in a strong sugar solution.
- (ii) What scientific term is used for the changes as shown in (i) above?
- (iii) What should be done to restore the cell back to its original condition?
- (iv) Give the scientific term for the recovery of the cell as a result of the step taken in (iii) above.
- (v) Define the term osmosis. [5]

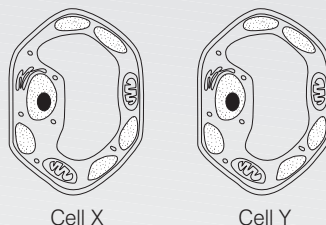
**2012**

24. Name the phenomenon by which living or dead plant cells absorb water by surface attraction. [1]
25. Give the biological term for a membrane which allows the passage of molecules selectively. [1]
26. Briefly explain the term osmosis. [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 In a fully turgid cell, ..... is zero.  
(a) osmotic pressure (b) diffusion pressure deficit  
(c) turgor pressure (d) wall pressure
- 2 In xerophytes, the osmotic concentration of cell sap is  
(a) less than normal (b) normal  
(c) more than normal (d) No osmotic pressure at all
- 3 Which of the following would result in an increase in the rate of diffusion?  
I. Using a thinner membrane.  
II. Increasing the concentration gradient.  
III. Increasing the size of the particles.  
(a) Only I (b) II and III  
(c) I and II (d) I, II and III
- 4 In order for water molecules to move from cell X to cell Y by osmosis, which of the following conditions must be met?



- (a) X must have a lower water potential than Y.  
(b) X and Y must have the same water potential.  
(c) Y must be less concentrated than X.  
(d) Y must have lower water potential than X.
- 5 A gardener forgot to water a potted plant for a day during summer, what will happen to the plant? Do you think it is reversible? If yes, how?
- 6 Give biological reasons for  
(i) On sprinkling salt on grass growing in a lawn, the grass is killed.  
(ii) Transplanting of seedling to a flower bud in the evening is better than doing so in the morning.
- 7 Potato cubes of 1 cm in size were placed in two containers, one containing water and the other containing concentrated sugar solution. After about 24 hours when the cubes were examined, then those placed in water were found to be firm and had increased in size by a few millimeters. Those placed in concentrated sugar solution were found to be soft and decreased in size. Use the above information to answer the questions that follows  
(i) Account for the firmness and increase in size of the potato cubes, which were placed in water.  
(ii) Account for the softness and decrease in size of the potato cubes, which were placed in the sugar solution.  
(iii) Name and define the physical process being investigated in this experiment.

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 304.

# Transpiration in Plants

All plants absorb water from soil through their roots. This water is conducted upward through stem and is distributed to all the aerial parts of the plant including the leaves. Plants utilise only a small fraction (about 2%) of absorbed water for photosynthesis and other activities.

The rest of it gets lost to the atmosphere through aerial parts (mainly leaves) in the form of water vapours by a process called **transpiration**. So, in this chapter, we will study about demonstrations, types, significance and adaptations in plants and factors affecting transpiration.

## Transpiration

The process of loss of water in the form of vapour from the exposed or aerial parts of a plant (such as leaves, etc.) is called transpiration. It is a vital process for both plants and environment and consequently to humans.

The loss of water through transpiration creates a suction force which helps in the upward movement of water from roots through xylem, i.e. **ascent of sap**. (as discussed in earlier chapter).

## Types of Transpiration

Transpiration is carried out by the aerial parts of plants. Depending upon the plant surface involved, transpiration is of three types, i.e. cuticular, lenticular and stomatal transpiration.

1. **Cuticular transpiration** Cuticle is a layer of wax-like covering on the epidermis of leaves and herbaceous stems. It provides a relatively impermeable covering through which less water is lost (3-10%).
2. **Lenticular transpiration** Lenticels are small openings in the bark of woody stems, twigs and fruits. Loss of water vapour through lenticels is called lenticular transpiration (about 0.1%).

## Chapter Objective

- Transpiration
- Types of Transpiration
- Mechanism of Stomatal Transpiration
- Regulation of Transpiration (Mechanism of opening and closing of stomata)
- Factors Affecting the Rate of Transpiration
- Adaptations in Plants to Reduce Excessive Transpiration
- Advantages of Transpiration
- Disadvantages of Transpiration
- Experiments Related to Transpiration
- Guttation
- Bleeding

3. **Stomatal transpiration** The loss of water vapour, which occurs through stomata is called stomatal transpiration. It accounts for 80-90% of the total water vapour loss from the plants.

**Note** ■ Bark transpiration is a minor mode of transpiration which occurs very slowly from the otherwise impermeable corky covering of the older stem.

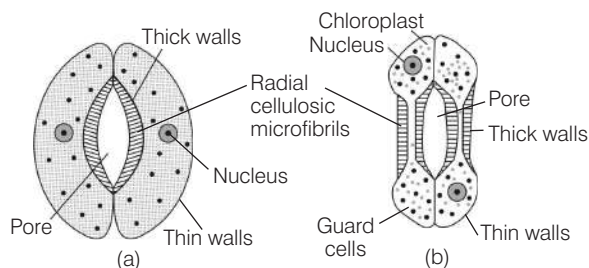
■ After leaf fall in autumn, lenticels are the only site of water loss in deciduous trees.

## Structure of Stomata

Stomata (sing. stoma) are the minute pores found in the epidermal layer of leaves and green stems. Each stoma is surrounded by the two **guard cells** which are of two different shapes, i.e. kidney-shaped (in dicot leaves) and dumb-bell-shaped (in monocot leaves).

Stomata are called as **turgor operated valves**. Generally, stomata are open during the daytime and closed at night. But in succulents like cacti, stomata close during day and open at night.

The number, structure, distribution, opening and closing of stomata influence the rate of transpiration.



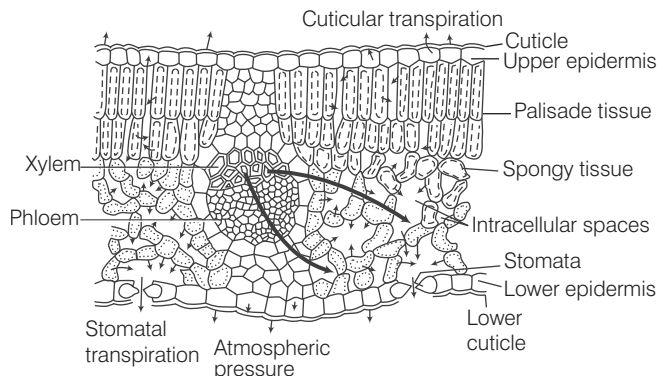
Open stomata (a) Dicotyledonous (kidney-shaped)  
(b) Monocotyledonous (dumb-bell-shaped)

Stomata vary in number in various types of plants. In **isobilateral leaves** (mostly in monocots), same number of stomata are found on the upper and the lower surfaces, whereas in **dorsiventral leaves** (mainly found in dicot plants), the number of stomata are very few on upper surface in comparison to those found on lower surface. Stomata are absent in the submerged hydrophytes (*Hydrilla* and *Vallisneria*).

## Mechanism of Stomatal Transpiration

A large number of spongy mesophyll cells present in the leaves (between the upper and lower epidermis) have their surfaces exposed to the intercellular spaces.

These communicate with the outer atmosphere through stomata and give off some water in the atmosphere in the form of water vapours.



Vertical section of leaf indicating diffusion of water vapour through stomata

The osmotic diffusion of water from xylem vessels (in leaves) maintains the turgidity of mesophyll cells. The water continuously evaporates from these cells, thus saturating the air inside the intercellular spaces.

The water from these intercellular spaces gets diffused into the other connecting intercellular spaces and finally reaches to the substomatal space. The water then escapes out through the stomata, since outer atmosphere is unsaturated compared to internal air.

This complete movement of water vapour from the cell surface to the outer atmosphere occurs by the process of diffusion. The molecules of water in the form of vapours move from the region of their higher concentration to their lower concentration.

## Regulation of Transpiration (Mechanism of Opening and Closing of Stomata)

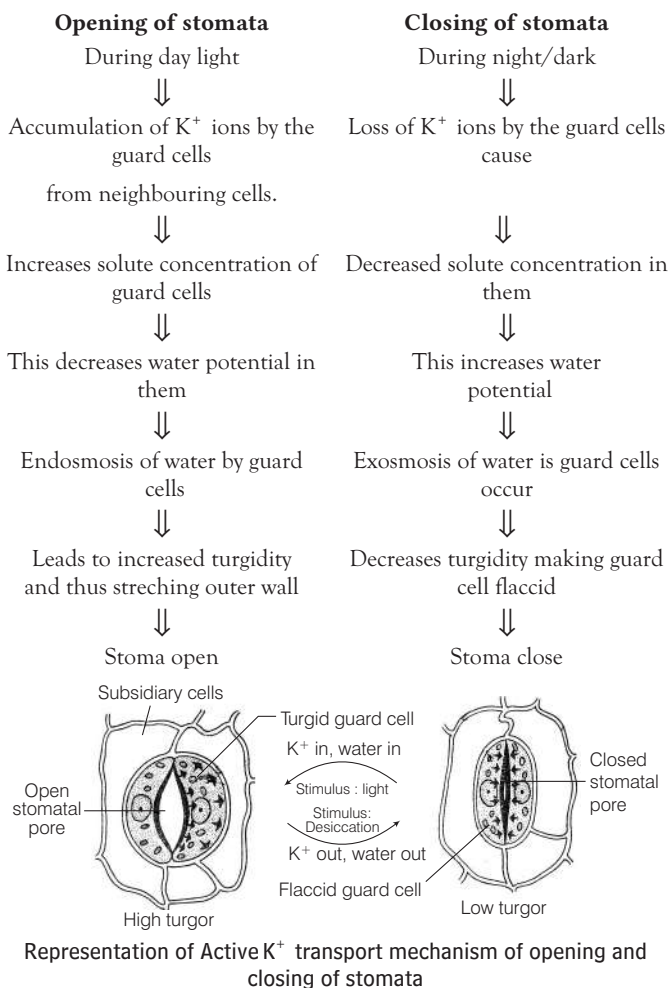
The process of transpiration in plants is regulated by the opening and closing of stomata. Transpiration occurs as long as the stomata are open, it stops when they are closed.

The opening and closing of stomata depend upon the turgid or flaccid state of guard cells or the amount of water and solutes present in the guard cells. The inner walls of guard cells are thick and elastic in nature.

## Potassium Ion Exchange Theory

According to the potassium ion exchange theory, the guard cells become turgid when  $K^+$  gradient is setup in the cells (during daytime). This causes the stomatal pores to open up and transpiration occurs.

At night, reverse happens, i.e. the  $K^+$  ions leak out, turning the guard cells flaccid thus, closing the stomatal pores. The process of opening and closing of stomata is explained below



## Factors Affecting the Rate of Transpiration

The rate of transpiration can be affected by both internal and external factors.

### Internal Factors

- (i) **Root-shoot ratio** The rate of transpiration directly depends upon the efficiency of the absorbing system (roots) and the evaporating system (leaves). The rate of transpiration increases with an increase in shoot-root ratio.
- (ii) **Leaf area** The greater the total leaf area of a plant, the greater is the rate of transpiration.
- (iii) **Leaf structure** The plants growing in dry conditions or arid areas show certain anatomical modifications to reduce the rate of transpiration.

- (iv) **Succulence** The succulent stems and leaves contain mucilage or latex in their tissues. This reduces the rate of transpiration by holding water.
- (v) **Orientation of leaves** Transpiration is noticed more in leaves placed perpendicular to the incident light than leaves placed parallel to the incident light.
- (vi) **Age of plants** Rate of transpiration is slow at the seedling stage, maximum at maturity and gradually decreases near senescence (ageing).
- (vii) **Water content of leaves** If the water content of leaves decreases due to insufficient absorption of water by roots, then the leaves wilt to reduce transpiration.

### External Factors

- (i) **Light** It increases the transpiration by raising the temperature of leaves. A rise in temperature of the leaf increases vapourisation of water in the internal atmosphere of leaf causing rapid water loss by transpiration. The water loss gets doubled with every  $10^\circ\text{C}$  rise in temperature.
- (ii) **Humidity of air** Humidity is the amount of water vapour in the air. Low and high humidity of air affect the transpiration.
- (iii) **Air temperature** Temperature also affects the rate of transpiration but indirectly. An increase in temperature decreases the humidity. Transpiration also increases or decreases along with rise or fall in temperature.
- (iv) **Wind** The prevalence of wind greatly affects transpiration. During high wind, rate of transpiration is greatly enhanced as it removes the water vapours transpired, thereby, not allowing the transpiring surface to become saturated.
- (v) **Soil water** The rate of transpiration also depends on the amount of water absorbed by the roots. If absorption lags behind, the rate of transpiration also diminishes. The factors affecting absorption of water by the roots indirectly affect the rate of transpiration.
- (vi) **Atmospheric pressure** The rate of transpiration is inversely proportional to the atmospheric pressure. Lowering of atmospheric pressures increases the rate of transpiration.
- (vii) **Carbon dioxide ( $\text{CO}_2$ ) concentration** Increase in carbon dioxide level in outside atmosphere over 0.03% (normal) results in stomatal closure and causes decrease in transpiration.

**CHECK POINT 01**

- 1 During transpiration in which form water is lost?
- 2 State different types of transpiration.
- 3 When the guard cells are flaccid, the stomata will be ..... ?
- 4 Name a plant in which stomata are absent.
- 5 Succulence of stems and leaves affects transpiration. How ?

## Adaptations in Plants to Reduce Excessive Transpiration

Many plants that grow in unfavourable conditions, i.e. dry, humid climate have evolved a number of permanent adaptations in order to reduce the rate of transpiration. Some of them are given below

- (i) **Sunken stomata** In dry environment, the stomata of leaves are deep seated in the leaf to reduce transpiration, e.g. *Nerium*.
- (ii) **Thick cuticle on leaves** In banyan and most evergreen trees, a thick waxy cuticle develops over the epidermis to reduce loss of water by transpiration.
- (iii) **Narrow leaves** In some plants, leaves become narrower by rolling or folding to reduce exposed surface area for transpiration, e.g. lavender.
- (iv) **Fewer stomata** In some plants, the number of stomata may be reduced.
- (v) **Loss of leaves** In some plants, there is complete loss of leaves during the dry season, e.g. tropical deciduous tree and in some, complete loss of leaves, e.g. cacti.
- (vi) Some plants (succulent plants) of the family-Crassulaceae reduce water loss by opening their stomata only at night, when the air is cooler and more humid.
- (vii) Carbon dioxide obtained at night is stored and is used next day during photosynthesis when the stomata remain closed.
- (viii) **Epidermal hairs** Leaf surface may be covered by thick coating of epidermal hairs to reduce transpiration, e.g. *Cucurbita*.

## Transpiration and Photosynthesis: A Compromise

The process of photosynthesis requires an adequate amount of water for its activity. Transpiration reduces the supply of available water for photosynthesis. As a result, the guard cells shut the stomata and become flaccid, i.e. closed, thereby reducing the supply of carbon dioxide (CO<sub>2</sub>) for photosynthesis.

## Advantages of Transpiration

Transpiration acts as a significant phenomenon for the plants.

Some major advantages of transpiration are given below

- (i) **Cooling effect** Transpiration reduces temperature of the plant leaf giving a cooling effect to the plant.
- (ii) **Suction force** Transpiration creates a suction force (transpiration pull) along with other factors is responsible for rise of water in tall plants.
- (iii) **Distribution of water and mineral salts** Transpiration helps in the distribution of water and mineral salts to various plant organs.
- (iv) **Maintenance of turgidity** Transpiration maintains the shape and structure of the plant parts by keeping the cells turgid.
- (v) **Contribution in precipitation** It contributes to atmospheric humidity and thus is a major contributor to precipitation.
- (vi) **Osmosis** Transpiration helps in osmosis
- (vii) Transpiration helps in exchange of gases in the plants.

## Disadvantages of Transpiration

If excess amount of transpiration occurs, it may lead to

- (i) **Wilting** When transpiration exceeds absorption through roots, leaf cells become flaccid causing wilting of plants.
- (ii) **Stunted growth** Excessive transpiration causes stunted growth of the plant.
- (iii) **Abscission** During water scarcity, transpiration results in the closing of stomata following the production of abscisic acid. It causes premature leaf fall and delayed flowering and fruit production.
- (iv) **Energy expenditure** Transpiration requires energy hence, it is a gross energy expenditure.

## Antitranspirants

- These are the chemical substances which reduce the rate of transpiration. These are used in dry farming. These are as follows
- **Phenyl Mercuric Acetate (PMA)** It closes the stomata for more than two weeks partially.
- Aspirin (Salicylic acid)
- Absciscic Acid (ABA)
- Oxi-ethylene
- Silicon oil
- CO<sub>2</sub>
- Low viscous wax

**CHECK POINT 02**

- 1 In which kind of the plants, the sunken stomata are present?
- 2 In which plant family opening of stomata occurs only at night.
- 3 Mention any one significance of transpiration.
- 4 Excessive transpiration causes abscission. Give reason.
- 5 Name the substances which act as antitranspirants.

## Experiments Related to Transpiration

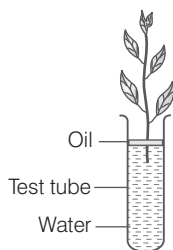
To demonstrate transpiration in plants, several experiments can be performed.

These experiments are discussed below

### Experiment 1 (a)

✓ *Experiment to demonstrate loss in weight due to transpiration.*

- **Procedure** Take a test tube and fill it with water.
- Insert a cut twig in it and carefully pour a layer of oil over the water.
  - Place the test tube in a small beaker and weight them together. Then remove the tube, keeping it straight with a test tube stand for few hours.
  - Weight the tube again by placing it in same beaker.
  - This oily layer prevents water loss through transpiration from the water surface.
  - After some time, it can be observed that the water level in the test tube goes down. This shows the phenomenon of **water loss through transpiration**.
  - If there is a difference in weights, it indicates loss of water by the shoot due to transpiration.



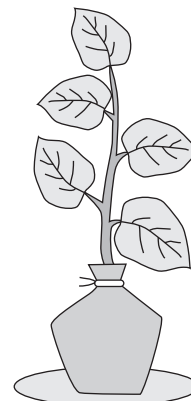
A shoot inserted in water transpires to show loss in weight

### Experiment 1 (b)

✓ *To study loss in weight of a potted plant by transpiration.*

- A small light weight potted plant can be weighed before and after the end of specified time period.

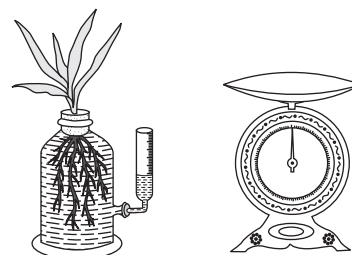
- The pot and the soil surface should be completely covered preventing water loss from surfaces other than the plant as shown in figure.



A potted plant with covered soil surface and pot

- The loss in weight of plant during the specified time period occurs due to water loss by transpiration.
- An improvement in the weighing method can be made by using a glass bottle with a graduated side tube, filled with water and a tube fitted into it (shown in figure).

The water level in the side tube falls to demonstrate loss of water through transpiration from the leaves.



An experiment setup indicating loss of water by volume as well as by weight

This would indicate the volume of water loss that can be compared with the loss in weight with the help of a weighing machine or by converting cc into grams (1 cc water weighs 1g).

## Experiment 2

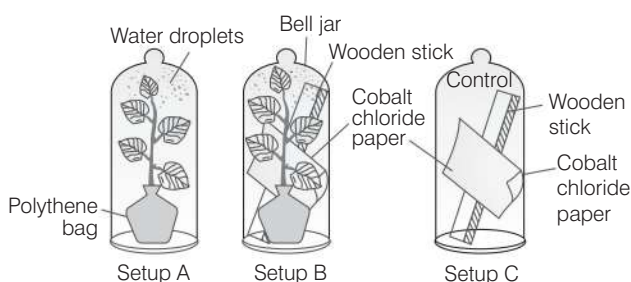
✓ *Bell Jar Experiment*

- **Procedure** For this experiment, arrange three set-ups as follows

**Set-up A** Take a small, well-watered potted plant, preferably one with broad leaves. Enclose the pot completely within a polythene bag and tie the mouth of the bag tightly around the base of the stem. This is done to prevent the escape of water vapour from the pot. Now, cover the entire plant under a bell jar.

**Set-up B** Arrange another similar plant and cover with a bell jar exactly in the same manner as the first one. Keep a piece of dry cobalt chloride paper by the side of the plant inside the bell jar. The paper may be pinned to a wooden stick or to a strip of cork sheet.

**Set-up C** Take a bell jar without a plant. Put only a similar piece of dry cobalt chloride. This paper is the control for the experiment. Now, keep all three bell jars together in the sunlight for approximately half an hour.



An experiment to demonstrate transpiration in plants.

It is observed that,

- the first bell jar (A) would show water vapour condensing on its inner walls.
- the second bell jar (B) would also show a similar condensation and at the same time, the initially blue cobalt chloride paper in it would turn pink.
- the blue colour of the cobalt chloride paper in the third bell jar (C) does not change at all. It is because there are no water drops on the jar's inner walls. It proves that there was no moisture in the air due to transpiration as there was no plant in it.

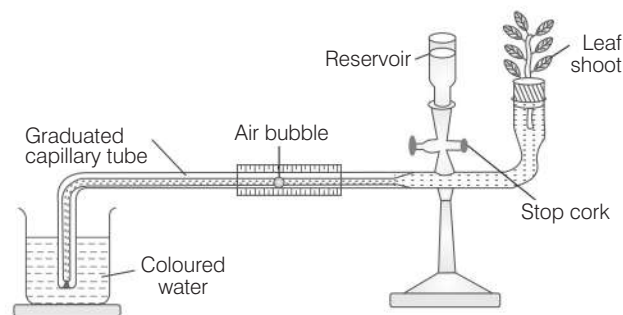
### Experiment 3

#### Measurement of rate of transpiration by Ganong's potometer

Potometer (*Patoton*-drink, *meter*-measures) is an apparatus that measures the rate of water intake by a plant shoot which is almost equal to the water lost through transpiration. It does not measure transpiration directly, but measures the water uptake by the cut shoot.

- To initiate the experiment, cut a twig of a suitable plant with a sharp knife and fix it into the upper end of the apparatus.
- Fill the entire apparatus with water (it is to be noted that there should be no air spaces in between).
- Introduce an air bubble into the horizontally graduated capillary tube (dipped inside the beaker). By introducing the air bubble, the rate of water uptake can be easily calculated.

- This can be done by noting the movement of an air bubble over a fixed distance on the scale of the capillary tube.
- The reservoir in the apparatus helps to bring air bubble to its original position. This can be done by releasing some more water into the capillary tube by opening the stop-cock.
- Leave the apparatus undisturbed for some time.



Ganong's potometer

- After few hours, it is observed that the air bubble has started moving through the horizontal capillary tube of potometer. This can be easily detected by noting the readings given on the capillary tube scale.
- This experiment shows that as the process of transpiration proceeds, a suction force was set-up due to which the water was pulled from the beaker and made the bubble to move along.

### Limitations of Using Potometer

There are some limitations of using a potometer.

These are

- Introducing the air bubble is not very easy.
- The twig may not remain alive if the experiment takes a long time.
- Any change in the outside temperature can affect the position of the air bubble in the capillary tube.

### Guttation

It occurs during warm humid conditions, i.e. when the amount of root pressure is high and rate of transpiration is low. Many herbaceous plants tend to lose small quantities of water in the form of drops from the **hydathodes** (water glands, i.e. pores present along leaf margin) or water stomata. These tiny drops appear mainly along the margins or tips of the leaves especially during the early morning time. These drops are rich in mineral salts, organic acids, carbohydrates and nitrogenous compounds.

Thus, guttation is the process by which the sap escapes from them. Guttation can be seen in garden nasturtium, grasses, tomatoes, potatoes and *Colocasia*.

## Conditions for Guttation

- (i) The presence of large amount of water in the plant.
- (ii) Suitable temperature (at very low temperatures, practically no guttation takes place).
- (iii) All conditions that inhibit transpiration favour guttation.

## Bleeding

The exudation of sap from the injured parts of the plants is called bleeding. When a cut is made in the stem of a plant growing in well-watered soil, xylem sap starts oozing out. It

happens due to root pressure. It is very common in mulberry. In *Calotropis* and *Euphorbia*, oozing of milky latex is seen.

### CHECK POINT 03

- 1 Name an experiment for the demonstration of transpiration.
- 2 On what principle does potometer work?
- 3 Name one type of commonly used potometer?
- 4 Mention any one limitation of using potometer.
- 5 What do you understand by bleeding from plant?

## SUMMARY

- Transpiration is the loss of water in the form of water vapours from the aerial parts of the plant.
- Rate of transpiration It is the amount of water lost by plant in specified time unit per surface area. It can be measured by weighing method, potometer method, etc.
- Transpiration is of three types, i.e. cuticular, lenticular and stomatal transpiration.
- Cuticular transpiration This occurs through the cuticle of the leaves and stem of green plants.
- Lenticular transpiration This occurs through the lenticels present in woody stems.
- Stomatal transpiration This occurs through stomatal openings.
- Stomata are small pores present on surfaces of leaves and sometimes on stem.
- Mechanism of transpiration There is maximum transpiration occurring through stomata. These are tiny pores on leaf surfaces which remain open in daytime. Continuous evaporation of water from mesophyll cells which makes them water deficient. These cells draw water from neighbouring cells in order to make up water deficiency.
- Ganong's potometer is used to measure the rate of transpiration. It is a specially designed apparatus in which movement of bubble in water-filled tube septum shows the amount of water transpired in a unit time.
- Regulation of transpiration The rate of transpiration is regulated by closing and opening of stomata. In the hot windy mid day, plants reduce transpiration by keeping stomata closed.
- Factors affecting transpiration Both internal factors (leaf area, structure, succulence, orientation, age of plant) and external factors (light, humidity, temperature, wind, soil, water, etc) affect the rate of transpiration.
- Adaptations in plants to reduce the rate of transpiration are sunken stomata, thick cuticle, cutinised hairs and reduced number of stomata.
- Transpiration is an important phenomenon as it helps in the absorption of water from soil by creating negative suction pressure.
- Antitranspirants are chemicals which reduce the rate of transpiration when applied to plant surfaces, e.g. dimethyl silicon, wax emulsions.
- Guttation is a phenomenon taking place in some plants having tiny pores on the leaf tips and margins called hydathodes. Under high humidity and high water content in soil, these plants form water droplets at the edges of leaves.
- Bleeding is the exudation of sap from injured plant parts.

# EXAM PRACTICE

## Multiple Choice Questions

1. In tall tree, maximum amount of water loss occurs through  
 (a) stomatal transpiration  
 (b) cuticular transpiration  
 (c) lenticular transpiration  
 (d) transpiration through bark

**Ans.** (a)

2. The lower surface of leaf will have more number of stomata in a  
 (a) dorsiventral leaf (b) isobilateral leaf  
 (c) Both (a) and (b) (d) None of these

**Ans.** (a)

3. During the mechanism of opening and closing of stomata, the important factor is  
 (a) the protein content of the cells  
 (b) the turgid and flaccid state of the guard cells  
 (c) the starch content of the cells  
 (d) the presence of chloroplast in the guard cells

**Ans.** (b)

4. Which one of the following will not directly affect transpiration?  
 (a) Temperature  
 (b) Light  
 (c) Wind speed  
 (d) Chlorophyll content of leaves

**Ans.** (d)

5. In which condition of the day amongst the following the transpiration will be maximum?  
 (a) Hot, dry, windy (b) Hot and humid  
 (c) Humid and cool (d) Humid and windy

**Ans.** (a)

6. Rate of transpiration increases with an increase in  
 (a) CO<sub>2</sub> concentration (b) Atmospheric humidity  
 (c) Root shoot ratio (d) Temperature

**Ans.** (d)

7. Which of the following conditions suit for the maximum transpiration pull?  
 (a) Open stomata, dry atmosphere and moist soil  
 (b) Open stomata, high humid atmosphere and well-irrigated soil  
 (c) Open stomata, high humid atmosphere and dry soil  
 (d) Close stomata, dry atmosphere and dry soil

**Ans.** (a)

8. With the decrease in atmospheric pressure, the rate of transpiration will  
 (a) increase (b) decrease rapidly  
 (c) decrease slowly (d) remain the same

**Ans.** (a)

9. The chemical used in the demonstration of experiment on transpiration is  
 (a) potassium hydroxide  
 (b) sodium hydroxide  
 (c) cobalt chloride  
 (d) calcium chloride

**Ans.** (c)

10. In which of the following conditions plants lose water by guttation?  
 (a) Soil is wet and atmosphere is dry  
 (b) Soil is wet and the atmosphere is humid  
 (c) Soil is dry and atmosphere is dry  
 (d) Rate of transpiration is high

**Ans.** (b)

11. The process of guttation takes place  
 (a) when the root pressure is high and the rate of transpiration is low  
 (b) when the root pressure is low and the rate of transpiration is high  
 (c) when the root pressure equals the rate of transpiration  
 (d) when the root pressure as well as rate of transpiration are high

**Ans.** (a)

## Fill in the Blanks

12. Fill in the blanks.  
 (i) Transpiration normally takes place in the presence of .....  
 (ii) 95% of the total transpiration takes place through .....  
 (iii) Plants become cool as a result of .....  
 (iv) ..... is used to measure the rate of transpiration.  
 (v) Stomata are of two different shapes, i.e. .... and .....  
 (vi) Guard cells become ..... when they gain water and become ..... when they lose water.  
 (vii) Transpiration helps in creating ..... force and in eliminating excess .....  
 (viii) Closing of ..... and shedding of leaves reduce ....

- Ans.** (i) sunlight  
 (ii) stomata  
 (iii) transpiration  
 (iv) Ganong's potometer  
 (v) kidney-shaped, dumb-bell-shaped  
 (vi) turgid, flaccid  
 (vii) suction, water  
 (viii) stomata, transpiration

### True-False

- 13.** State whether the following statements are true (T) or false (F). Also rewrite the false statement correctly.
- Transpiration is a physiological process.
  - Mesophyll cells are the extensions of the outer epidermal cells of the root.
  - More transpiration occurs from the upper surface of a leaf.
  - Transpiration takes place in all plants.
  - The pH of the guard cells increases during day time.
  - Plants utilise the total amount of water absorbed by them.
  - The cobalt chloride paper when exposed to moisture turns into black colour.
  - Lenticular transpiration takes place during day time only.
  - Wind velocity affects the process of transpiration.
- Ans.** (i) True  
 (ii) False. Root hairs are the extensions of the outer epidermal cells of the root.  
 (iii) False. More transpiration occurs from the lower surface of a leaf.  
 (iv) False. Transpiration takes place only in plants with green leaves.  
 (v) True  
 (vi) True  
 (vii) False. The cobalt chloride paper when exposed to moisture turns into pink colour.  
 (viii) False. Lenticular transpiration takes place throughout day and night.  
 (ix) True

### Match the Columns

- 14.** Match the following columns.

Column I	Column II
A. Kidney-shaped	1. Leaves
B. Mesophyll cells	2. <i>Nerium</i>
C. Sunken stomata	3. Guard cell
D. Epidermal hair	4. Cucurbits

**Ans.** A – 3, B – 1, C – 2, D – 4

- 15.** Match the following columns.

Column I	Column II
A. Transpiration	1. Loss of water as water vapour from the surface of water bodies
B. Evaporation	2. Hydathodes
C. Guttation	3. Green leaves
D. Stomata	4. Water lost in the form of vapour from aerial parts of the plant.

**Ans.** A – 4, B – 1, C – 2, D – 3

### 1 Mark Questions

- 16.** Give the biological/technical term for the permanently open structures seen on the bark of an old woody stem. [2013]

**Ans.** Lenticels.

- 17.** State the function of lenticels. [2014]

*Or* Give the exact location and one function of lenticels. [2005]

*Or* Give the exact location of lenticels. [2013]

**Ans.** **Location** In woody stem.

**Function** Exchange of respiratory gases.

- 18.** State the main function of guard cells. [2016]

**Ans.** Guard cells regulate opening and closing of stomata. Thus, control gaseous exchange and transpiration.

- 19.** How are guard cells adapted for transpiration?

**Ans.** The outer wall of guard cell is thin while the inner wall is thick. The guard cells control the opening and closing of stomata by changing their turgidity.

- 20.** Given below are five terms. Arrange and rewrite the terms in the correct order as to be in logical sequence.  
Spongy cells, upper epidermis, stoma, palisade tissue, substomatal space. [2013]
- Ans.** Upper epidermis, palisade tissue, spongy cells, substomatal space, stoma.
- 21.** Given below is a set of five terms. Rewrite the terms in logical sequence as directed at the end of the statement.  
Stoma, mesophyll cells, xylem, substomatal space, intercellular space (loss of water due to the transpiration). [2010]
- Ans.** Xylem, mesophyll cells, intercellular space, substomatal space and stoma.
- 22.** The wax-like layer on the epidermis of leaves which reduces transpiration. [2018]
- Ans.** Cuticle is the water impervious protective layer covering the epidermal cells of leaves and other parts that reduces water loss during transpiration.
- 23.** Atmospheric humidity promotes transpiration from a green plant. Do you agree? [2008]
- Ans.** No, high atmospheric humidity reduces the rate of outward diffusion of the internal water vapour across stomata, thereby reducing the rate of transpiration.
- 24.** Differentiate between the following pair on the basis of what is indicated in brackets.  
Leaf and liver (form in which glucose is stored) [2018]
- Ans.** Glucose is stored in the form of starch in leaves and as glycogen in liver.
- 25.** Give biological reasons for the following statement. [2017]  
In some xerophytes, leaves are modified into spines.
- Ans.** Xerophytes grow in dry conditions where water is less, therefore in order to reduce transpiration their leaves are modified into spines.
- 26.** Name the waxy layer on the epidermis of the leaf meant to reduce transpiration. [2013]
- Ans.** Cuticle is the waxy layer on epidermis meant to reduce transpiration.
- 27.** Some plants show wilting in their leaves during mid-day even when the soil is well-watered. Give biological reason.  
Or Give scientific reason why balsam plants wilt during mid-day even if the soil is well-watered. [2014]
- Ans.** During mid-day the rate of transpiration is more than the rate of absorption of water. So, plants show wilting of leaves.
- 28.** Give the appropriate technical term for the following.  
An apparatus that measures the rate of water uptake in a cut shoot due to transpiration. [2017]
- Ans.** Potometer.
- 29.** Define guttation. [2013]
- Ans.** The exudation of water drops from the edges or tips of leaves through hydathodes.
- 30.** Choose between the two options to answer the question specified in the brackets for the following  
Lenticels or stomata (Which one remains open always)? [2018]
- Ans.** Lenticels
- 31.** Mention the exact location of the following  
Hydathodes. [2018]
- Ans.** Hydathodes (water glands) are present along leaf margin.
- 32.** Give the exact location of hydathodes. [2011]
- Ans.** Hydathodes-in the margins of the leaf.
- 33.** Differentiate between the transpiration and guttation on the basis of structures involved. [2013]
- Ans.** Transpiration occurs through stomata.  
Guttation occurs *via* hydathodes.
- 34.** Identify the odd one in a set given below and name the category to which the remaining three belong.  
Transpiration, photosynthesis, phagocytosis, guttation [2014]
- Ans.** Odd term – Phagocytosis  
Category of the other three – Plant physiology.

- 35.** Choose the correct alternative. [2010]

Loss of water as droplets through leaves of an intact plant is termed (bleeding, guttation, transpiration).

**Ans.** Guttation

- 36.** Give the technical term.  
Exudation of sap from injured parts of a plant. [2008]

**Ans.** Bleeding.

- 37.** Write down the difference between the following pairs as indicated within the brackets. Guttation and bleeding in plants (cause). [2011]

**Ans.**

Guttation	Bleeding
It is exudation of water from leaves occurring when the amount of root pressure is high and rate of transpiration is low.	It is the exudation of cell sap from the injured or cut part of a plant, due to increased root pressure.

## **b** 2 Marks Questions

- 38.** Transpiration is a necessary evil in plants. Explain.

**Ans.** Transpiration controls the rate of water absorption. It helps in the absorption of minerals and regulates the temperature.

At the same time, it has disadvantages such as it leads to water deficiency in plants and thus, impairs the processes of photosynthesis, growth, etc.

It is therefore said that 'transpiration is a necessary evil'.

- 39.** How does root-shoot ratio affect the rate of transpiration?

**Ans.** Root-shoot ratio plays a role in affecting transpiration because of greater availability of water due to extensive root system.

Thus, low root-shoot ratio decreases the rate of transpiration, while high root-shoot ratio increases that rate of transpiration.

- 40.** Some desert plants have sunken stomata on their leaves. Justify.

**Ans.** Many plants, specially those which grow in a dry climate evolve a variety of permanent adaptations to curtail transpiration. Sunken stomata is one such adaptation in desert plants.

- 41.** On a bright sunny day, the leaves of certain plants roll up. Elaborate it.

**Ans.** On a bright sunny day, the rate of transpiration is high. This leads to excess loss of water from leaves and that water is not compensated by water from the roots.

As a result, the guard cells and other cells of the leaf become flaccid and the leaves roll up.

This is a kind of defence mechanism which prevents further water loss from the plant.

- 42.** Explain how the rate of transpiration is affected on [2009]

- (i) a windy day  
(ii) a foggy day

**Ans.** (i) On a windy day, the water vapour released from the leaves by transpiration is removed faster and the leaf does not get saturated with water. So, transpiration is more.

- (ii) On a foggy day, the areas outside the leaf is saturated with water.

So, water vapour from the leaves is removed very slowly thereby reducing transpiration. [1 × 2]

- 43.** Differentiate between evaporation and guttation.

**Ans.** Differences between evaporation and guttation are as follows

Evaporation	Guttation
It is a physical process of loss of water in the form of water vapour without incorporation of living cells.	It is the loss of water in the form of droplets from the margins of the leaves.
It occurs during day.	It occurs during night.

## **c** 3 Marks Questions

- 44.** Explain the mechanism of stomatal transpiration.

**Ans.** From the xylem, vessels of the veins of the leaf diffuse water vapour out into the intercellular spaces and from there to the guard cells.

When the guard cells become turgid the inner thick walls are pulled apart by the inner walls of the guard cells.

Due to this, the gap between the guard cells increases, the stoma opens and transpiration occurs through it.

**45.** Mention three adaptations found in plants to reduce transpiration.

**Ans.** Three adaptations are as follows

- (i) Presence of sunken stomata
- (ii) Leaf may be modified into spines.
- (iii) Presence of thick cuticle on the epidermis. [1 × 3]

**46.** Mention three advantages of transpiration.

**Ans.** Three advantages are as follows

- (i) It provides a suction force
- (ii) It produces a cooling effect
- (iii) It helps in the distribution of water. [1 × 3]

**47.** Guttation results in the loss of water in the form of droplets. State the components of these droplets and explain the term 'guttation'.

**Ans.** Guttation results in the loss of water droplets. These drops are rich in mineral salts, organic acids, carbohydrates and nitrogenous compounds.  
Refer to text on page 67.

### d 4 Marks Questions

**48.** Discuss wilting. Some plants show wilting of their leaves at noon even when the soil is well-watered. Why is it so?

**Ans.** When the rate of transpiration is more than the rate of absorption of water by the roots, the leaves drop down due to lowering of turgor pressure. This flaccid condition is known as wilting.

Some plants show wilting of their leaves during mid day even when the soil is well-watered. This is because the rate of transpiration during mid-day exceeds the rate of absorption of water by the roots. Consequently cells lose turgidity and the leaves wilt.

**49.** Droplets of water may sometimes appear on the margins of the leaves of a banana plant in the early morning. Are these dew droplets? Discuss.

**Ans.** The droplets on the leaves of banana plant are not dew drops but water droplets. Banana plants usually grow in moist conditions.

Thus, higher humidity reduces the rate of transpiration. But banana plant gets plenty of water supply. During night and early morning, the transpiration is nil, but the plant is getting water from roots which creates hydrostatic pressure in the plant. This results in loss of water through leaf margins. This phenomenon is called guttation.

### e 5 Marks Questions

**50.** Under what condition, the rate of transpiration will be maximum, when soil is dry and atmosphere is humid or when soil is humid and atmosphere is dry. Give reason.

**Ans.** The rate of transpiration will be maximum when the soil is humid and atmosphere is dry because of the following reasons

(i) Availability of more water in the soil is necessary for the absorption of water by the roots in order to carry it up to the xylem. Thus, lack of water decreases transpiration and overall health of the plants. Whereas, more water in soil increases transpiration rate.

(ii) In dry climates, transpiration is increased. Water is forced to diffuse more rapidly into the air due to the concentration difference between the environment outside and inside the plant. Low humidity creates a vapour gradient between the plant and the air.

In dry air, there is a lack of water, forcing water to be pulled from the plant to the atmosphere increasing transpiration. Therefore, in humid climates, transpiration is less affected by diffusion.

**51.** Differentiate between the following.

- (i) Stomata and lenticels
- (ii) Transpiration and translocation
- (iii) Stomatal transpiration and cuticular transpiration
- (iv) Evaporation and transpiration
- (v) Transpiration and perspiration

**Ans.** (i) Differences between stomata and lenticels are as follows

Stomata	Lenticels
Minute opening present mainly on leaves.	These are found in the bark of woody stems.
Stomata can be opened and closed.	These are always open.
Contain guard cells.	Guard cells are absent.

(ii) Differences between transpiration and translocation are as follows

Transpiration	Translocation
It is the loss of water in the form of vapour.	It is the transportation of food materials within the plant body.
It occurs through stomata.	It occurs through vascular tissues xylem and phloem.

- (iii) Differences between stomatal transpiration and cuticular transpiration are as follows

Stomatal transpiration	Cuticular transpiration
It occurs through stomata.	It occurs through cuticle of the leaves.
Water lost is more.	Water lost is less.

- (iv) Differences between evaporation and transpiration are as follows

Evaporation	Transpiration
Loss of water from the surface of water bodies as vapour.	Loss of water in the form of vapour from aerial parts of the plant.
It is a physical change controlled by the temperature and humidity of the atmosphere.	It is a vital and partly a physical process controlled by both internal and external factors.
It is a fast process.	It is a slow process.

- (v) Differences between transpiration and perspiration are as follows

Transpiration	Perspiration
It takes place in plants.	It takes place in animals.
It takes place mainly through stomata.	It takes place through sweat pores.

[1 × 5]

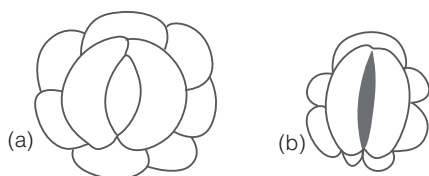
- 52.** Differentiate between transpiration and guttation.

**Ans.** Differences between transpiration and guttation are as follows

Transpiration	Guttation
Loss of water in the form of water vapour.	Loss of water in the form of water droplets.
Occurs in the presence of sunlight.	Does not require sunlight, seen in early morning or at night.
Water loss through stomata, lenticels and cuticles.	Water loses through hydathodes.
Provides cooling effect to the body.	Does not provide any cooling effect.
May cause wilting of leaf cells by affecting turgidity.	Does not affect turgidity of leaf cells.

## Diagram Based Questions

- 53.** Observe the diagram and answer the following



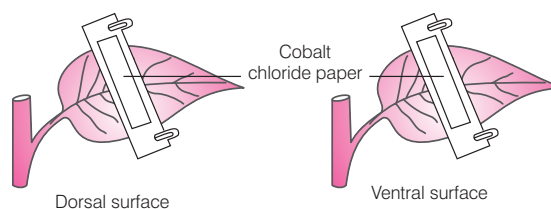
- (i) Are these types of guard cells found in monocots or dicots?  
 (ii) Which of these shows a higher water content (a) or (b)?  
 (iii) State the conditions of the guard cells in (a) and (b).

**Ans.** (i) These types of guard cells are found in dicots.

(ii) (a) shows higher water content.

(iii) Guard cells in (a) are turgid and in (b) are flaccid.

- 54.** Given below is an experimental set-up to demonstrate a particular process. Study the same and answer the questions that follows



- (i) Name the physiological process being studied.  
 (ii) Explain the process mentioned above.  
 (iii) What is the aim of the above experiment?  
 (iv) What would you observe in the experimental set-up after an hour? Give a reason to support your answer.  
 (v) Mention any three adaptations found in plant to overcome the physiological process mentioned in (i) above.

**Ans.** (i) Transpiration

(ii) In this process, pieces of dry cobalt paper are attached to the two surfaces of a leaf still attached to the plant. These are held in position by two glass slides on either sides tied together by elastic bands or clips.

(iii) Aim – To demonstrate that increased transpiration occurs from lower surface of leaves.

(iv) The piece of paper facing upper surface of leaf does not turn pink (or turns pink in long time). Whereas the paper on lower surface of leaf turns pink much faster.

(v) Refer to text on page 65.

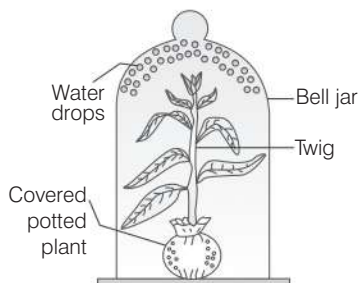
- 55.** An apparatus as shown below was setup to investigate a physiological process in plants. The set-up was kept in sunlight for two hours. Droplets of water were then seen inside the bell jar.

Answer the questions that follows.

[2015]

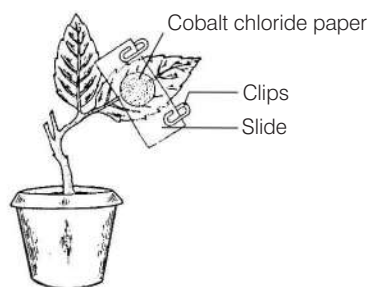
- (i) Name the process being studied.

- (ii) Explain the process named in (i) above.
- (iii) Why was the pot covered with a plastic sheet?
- (iv) Suggest a suitable control for this experiment.
- (v) List three adaptations in plants to reduce the above mentioned process.



- Ans.** (i) The process being studied through this experiment is transpiration.
- (ii) Refer to text on page 62 Transpiration.
- (iii) Pot is covered with a plastic sheet so as to prevent the escape of water vapour from the pot.
- (iv) Control for the experiment can be similar to an empty plastic sheet (with its mouth tied) kept in the sunlight. This will not show any drops of water on the bell jar.
- (v) Refer to text on page 65.

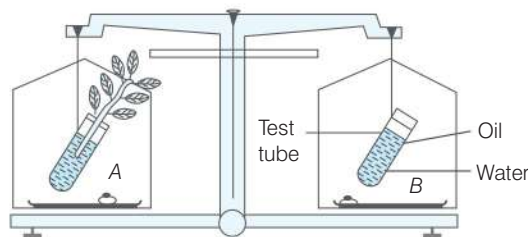
- 56.** Given below is the diagram of an experimental set-up to study the process of transpiration in plants. Study the same and then answer the questions that follows



- (i) What is the colour of dry cobalt chloride paper?
- (ii) Is the experimental leaf a monocot or a dicot?
- (iii) Why are glass slides placed over the dry cobalt chloride papers?
- (iv) After about half an hour what change, if any, would you expect to find in the cobalt chloride papers placed on the dorsal and ventral sides of the leaf? Give a reason to support your answer.

- Ans.** (i) Blue
- (ii) Dicot leaf (It has reticulate venation)
- (iii) To keep the strips of cobalt chloride paper at their places, glass slides are placed over the dry cobalt chloride papers.
- (iv) The cobalt chloride paper on the dorsal side will turn light pink than the ventral side which will turn dark pink due to unequal stomata distribution on both the sides.

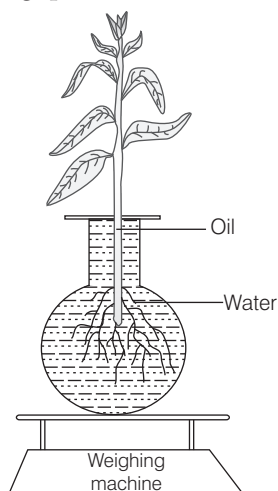
- 57.** The figure given below represents an experimental set-up with a weighing machine to demonstrate a particular process in plants. The experimental set-up was placed in bright sunlight. Study the diagram and answer the following questions. [2014]



- (i) Name the process intended for study.
- (ii) Define the above mentioned process.
- (iii) When the weight of the test tube (A and B) is taken before and after the experiment, what is observed? Give reasons to justify your observation in A and B.
- (iv) What is the purpose of keeping the test tube B in the experimental set-up?

- Ans.** (i) The process intended for study is transpiration.
- (ii) Transpiration is the process of loss of water in the form of vapour from the aerial parts of the plant.
- (iii) It was observed after the experiment, that the test tube A has risen up due to the loss of weight and in test tube B, the weight remains unchanged. This happens because in test tube A plant undergoes the transpiration and loses water while, in test tube B no transpiration occurs because there was no plant in the test tube. Also direct evaporation was prevented from the surface so, weight remains unchanged.
- (iv) Test tube B was kept in the experimental set-up as a control.

58. The diagram below represents a process in plants. The setup was placed in bright sunlight. Answer the following questions. [2018]

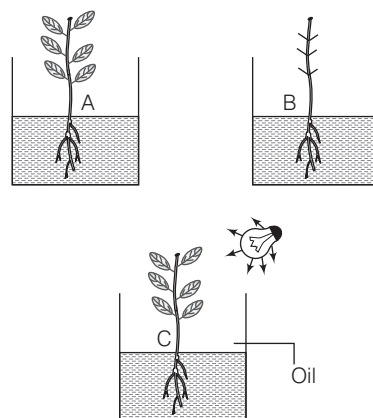


- Name the physiological process depicted in the diagram.  
Why was oil added to the water?
- When placed in bright sunlight for four hours, what do you observe with regard to the initial and final weight of the plant?  
Give a suitable reason for your answer.
- What happens to the level of water when this setup is placed in
  - Humid conditions?
  - Windy conditions?
- Mention any three adaptations found in plants to overcome the process mentioned in (i).
- Explain the term 'guttation'.

- Ans.**
- The given diagram shows the process of transpiration.  
Oil is added to prevent any loss of water due to evaporation.
  - We will observe a decrease in the weight of plant due to the loss of water in the form of water vapour by transpiration.
  - In humid conditions, there is no or very little decrease in level of water as rate of transpiration is minimum.
    - Transpiration increases with the velocity of wind. Thus, water level will decrease in windy conditions.

- Adaptations found in plants to overcome excessive transpiration are as follows
  - Presence of sunken stomata (e.g. *Nerium*).
  - Presence of thick cuticle on leaves (e.g. banyan).
  - Loss of leaves or leaves reduced to spines (e.g. cactus, xerophytes).
- Guttation is the process of loss of water in the form of water droplets through hydathodes present along leaf margin.  
It occurs when the amount of root pressure is high and rate of transpiration is low.

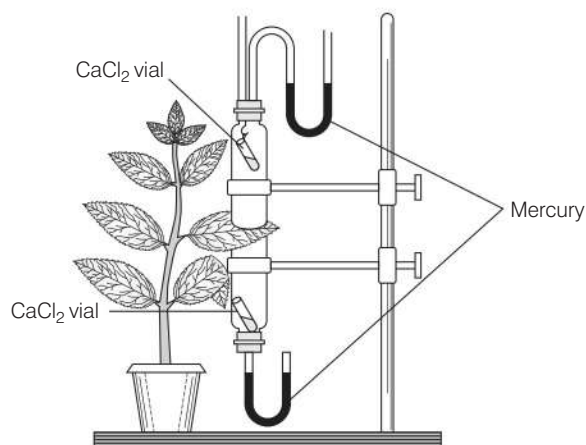
59. Three plants A, B and C are placed in a beaker containing coloured water as shown in the figure below. The water in each beaker is covered with a layer of oil. The leaves were removed from plant B, while plant C was exposed to strong light.



- In which plant, A, B or C, would the water move up fastest?
- In which plant would water move slowly?
- What is being investigated by this experiment?
- Water is covered with oil why?

- Ans.**
- Water moves up fastest in plant C as the rate of transpiration increases in strong sunlight.
  - Water moves slowly in plant B as there are no leaves and therefore very little transpiration will take place.
  - Transpiration and various factors affecting transpiration are being investigated by this experiment.
  - Water is covered with oil as a precaution to prevent evaporation of water from the beaker.

60. The apparatus shown here is Garreau's potometer designed to demonstrate unequal transpiration from the two surfaces of a dorsiventral leaf. Before keeping the leaf in between the cups, anhydrous calcium chloride ( $\text{CaCl}_2$ ) contained in two small vials was weighed and placed in both the cups. The ends of the cups were closed with corks through which two mercury manometers were connected.



After a few hours,  $\text{CaCl}_2$  vials were taken out and weighed again.

- What is the purpose of keeping  $\text{CaCl}_2$  vials inside the cup?
- After a few hours,  $\text{CaCl}_2$  vials were taken out and weighed again. Will you expect any difference in weight? If so, give reasons.
- What was the purpose of using a manometer?
- What do you mean by transpiration?

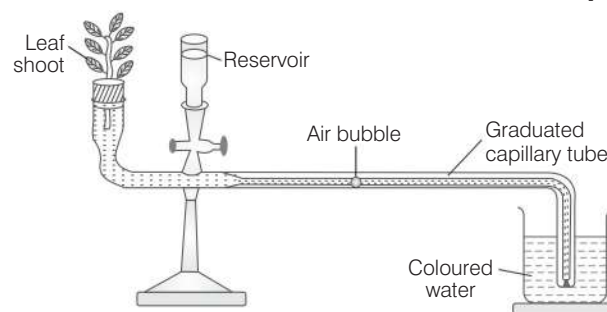
**Ans.** (i) To absorb moisture present inside the cup.

- Yes, because  $\text{CaCl}_2$  vials will absorb water vapours given out from the surface of leaf due to transpiration and will weigh more.

- To measure the pressure in the cups.

- Transpiration is the process in which water is lost in form of vapours from the aerial parts of the plant.

61. The diagram of an apparatus given below demonstrates a particular process in plants. Study the same and answer the questions that follows. [2016]



- Name the apparatus.
- Which phenomenon is demonstrated by this apparatus?
- Explain the phenomenon mentioned in (ii) above.
- State two limitations of using this apparatus.
- What is the importance of the air bubble in this experiment?
- Name the structure in a plant through which the above process takes place.

**Ans.** (i) Ganong's potometer.

- Transpiration.
- Transpiration is loss of water vapours from aerial parts of the plant into the atmosphere.
- The two limitations are
  - Introduction of air bubble is not easy.
  - The twig may die if the experiment takes long time.
- The movement of bubble signifies the amount of water lost by transpiration.
- The experiment demonstrates transpiration which takes place through stomata present on the leaves.

# CHAPTER EXERCISE

## Multiple Choice Questions

- Which of the following is not involved in the process of transpiration?  
(a) Roots (b) Leaves  
(c) Bark (d) Lenticels
- After leaf falls in the autumn, which of the following is the only site of water loss in deciduous trees?  
(a) Cuticle (b) Lenticel  
(c) Stomata (d) Bark
- In which of the plant, leaf surface may be covered by thick coating of epidermal hair to reduce transpiration?  
(a) Cucurbits  
(b) Banyan  
(c) *Nerium*  
(d) Lavender

Ans. 1. (a) 2. (b) 3. (a)

## Fill in the Blanks

- Complete the following statements by using appropriate words.  
(i) Openings found on the under surface of the dorsiventral leaf are .....  
(ii) The leaves of the ..... plants have thick cuticles.  
(iii) Transpiration ..... with wind speed.  
(iv) ..... is an antitranspirant.  
(v) In *Nerium*, stomata are .....

## True-False

- State whether the following statements are true or false. Also rewrite the false statements correctly.  
(i) Potometer is used to reduce transpiration.  
(ii) Lenticels can open and close.  
(iii) Transpiration pull is one of the causes responsible for ascent of sap.  
(iv) Transpiration will be more in dim light.  
(v) Calcium chloride paper is used to demonstrate transpiration.

## Match the Columns

- Match the following columns.

Column I	Column II
A. Exudation of sap from the injured parts of plant	1. Bleeding
B. Helps in loss of water vapours due to transpiration	2. Guard cells
C. Control the opening and closing of stomata	3. Lenticels
D. Protects the surface and reduces water loss	4. Stomata
E. Help in gaseous exchange	5. Cuticle

- Match the following columns.

Column I	Column II
A. Transpiration	1. Cactus
B. Movement of water	2. Stomata
C. Guttation	3. Maize plant
D. Low rate of transpiration	4. Xylem
E. High rate of transpiration	5. Hydathodes

## 1 Mark Questions

- Give the exact location and one function of stoma.
- In succulents like cacti, stomata close during day. Why?
- Differentiate between the following on the basis of what is mentioned in brackets.  
Lenticels and stomata in old plants (gases given out during daytime)
- Leaf area affects the rate of transpiration. Justify.
- If the rate of transpiration becomes more than the rate of photosynthesis, what will happen?

## 2 Marks Questions

- Suggest the theories to explain the changes that occur in osmotic pressure of the guard cells during the mechanism of opening and closing of stomata.
- Air movement affects the rate of transpiration. Comment.
- Is it true that all conditions that inhibit transpiration, favour guttation? Justify.

### 3 Marks Questions

16. Reduction in weight of the potted plant after certain period confirms loss of water through transpiration. Justify.
17. Do you think that air bubbles are helpful in measuring the rate of transpiration? If yes, briefly explain the apparatus in which air bubbles are used for this purpose.
18. In a dorsiventral leaf, the rate of transpiration is unequal. Do you agree? Name the apparatus that is used for comparing the rate of transpiration from both surfaces of such a leaf.

### 4 Marks Question

19. Write a short note on the movement of water in the leaves with necessary explanatory diagrams.

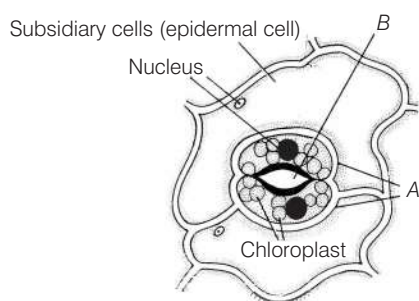
### 5 Marks Questions

20. Describe the types of transpiration. Which of these accounts for maximum transpiration in the plant?
21. Discuss the role of cobalt chloride paper while performing the experiment to demonstrate the process of transpiration.
22. Explain the bell jar experiment. What is its significance?

### Diagram Based Questions

23. The diagram given represents a structure found in a leaf.

Study the same and answer the questions that follows

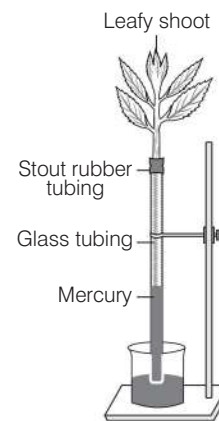


- (i) Name the parts labelled A and B.
- (ii) What is the biological term for the above structure?
- (iii) What is the function of the part labelled A?

- (iv) Mention two structural features of A, which help in the function mentioned in (iii) above.
- (v) Where is this structure likely to be found in a leaf?
- (vi) The above structure helps in the process of transpiration. Explain the term transpiration.
- (vii) How many other cells are found surrounding this structure as seen in the diagram?

24. The given diagram represents an experiment to demonstrate a certain phenomenon in a green plant.

- (i) Has the level of mercury in the glass tubing risen or fallen?
- (ii) Name the life process of the plant which has caused the change in the level of mercury.
- (iii) Define the process named above.
- (iv) State any three advantages of this process to the plant.
- (v) Which conducting tissue of the plant does the glass-tubing represent-xylem or phloem?



25. The figure below represents an experiment performed to demonstrate certain phenomenon in plants. The set-up was kept in sunlight for about two hours.



- (i) What is the aim of the experiment?
- (ii) Define the process mentioned in (i) above.
- (iii) What do you observe in the experiment as an evidence of the process stated in (i) and (ii) above?
- (iv) Suggest a suitable control experiment for comparison.
- (v) Mention the precautions that should be taken for proper results in the experiment.

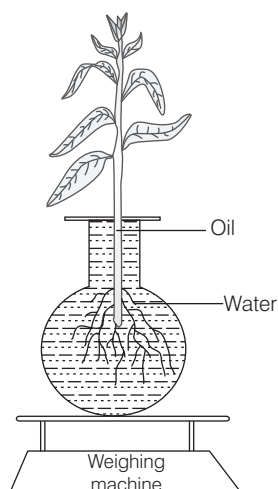
# ARCHIVES

## (Last 8 Years)

Collection of Questions Asked in Last 8 Years' (2018-2011) ICSE Class 10th Examinations

### 2018

1. Choose between the two options to answer the question specified in the brackets for the following Lenticels or stomata (Which one remains open always?) [1]
2. The wax-like layer on the epidermis of leaves which reduces transpiration. [1]
3. Mention the exact location of the following. Hydathodes [1]
4. Differentiate between the following pair on the basis of what is indicated in brackets. Leaf and liver (form in which glucose is stored) [1]
5. The diagram below represents a process in plants. The setup was placed in bright sunlight. Answer the following questions. [1]



- (i) Name the physiological process depicted in the diagram.  
Why was oil added to the water?
- (ii) When placed in bright sunlight for four hours, what do you observe with regard to the initial and final weight of the plant?

Give a suitable reason for your answer.

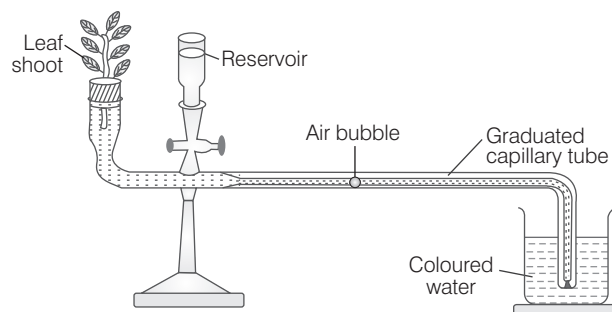
- (iii) What happens to the level of water when this setup is placed in
  1. Humid conditions?
  2. Windy conditions?
- (iv) Mention any three adaptations found in plants to overcome the process mentioned in (i).
- (v) Explain the term 'guttation'. [5]

### 2017

6. Give the appropriate technical term for the following
  - (i) An apparatus that measures the rate of water uptake in a cut shoot due to transpiration. [1]
7. Give biological reason for the following statement. In some xerophytes, leaves are modified into spines. [1]

### 2016

8. State the main function of guard cells. [1]
9. The diagram of an apparatus given below demonstrates a particular process in plants. Study the same and answer the questions that follows

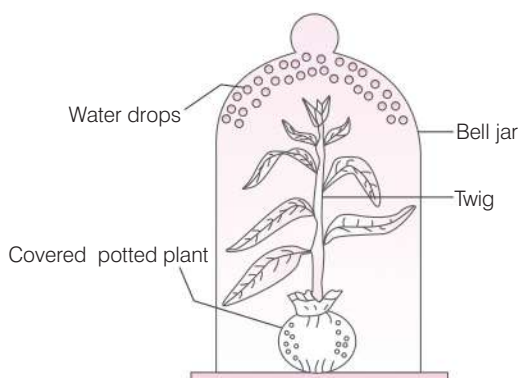


- (i) Name the apparatus.
- (ii) Which phenomenon is demonstrated by this apparatus?

- (iii) Explain the phenomenon mentioned in (ii) above.
- (iv) State two limitations of using this apparatus.
- (v) What is the importance of the air bubble in this experiment?
- (vi) Name the structure in a plant through which the above process takes place. [5]

## 2015

- 10.** An apparatus as shown below was set-up to investigate a physiological process in plants. The set-up was kept in sunlight for two hours. Droplets of water were then seen inside the bell jar. Answer the questions that follows.

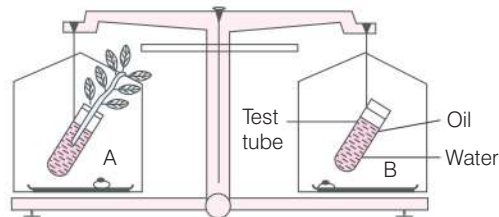


- (i) Name the process being studied.
- (ii) Explain the process named above in (i).
- (iii) Why was the pot covered with a plastic sheet?
- (iv) Suggest a suitable control for this experiment.
- (v) List three adaptations in plants to reduce the above mentioned process. [5]

## 2014

- 11.** State the function of lenticels. [1]
- 12.** Identify the odd one in a set given below and name the category to which the remaining three belong. Transpiration, photosynthesis, phagocytosis, guttation. [1]
- 13.** Give scientific reason why balsam plants wilt during mid-day even if the soil is well-watered. [1]
- 14.** The figure given below represents an experimental set-up with a weighing machine to demonstrate a particular process in plants.

The experimental set-up was placed in bright sunlight. Study the diagram and answer the following questions



- (i) Name the process intended for study.
- (ii) Define the above mentioned process.
- (iii) When the weight of the test tube (A and B) is taken before and after the experiment, what is observed? Give reasons to justify your observation in A and B.
- (iv) What is the purpose of keeping the test tube B in the experimental set-up? [5]

## 2013

- 15.** Name the waxy layer on the epidermis of the leaf meant to reduce transpiration [1]
- 16.** Give the biological/technical term for the permanently open structures seen on the bark of an old woody stem. [1]
- 17.** Define guttation. [1]
- 18.** Given below are five groups of terms. In each group arrange and rewrite the terms in the correct order as to be in logical sequence. Spongy cells, upper epidermis, stoma, palisade tissue, substomatal space. [1]

## 2012

- 19.** Give the exact location of lenticels. [1]
- 20.** Differentiate between the transpiration and guttation on the basis of structures involved. [1]

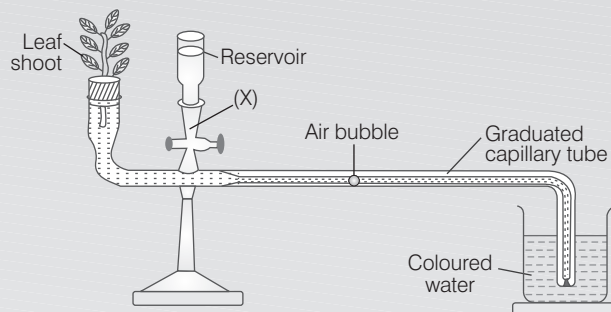
## 2011

- 21.** Give the exact location of hydathodes. [1]
- 22.** Write down the difference between the following pairs as indicated within the brackets. Guttation and bleeding in plants (cause). [1]

# CHALLENGERS\*

## *A Set of Brain Teasing Questions for Exercise of Your Mind*

The amount of water taken up by a plant can be investigated experimentally using a potometer. Refer to the following diagram showing a potometer to answer questions 1 - 2.



- 1 What is expected to occur after the leafy shoot, together with the potometer, is placed in a dark, cool cupboard for one hour?
  - (a) The air bubble in the capillary tube moves towards the leafy shoot at a faster rate
  - (b) The air bubble in the capillary tube moves towards the leafy shoot at a slower rate
  - (c) The air bubble in the capillary tube moves away from the leafy shoot
  - (d) There is no observable change in the set-up
- 2 A leak occurred in the potometer at position X indicated in the diagram.
  - (a) The shoot would take up water at a faster rate than if the leak did not occur
  - (b) The shoot would take up water at a slower rate than if the leak did not occur
  - (c) The estimated rate of transpiration using this apparatus would be higher than the true value
  - (d) The estimated rate of transpiration using this apparatus would be lower than the true value
- 3 Water conservation is key to the survival of plants that live in deserts. A first year botany student suggests that permanent closure of the stomata of such plants would be beneficial for their survival. How would you refuse his suggestion?
  - (a) The stomata must be open to allow the plant to take in carbon dioxide for photosynthesis
  - (b) The stomata must be open to allow the plant to take in oxygen for photosynthesis
  - (c) Significant water loss would still occur through the epidermis even if the stomata are closed
  - (d) Closing the stomata would curb the transpiration stream
- 4 Transpiration is the loss of water from the surfaces of a plant. Which of the following statements describe(s) why transpiration is useful for plants?
  - I. It gets rid of excess water, protecting plant cells from bursting.
  - II. It cools plant down, preventing overheating on sunny days.
  - III. It enables the mass flow of inorganic nutrients and water up the plant body.
  - (a) Only I
  - (b) I and III
  - (c) II and III
  - (d) I, II and III
- 5 On a rainy day, there is no transpiration. Explain.
- 6 If 50% of the leaves are removed from a plant, the rate of transpiration by the remaining leaves increases. Explain.
- 7 In an experiment, four freshly plucked leaves (A-D) of a plant, such as those of China rose, were treated as follows
 

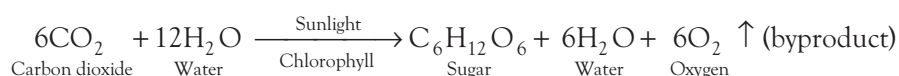
(a) Coated with vaseline on its upper surface	(b) Coated on the lower surface
(c) Coated on both surfaces	(d) Left uncoated

 All the four leaves A, B, C and D were left in a room for about 24 hours.
  - (i) Which leaf would become most limp? Why?
  - (ii) Which leaf would show least limping? Why?

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 304.

# Photosynthesis

Energy required by all living organisms comes directly or indirectly from the sunlight. It is the main source of energy for life on earth. Photosynthesis is a process by which green plants, some bacteria and some protists fix energy from sunlight to synthesise food (sugar) in the presence of  $\text{CO}_2$  and water with the help of chlorophyll. Overall reaction of photosynthesis can be summarised as follows

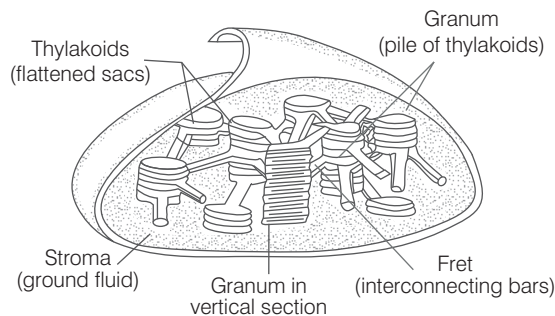


In plants and algae, photosynthesis takes place in organelles called **chloroplast**. A typical plant cell contains 10-100 chloroplast. The structure of chloroplast is discussed below

## Chloroplast : Site of Photosynthesis

A chloroplast is an oval, minute and double-membraned bound cell organelle found typically in plant cells. It contains an entire photosynthetic machinery within it. It contains a green pigment called **chlorophyll**, which absorbs light energy for photosynthesis. Internally, chloroplast contains a liquid proteinaceous ground substance known as **stroma** and a membrane system containing a number of disc-like sacs, known as **thylakoids**.

At some places, the thylakoids arrange themselves to form a stack of coin-like structure forming a cylindrical dense granular bodies called **grana** (green in colour).



A chloroplast showing internal structure revealed by electron microscope

## Chapter Objective

- Chloroplast : Site of Photosynthesis
- Stomata
- Raw Materials for Photosynthesis
- Mechanism of Photosynthesis
- Adaptations of Leaves for Photosynthesis
- Factors Affecting Photosynthesis
- Importance of Photosynthesis
- Carbon Cycle
- Experiments Based on Photosynthesis

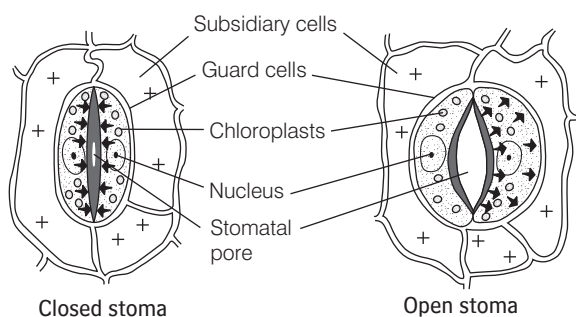
Each stack of thylakoid sacs is connected by a structure known as **stroma lamellae**, which helps in keeping the sacs at a distance from each other. On the inner surface of the lamella membrane, small spherical structure called **quantasomes** are present.

These are the structural and functional units of chloroplast. The chloroplasts mainly occur in chlorenchymatous cells, particularly in mesophyll of leaves. They are also found in the guard cells of the stomata and in the outer layers of the green stems.

## Stomata

Stomata are tiny openings present on the lower epidermis (maximum surface) of the leaf. It is responsible for the gaseous exchange in the process of photosynthesis, respiration and transpiration. Stomata open during the daytime in the presence of light to allow  $\text{CO}_2$  to diffuse in.

On the other hand, they get closed when plants are not photosynthesising, i.e. in the absence of light. The opening and closing of stomata depend on the turgidity of the guard cells, which have **inner** (thick and rigid) wall and **outer** (thin and elastic) wall.



## Potassium Ion ( $\text{K}^+$ ) Exchange Theory

For this, see chapter 4 on page no. 63-64.

## Raw Materials for Photosynthesis

Before studying the mechanism of photosynthesis, let's take a brief look on the essentials or raw materials required for the process of photosynthesis.

### Chlorophyll

It is the most important pigment in plants. It facilitates photosynthesis and gives plants green colour. The molecule of chlorophyll consists of a porphyrin ring with  $\text{Mg}^{2+}$  ions

at its centre and a long hydrocarbon chain attached to the porphyrin ring. There are nine different types of chlorophyll pigments found in plants like chlorophyll-*a*, chlorophyll-*b*, etc. out of which chlorophyll-*a* is the most widely occurring. Chlorophyll absorbs blue, violet and red wavelengths more intensely, while green wavelength is weakly absorbed.

The green light is reflected away for the chlorophyll (chloroplast) to appear green. Chlorophyll is highly sensitive to light. Too much exposure of light can destroy it.

### Carotenoids

These are a large group of hydrocarbon pigments found in plants. Xanthophylls are yellow coloured pigments and carotene is a orange pigment. These pigments are not visible due to dominance of green colour of chlorophyll but can be observed in leaves before they fall. Carotenoids protect the chlorophyll from photooxidation. It also absorbs and transfers the light energy to chlorophyll centre.

### Carbon Dioxide

Plants absorb  $\text{CO}_2$  from the atmosphere and use it as a substrate. It gets converted to glucose at the end of reaction.

### Water

Plants absorb water from the soil with the help of roots. It is said that the oxygen produced in the end of reaction comes from water.

### Light Energy

Energy from the sun is necessary for photosynthesis to takes place. It activates photosystems.

### CHECK POINT 01

- 1 Name the cell organelle that traps light energy for making food for the plants.
- 2 What are quantasomes?
- 3 State the location of chlorophyll molecule in the chloroplast?
- 4 What is the role of water in the mechanism of photosynthesis?
- 5 Why is light energy necessary for photosynthesis?

## Mechanism of Photosynthesis

Photosynthetic process begins when the sunlight falls on the mesophyll cells of the leaf. Both palisade and spongy mesophyll cell are the principal centre for this activity. The light energy is trapped by the chlorophyll present on the layers of mesophyll cells.

During the process, the raw materials, i.e.  $\text{CO}_2$  and water together with the solar energy trapped by the chlorophyll get converted into chemical energy in the form of food, i.e. glucose and starch.

The process of photosynthesis takes place in two phases

1. Light reaction (photochemical phase)
2. Dark reaction (biosynthetic phase)

## 1. Light Reaction (Photochemical Phase)

This is a **light dependent phase**, where a quick succession of chemical reactions initiated by light occurs, that's why it is also called **photochemical phase**.

The light of visible wavelengths, i.e. 400-700 nm are absorbed by chlorophyll molecules present in the **thylakoids** of the chloroplast.

This phase is completed in two main sub-stages

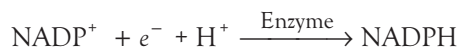
### Photolysis of Water

It is splitting of water by light. This process gets completed into two steps

- Step 1 Activation of chlorophyll** The chlorophyll molecule gets activated by absorbing photons of the light energy.
- Step 2 Splitting of water** The absorbed energy by the activation of chlorophyll is used in splitting of water molecules into two major components, i.e. hydrogen and  $\text{O}_2$  (**photolysis of water**).



At the end of photolysis, the hydrogen ions ( $\text{H}^+$ ) are picked up by a compound  **$\text{NADP}^+$**  (Nicotinamide Adenine Diphosphate), which gets converted into  **$\text{NADPH}$**  (Nicotinamide Adenine Dinucleotide Phosphate Hydrogen).

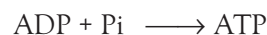


The oxygen component is released in the form of  $\text{O}_2$  (molecular oxygen).



### Photophosphorylation

It is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e., inorganic phosphate. This is utilising of the energy from the photons.



To summarise, light reaction involves conversion of light energy to chemical energy in the form of ATP and NADPH molecules.

## Photosystems

The light harvesting complexes in plants are the photosystems. These are made up of hundreds of pigment molecules bounded by proteins. The photosystem contains a reaction centre, where the actual photosynthetic reaction occurs.

Photosystems are of two types I and II,

**PS-I** It absorbs solar energy at 700 nm and supplies the electron to  $\text{NADP}^+$ .

**PS-II** It absorbs solar energy at 680 nm and supplies the excited electrons to the cytochrome centre.

## 2. Dark Reaction (Biosynthetic Phase/Calvin Cycle)

The phase in which synthesis of organic substances takes place is called **biosynthetic phase**.

This is a light independent phase. The term '**dark reaction**' does not mean that the reaction is occurring only at night. Its light independence means that absence of light does not hinder these reactions.

That is why these are also called '**light independent reactions**'. This reaction takes place in the **stroma** or **matrix** of the chloroplast. The dark reaction and light reaction take place simultaneously with the time gap of less than one thousand of a second.

During dark reaction, fixation and reduction of  $\text{CO}_2$  occurs. It results in the formation of carbohydrates by the utilisation of ATP and NADPH, (produced as the result of light reaction). RuBP (Ribulose biphosphate) acts as a primary acceptor of atmospheric  $\text{CO}_2$  in the beginning of this phase and at the end of the cycle, glucose is synthesised and RuBP is regenerated. This process occurs through Calvin cycle.

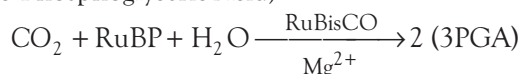
### Calvin Cycle ( $\text{C}_3$ Pathway)

In dark reaction, the reduction of  $\text{CO}_2$  occurs in the stroma of chloroplasts by a series of sequential reactions known as **Calvin cycle** (named after its discoverer **Melvin Calvin**).

Calvin cycle although does not require light, but it occurs during the day. When a green plant is producing high levels of ATP and NADPH. The three major steps of Calvin or  $\text{C}_3$  cycle are summarised below

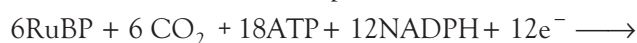
- (i) **Carboxylation** It is the most crucial step of the Calvin cycle in which utilisation of  $\text{CO}_2$  takes place for the carboxylation of RuBP. This reaction is catalysed by the enzyme **RuBP carboxylase**, which finally results in the

formation of 2 molecules of 3PGA  
(3-Phosphoglyceric Acid)



- (ii) **Reduction** After the carboxylation reaction, reduction of PGA takes place through a series of reactions leading to the formation of glucose.
- (iii) **Regeneration** This step requires one ATP molecule for phosphorylation. Hence, for every  $\text{CO}_2$  molecule that enters the Calvin cycle, requires 3 molecules of ATP and 2 molecules of NADPH.

The overall reaction of this phase is



The hydrogen ions combine with  $\text{CO}_2$  to form glucose, which later stored in the form of starch by the process of **polymerisation** (where several molecules of glucose form from one molecule of starch).

**Note** Dark reaction does not require direct sunlight, but it depends on the products of the light reaction.

## End Products of Photosynthesis

At the end of a photosynthetic reaction, the products formed are

- (i) **Glucose** The carbohydrates formed during photosynthesis can be utilised in/for respiration, food storage and growth, e.g. the glucose is either immediately utilised by the cells or stored as sucrose, starch or cellulose and used in the synthesis of complex molecules like proteins.
- (ii) **Oxygen** Some fraction of oxygen is used in respiratory process by plants and rest diffuses out into the atmosphere through stomata.
- (iii) **Water** It is reused by plants for photosynthetic process.

### CHECK POINT 02

- 1 Name the two main steps involved in the mechanism of photosynthesis.
- 2 Where does photolysis of water occur? What is its importance?
- 3 What do ATP and ADP mean? What are the roles of these molecules in the energy metabolism of a cell?
- 4 Why is the nickname 'dark reaction' not entirely correct for the chemical stage of photosynthesis?
- 5 Why is Calvin cycle called  $\text{C}_3$  cycle?
- 6 Explain the process of carboxylation in dark reaction.
- 7 Name the products produced by photosynthesis.

## Adaptations of Leaves for Photosynthesis

Leaves of some plants are adapted in various ways to perform the process of photosynthesis.

These are as follows

- (i) Presence of more stomata to allow rapid exchange of gases like  $\text{CO}_2$  and  $\text{O}_2$ .
- (ii) Arrangement of more number of chloroplasts on the upper surface of leaves, so as to capture maximum amount of light.
- (iii) Large and expanded surface area of leaves for absorbing maximum light.
- (iv) Presence of transparent cuticle and upper epidermis to allow light to enter freely and move easily and to reduce evaporation.
- (v) Thinness of leaves, which reduces the distance between cells, so as to facilitate the rapid transport of raw materials, like  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ , etc.
- (vi) Arrangement of leaves at right angle to the sunlight, so as to trap the maximum solar radiation.
- (vii) Extensive variation for rapid transport to and from the mesophyll cells.

## Factors Affecting Photosynthesis

Rate of photosynthesis is affected by the several internal and external factors. These are given below

### External Factors

External factors that affect the rate of photosynthesis are

- (i) **Intensity of light** Rate of photosynthesis increases with the increase in the intensity of light and *vice-versa*.
- (ii) **Quality of light** Rate of photosynthesis is higher in red and blue light than in any other light.
- (iii)  **$\text{CO}_2$  concentration** Rate of photosynthesis increases with rise in  $\text{CO}_2$  concentration, but upto a certain limit. It acts as a limiting factor in photosynthesis.
- (iv) **Temperature** Rate of photosynthesis also increases with the rise in temperature, but upto a limit, thereafter, it decreases. The optimum temperature for photosynthesis is said to be  $35^\circ\text{C}$ .

- (v) **Water content** Rate of photosynthesis decreases with the scarcity of water, due to less absorption through soil or excessive loss through transpiration. A decrease in water content of leaves reduces the rate of photosynthesis due to closure of stomata.

## Internal Factors

Internal factors that affect the rate of photosynthesis are

- (i) **Chlorophyll content in leaves** Less pigment amount will affect the occurrence of photosynthesis as sufficient light cannot be trapped.
- (ii) **Structure of leaf** We have already discussed the adaptations of leaf to carry out photosynthesis. If the parameters are not met, the photosynthetic rate will suffer.
- (iii) Internal concentration of  $\text{CO}_2$  in leaf tissue.
- (iv) Age of leaf.
- (v) **Protoplasm** Dehydration of protoplasm for some reasons, reduces the photosynthetic rate in plants.
- (vi) **Accumulation of end products** The progress of photosynthesis in the green cells is maintained as long as the concentration of the products formed is removed. Their accumulation slows down the process of photosynthesis.

## Importance of Photosynthesis

Photosynthesis is important for supporting life on earth in the following ways

- (i) It provides food to all organisms through food chain.
- (ii) Photosynthesis gives off oxygen, which acts as a life supporting gas. As a result of photosynthesis, some amount of oxygen produced is used by the plant itself for the process of respiration. But the major amount of  $\text{O}_2$  is diffused out into the atmosphere through stomata. Thus, this oxygen which gets diffused out, is not a waste material because it acts as a life supporting gas for other living organisms including humans on earth.
- (iii) It helps in maintaining balanced level of  $\text{O}_2$  and  $\text{CO}_2$  in the atmosphere.

- (iv) The fossil fuels like coal, petroleum and natural gas are formed by the decomposition of photosynthetic organisms.

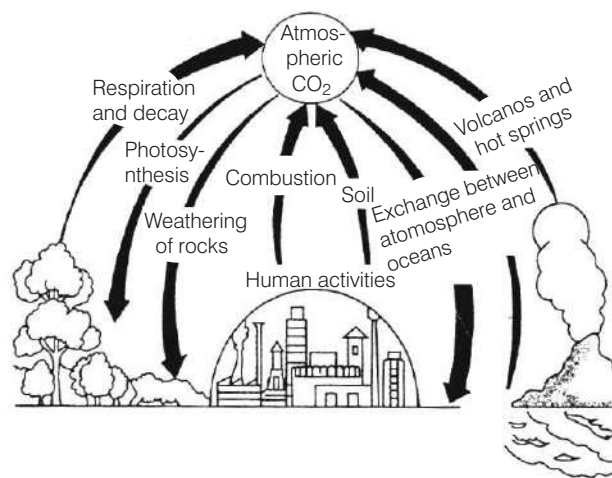
## Carbon Cycle

It is a series of chemical reactions, where carbon is removed from the air, used by living organisms in the form of food and is finally returned to the atmosphere. The steps involved in carbon cycle are

- I. Photosynthetic plants use carbon in the form of  $\text{CO}_2$  from the atmosphere to produce carbohydrates (food).
- II. Carbon through the food chain is passed on to animals including humans.
- III. By respiration, decay of plant and animal dead bodies, burning of fuel (like coal, petroleum, etc.), and carbon returned back to the atmosphere in the form of  $\text{CO}_2$ .

Green plants perform photosynthesis by utilising  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in the presence of sunlight and chlorophyll. In this process,  $\text{CO}_2$  is transformed into simple carbohydrate (sugar) and  $\text{O}_2$  is liberated as byproduct.

Carbohydrates (sugar) are further broken into simpler molecules, i.e. glucose, fructose, etc. These glucose molecules provide energy for the synthesis of other biologically important molecules or are converted into other substances.



Carbon cycle

**CHECK POINT 03**

- 1 Name some adaptations of leaves for photosynthesis.
- 2 What is the optimum temperature for photosynthesis?
- 3 The rate of photosynthesis is minimum at what time of the day?
- 4 Name two internal factors which affect rate of photosynthesis.
- 5 How fossil fuels are formed?
- 6 What is carbon cycle?

## Experiments Based on Photosynthesis

Number of experiments have been performed to prove that various raw materials are required for photosynthesis, i.e. light,  $\text{CO}_2$ , water and chlorophyll. Optimum conditions are essential for the process of photosynthesis to take place.

Before discussing the experiments, it is important to know about the **process of destarching** and its importance in plants. Destarching is carried out in following manner.

To destarch the leaves, they are kept in a dark room (with no exposure of natural or artificial light) for 1 or 2 days. By doing this, all starch from the storage organs of the leaves will be removed.

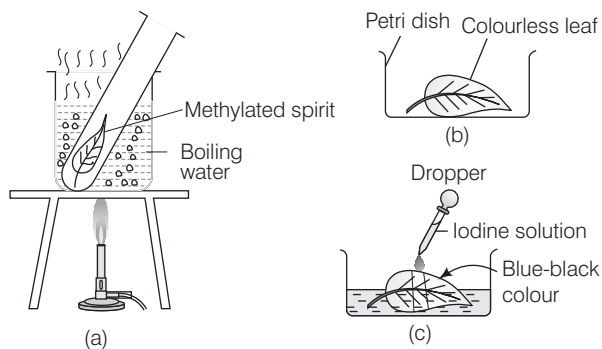
### Experiment 1

- ✓ *To test the leaf for the presence of starch.*

■ **Procedure** Pluck the leaf and boil it in water for a minute, so that all the cells are killed. Remove the leaf from water and boil it in alcohol to remove its chlorophyll (destarching). This will make leaf little hard and brittle.

Now, placed leaf again in hot water to soften it. Spread the leaf in petri dish and pour iodine solution on it dropwise with the help of dropper.

The leaf shows a blue-black colour which indicates the presence of starch in leaf.



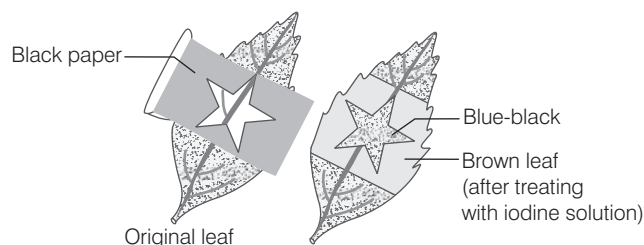
Experimental setup for starch test

### Experiment 2

- ✓ *To show that sunlight is necessary for photosynthesis.*

■ **Procedure** Take a potted plant and destarch it for 48 hours. Cover one of the leaf with black paper (with a star design being cut).

Keep the pot under the sunlight. Remove it after 1 hour and test the covered leaf for the presence of starch, by pouring iodine solution on it.



Only the parts of the leaf exposed to sunlight give the iodine test, proving that light is necessary for photosynthesis

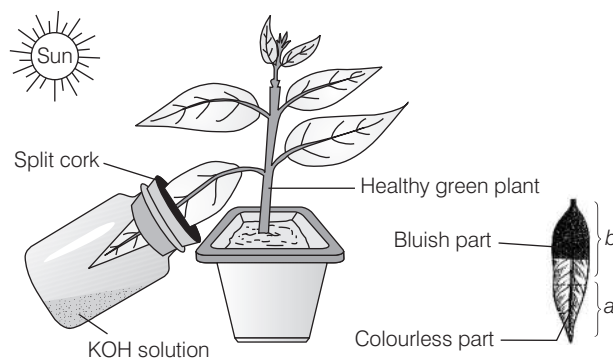
It will be observed that uncovered leaves and the part of the leaf, which was able to get light through the cut design will turn into blue-black colour. This indicates the presence of starch, while the portion which was covered with black paper will turn into brown colour (showing the absence of starch). This experiment thus, proves that the light is an essential requirement for the process of photosynthesis to take place.

### Experiment 3

- ✓ *To show that  $\text{CO}_2$  is necessary for photosynthesis.*

■ **Procedure** Take destarched potted plant.

Take wide mouthed corked bottle and put strong KOH solution in it. KOH solution absorbs all  $\text{CO}_2$  present in a bottle. Insert about half of the leaf inside the bottle through the split cork as shown in the figure



Experiment to prove that carbon dioxide is necessary for photosynthesis

Place the whole apparatus in light and test the leaf for starch after 8 hours.

Portion of the leaf inside the bottle and within cork gives negative test for starch because  $\text{CO}_2$  is not present in the bottle. It proves that  $\text{CO}_2$  is necessary for photosynthesis.

## Experiment 4

✓ *To show that chlorophyll is necessary for photosynthesis.*

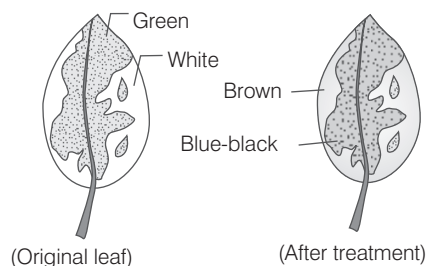
■ **Procedure** Take a potted plant with variegated leaves (having different colour zones, i.e. green and non-green areas), e.g. *Croton*, *coleus*, etc.

First, destarch the leaves by keeping them in the dark room for about 2-3 days. Then restarch them by keeping the plant in the sun.

After few hours of keeping under sun, pluck one leaf. Draw the outline on a paper, marking the green and non-green areas on the outline.

Now, when you will test the leaf for starch, you will observe that only the areas of leaf which was green (contain chlorophyll), will turn into blue-black colour showing the presence of starch, while the non-green area will not.

This experiment proves that photosynthesis can occur only in the presence of chlorophyll, which is present in the green areas of the leaf.



Coleus leaf demonstrating that chlorophyll is necessary for photosynthesis (by starch test)

## Experiment 5

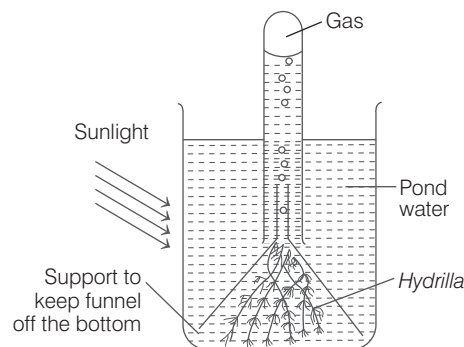
✓ *To show that oxygen is released during photosynthesis.*

■ **Procedure** Fill a beaker with pond water and keep the water plant, (e.g. *Hydrilla*) into the beaker.

Cover the plant by a short-stemmed funnel (it is to be noted that funnel should not touch the base of the beaker).

Now take a test tube full of water and invert it over the stem of the funnel. Allow the set-up to stand in the sunlight for about few hours.

After few hours, you will observe the presence of bubbles in the inverted test tube, which will get collected in the form of gas in the test tube. The gas formed is oxygen. This demonstrates that  $\text{O}_2$  is liberated as a byproduct in photosynthesis.



Experiment to show that oxygen is given out during photosynthesis

### CHECK POINT 04

- 1 How to destarch the leaves of a plant?
- 2 Why do we perform iodine test?
- 3 What is the role of KOH in experiment?
- 4 Which plant leaf is taken in chlorophyll testing and why?
- 5 How will you prove that oxygen is released during photosynthesis?

# SUMMARY

- Photosynthesis is the biggest biological reaction occurring on earth. By this process, the green plants manufacture food (carbohydrate) with the help of chlorophyll using carbon dioxide and water in the presence of sunlight.
- Chloroplast is an important cell organelle found only in plants which act as a site of photosynthesis. The chlorophyll pigment is found in the membrane of thylakoids of chloroplast which harvest solar energy to be used in the process.
- The mechanism of photosynthesis occurs in two steps, i.e. light reaction and dark reaction.
- The light reaction occurs in the presence of light. It has two steps
  - (i) Photolysis of water that occurs in the presence of light, Mn ions into  $\text{OH}^-$  and  $\text{H}^+$  ions.
  - (ii) Photophosphorylation means formation of ATP from ADP and inorganic phosphates. During light reaction, NADPH and ATP are produced which are called reducing power to be used in dark reaction.
- Dark reaction is light independent reaction which occurs in the stroma of the chloroplast. During this,  $\text{CO}_2$  is reduced to produce glucose molecule through series of biochemical reactions called Calvin cycle.
- There are certain factors which affect the rate of photosynthesis. The external factors include intensity, quality and duration of light,  $\text{CO}_2$  concentration, temperature, water availability. The internal factors affecting photosynthesis are chlorophyll content,  $\text{CO}_2$  concentration in leaf tissue, age of leaf, accumulation of end products and conditions of protoplasm.
- Glucose is the end product of photosynthesis which forms sucrose. It gets translocated in different parts of the plant to be used as source of energy. Excess sucrose and glucose get polymerised from starch.
- Leaves of plants get modified to perform photosynthesis. These adaptations are increased number of stomata to facilitate  $\text{CO}_2$  availability, arrangement of more chloroplast on the light falling surfaces of leaves, larger surface area of leaves. Thin leaf structure allows all raw materials available in leaf to perform photosynthesis.
- Photosynthesis is important biological process which provides food to most of the organisms.
- Carbon cycle plays important role as a source of  $\text{CO}_2$  in photosynthesis. The amount of  $\text{CO}_2$  present in the atmosphere is the source of  $\text{CO}_2$  for plants.

# EXAM PRACTICE

## Multiple Choice Questions

1. The site of photosynthesis process in plants is  
 (a) ribosomes (b) chloroplasts  
 (c) pyrenoids (d) nucleus

Ans. (b)

2. Stroma is the ground substance in  
 (a) ribosomes (b) cytoplasm  
 (c) chloroplast (d) vacuoles

Ans. (c)

3. The main photosynthetic pigment is  
 (a) chlorophyll-*a* (b) carotene  
 (c) chlorophyll-*b* (d) xanthophyll

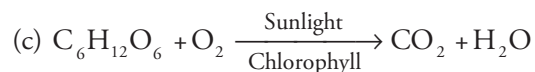
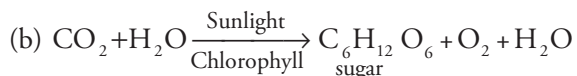
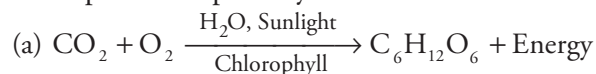
Ans. (a)

4. During the process of photosynthesis, the oxygen in glucose comes from  
 (a) CO<sub>2</sub> (b) water  
 (c) Both (a) and (b) (d) atmosphere

Ans. (b)

5. Green plants absorb solar energy and convert simple inorganic raw materials like carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) into food. This process is known as photosynthesis.

Which of the following reactions illustrates the above process of photosynthesis?



(d) None of the above

Ans. (b)

6. The first stable product formed during CO<sub>2</sub> fixation is  
 (a) Phosphoglyceric Acid (PGA)  
 (b) glucose  
 (c) abscisic acid  
 (d) oxygen

Ans. (a)

7. Given below are the adaptations found in leaves to favour the occurrence of photosynthesis process. Select a statement which is incorrect.

- (a) Presence of numerous stomata  
 (b) Large surface area of leaves  
 (c) Increased chloroplasts on lower surface  
 (d) The thinness of leaves

Ans. (c)

8. A destarched plant is one whose  
 (a) leaves are free from chlorophyll  
 (b) aerial parts are free from starch  
 (c) leaves are free from starch  
 (d) plant is free from starch

Ans. (c)

9. Choose the correct answer from the four options given below in the statement.

A plant is kept in a dark cupboard for about 48 hours before conducting any experiment on photosynthesis to

[2013]

- (a) remove chlorophyll from the leaves  
 (b) remove starch from the plant  
 (c) ensure that no photosynthesis occurs  
 (d) ensure that the leaves are free from starch

Ans. (b)

10. Arrange the given steps of the experiment showing that light is necessary for photosynthesis in a sequence.

- (i) Treat with iodine.  
 (ii) Fasten the leaf with two strips of black paper.  
 (iii) Place the plant in sunlight for 8 hours.  
 (iv) Destarch the plant.

Choose the correct option.

- (a) (i), (ii), (iii) and (iv)  
 (b) (iii), (iv), (i) and (ii)  
 (c) (ii), (iii), (iv) and (i)  
 (d) (iv), (ii), (iii) and (i)

Ans. (d)

11. The individual flattened stacks of membranous structures inside the chromoplasts are known as  
 (a) grana (b) stroma  
 (c) thylakoids (d) cristae [2016]

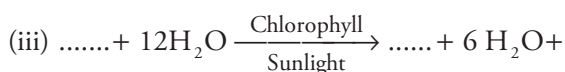
Ans. (c)

12. NADP is expanded as [2012]  
 (a) Nicotinamide Adenosine Dinucleoside Phosphate  
 (b) Nicotinamide Adenine Dinucleotide Phosphate  
 (c) Nicotinamide Adenine Dinucleolus Phosphate  
 (d) Nicotinamide Adenosine Dinucleolus Phosphate

Ans. (b)

### Fill in the Blanks

13. Complete the following sentences.  
 (i) The carbon dioxide from atmosphere enters the leaf through .....  
 (ii) In the process of photosynthesis, ..... energy is converted into ..... energy.



Ans. (i) stomata

(ii) light, chemical

(iii)  $6\text{CO}_2$ ,  $\text{C}_6\text{H}_{12}\text{O}_6$ ,  $6\text{O}_2$ .

14. Insert the word, given in the box to complete the blanks in the paragraph given below. A word can be used only once.

Photosynthesis, stroma, grana, lamellae  
 thylakoids, chlorophyll, photolysis

A chloroplast is oval in shape and is bounded by two membranes .....(i).... is the ground substance present in chloroplast. A number of disc-like covered sacs called .....(ii)..... are present arranged like stalk of coins forming a cylindrical dark green granular bodies called ...(iii)..... . These bodies are connected by .....(iv)..... .

Ans. (i) Stroma (ii) thylakoids (iii) grana (iv) lamellae

15. Complete the following paragraph by filling in the blanks (i-v) with appropriate words/terms/phrases.

To test the leaf for starch, the leaf is boiled in water to (i)..... . It is next boiled in methylated spirit to (ii) .....

The leaf is placed in warm water to soften it. It is then placed in a dish and (iii) ..... solution is added. The region which contains starch turns (iv)..... and the region which does not contain starch turns (v) ..... [2018, 11]

Ans. To test the leaf for starch, the leaf is boiled in water to (i) **kill** the cells. It is next boiled in methylated spirit to (ii) **remove chlorophyll**.

The leaf is placed in warm water to soften it. It is then placed in a dish and (iii) **iodine** solution is added.

The region which contains starch turns (iv) **blue-black** and the region which does not contain starch turns (v) **brown**.

### True-False

16. State whether the following sentences are true/false. Rewrite the statements after correcting the false term.  
 (i) Light dependent reactions of photosynthesis are observed to occur in stroma of chloroplast.  
 (ii) In a leaf, photosynthesis occurs in the spongy mesophyll cells.  
 (iii) During photophosphorylation stage, the ATP is converted into ADP.  
 (iv) The electrons used during photosynthesis come from water.  
 (v) The immediate product of photosynthesis is sucrose.  
 (vi) Dark reaction occurs in dim light or at night.  
 (vii) Photolysis is splitting of  $\text{H}_2\text{O}$  molecules into  $\text{OH}^-$  and  $\text{H}^+$ .  
 (viii) The presence of starch is verified by appearance of green-black colour.  
 (ix) The chemical substance used to test the presence of starch in leaf, is the Benedict's solution.  
 (x) Photosynthesis can take place in the absence of chlorophyll molecule.  
 (xi) Oxygen is liberated as the byproduct in photosynthesis process from  $\text{H}_2\text{O}$ , not  $\text{CO}_2$ .

Ans. (i) False. Light dependent reaction of photosynthesis are observed to occur in grana (thylakoid) of chloroplast.

(ii) False. In the leaf, photosynthesis occurs in both palisade and spongy mesophyll cells.

(iii) False. During photophosphorylation stage, the ADP adds a  $\text{P}_i$  and forms ATP.

(iv) True

- (v) False. The immediate product of photosynthesis is glucose.
- (vi) False. Photolysis is splitting of water molecule into  $H^+$  and  $O_2$ .
- (vii) True
- (viii) False. The presence of starch is verified by the appearance of blue-black colour.
- (ix) False. Iodine solution is used to test the presence of starch in leaf.
- (x) False. Photosynthesis cannot take place in the absence of chlorophyll.
- (xi) True

### Match the Columns

17. Match the following columns.

Column I	Column II
A. KOH solution	1. Leaves with green and non-green areas.
B. Variegated leaves	2. To test liberation of $O_2$ during photosynthesis.
C. <i>Hydrilla</i>	3. Presence of starch gives blue-black colour.
D. Iodine	4. Absorbs the $CO_2$ released during photosynthesis.

Ans. A – 4, B – 1, C – 2, D – 3

18. Match the following columns.

Column I	Column II
A. Oxygen and water	1. Stimulated by light
B. Glucose (sugar)	2. machinery
C. Chloroplast	3. raw materials
D. $CO_2$ and water	4. by products
E. Grana	5. end product

Ans. A – 4, B – 5, C – 2, D – 3, E – 1

### 1 Mark Questions

19. Name the cell organelle responsible for photosynthesis. [2009]  
 Ans. Chloroplast is the cell organelle responsible for the photosynthesis.
20. State the exact location of chloroplasts. [2013]  
 Ans. Chloroplasts are mainly found in the mesophyll cells located between the upper and lower epidermis of the leaves.

21. Name the structural and functional unit of chloroplast.

Ans. Quantasomes.

22. Does moonlight support photosynthesis? Find out.

Ans. The intensity of moonlight is several thousands times less than that of direct sunlight. It is insufficient for the light-dependent phase of photosynthesis. So it does not support photosynthesis. [ $\frac{1}{2} \times 2$ ]

23. Name any two plants that do not perform photosynthesis.

Ans. *Cuscuta* and Mushroom. [ $\frac{1}{2} \times 2$ ]

24. Under which colour, the rate of photosynthesis is minimum?

Ans. Green

25. Complete the following process to show how the oxygen in the air reaches a mesophyll cell of the leaf. Oxygen in air  $\longrightarrow$   $\xrightarrow{1}$   $\longrightarrow$   $\xrightarrow{2}$  mesophyll cell. [2004]

Ans. 1-stoma, 2- substomatal space

26. State the role of chlorophyll.

Ans. Chlorophyll absorbs photons of sunlight and helps in the splitting of water molecules into hydrogen ions and hydroxyl ions.

27. State the main function of thylakoids. [2012]

Ans. The function of thylakoid is to trap the light energy and to transform this energy into chemical energy form, i.e. ATP and NADPH to be used in dark reactions.

28. Differentiate stroma and grana.

Ans. Stroma

(i) Site of dark reaction.

(ii) Non-green granular matrix.

Grana

(i) Site of light reaction.

(ii) Green flattened sac-like structures.

29. State the main function of guard cells. [2016]

Ans. They regulate the opening and closing of stomata.

30. Differentiate between the following pair on the basis of what is indicated in brackets.

ATP and AIDS (expand the abbreviations) [2018]

Ans. ATP stands for Adenosine Triphosphate. AIDS stands for Acquired Immuno Deficiency Syndrome.

- 31.** Give one example of the following  
Aquatic plant used in the lab to demonstrate  $O_2$  liberation during photosynthesis [2014]

**Ans.** *Hydrilla* is an aquatic plant used in the lab to demonstrate  $O_2$  liberation during photosynthesis.

- 32.** You want to study the effect of the absence of chlorophyll in leaves on photosynthesis.  
(i) What will be the aim of your experiment?  
(ii) Name the plant you will select for this experiment.

**Ans.** (i) To show that chlorophyll is necessary for photosynthesis.  
(ii) Plant with variegated leaves like coleus. [ $\frac{1}{2} \times 2$ ]

- 33.** The statement given below is incorrect, rewrite the correct statement by changing the underlined words of the statement.

The solvent used to dissolve the chlorophyll pigments while testing a leaf for starch is soda lime.

[2017]

**Ans.** The solvent used to dissolved the chlorophyll pigments while testing leaf for starch is alcohol or methylated spirit.

## b 2 Marks Questions

- 34.** Differentiate between the following pairs on the basis of what is mentioned in bracket.  
(i) Stoma and stroma (describe its structure)  
(ii) NADP and ATP (expand the abbreviation) [2017]

**Ans.** (i) Difference between stoma and stroma is as follows

Stoma	Stroma
Stoma is the opening of the stomata <i>via</i> which transpired water and respiratory gases pass through.	Stroma is the part/region in the chloroplast (matrix), where dark reaction of the photosynthesis takes place.

(ii) Difference between NADP and ATP is as follows

NADP	ATP
Nicotinamide Adenine Dinucleotide Phosphate	Adenosine Triphosphate

[1 × 2]

- 35.** (i) Differentiate between the following pair on the basis of what is mentioned in bracket.  
Photolysis and photophosphorylation (definition). [2013]

(ii) Name the raw material from which  $O_2$  evolves during photosynthesis.

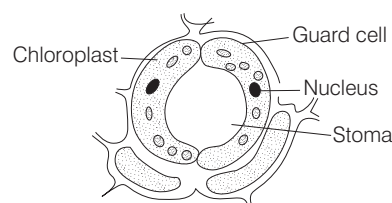
**Ans.** (i) The difference between photolysis and photophosphorylation is given below

Photolysis	Photophosphorylation
It is a process of splitting of water molecule into $2H^+ + 4e^- + \frac{1}{2}O_2$ in the presence of sunlight by activated photosynthetic pigments.	It is a process of formation of ATP from ADP and inorganic phosphate by the utilisation of energy released by electrons emitted during photolysis of water.

(ii)  $H_2O$ . [1 × 2]

- 36.** Draw a simple labelled diagram of a stomatal apparatus as seen in surface view.

**Ans.**



- 37.** Give reasons for the following  
(i) Light reaction is called the photochemical phase.  
(ii) Dark reaction is called the biosynthetic phase

**Ans.** (i) Light reaction involves the light from sun, which initiates a series of chemical reactions in the thylakoids of chloroplast.

(ii) In dark reaction, stepwise synthesis of glucose occurs using certain enzymes. It is a light independent reaction. [1 × 2]

- 38.** What conditions enable RuBisCO to function as an oxygenase? Explain the ensuring process.

**Ans.** Carboxylation is the most crucial step of the Calvin cycle, where  $CO_2$  is utilised for the carboxylation of RuBP. This reaction is catalysed by the enzyme RuBP carboxylase which results in the formation of 2 molecules of 3PGA. Since, this enzyme also has an oxygenation activity, it would be more correct to call it RuBP carboxylase-oxygenase or RuBisCO.

- 39.** Why is sleeping under a tree at night, not advisable? [2010]

**Ans.** Sleeping under a tree at night is not advisable because plants respire at night due to which the atmosphere surrounding the tree is rich in  $CO_2$ , which is harmful to us.

- 40.** Account for the statement given below, briefly.  
Animals owe their existence to chlorophyll. [2008]

**Ans.** Animals owe their existence to chlorophyll, because plant with chlorophyll produces food, which in turn is used by all living organisms for their existence.

**c 3 Marks Questions**

**41.** Explain the mechanism of opening and closing of stomata.

**Ans.** Opening and closing of stomata is controlled by turgor changes in the guard cells. The inner concave walls of the guard cells are thick than their outer walls. Due to absorption of water, the guard cells become turgid. Their inner walls are pulled apart by their outer wall. The gap between the guard cells becomes wider and stomata open. When guard cells are flaccid due to loss of water, the outer walls are not stretched, their inner walls are not pulled apart decreasing the gap between the guard cells. Thus, the stomata close.

**42.** Suppose there were plants that had a high concentration of chlorophyll-*b* lacked chlorophyll-*a*, would it carry out photosynthesis? Also mention why do plants have chlorophyll-*b* and other accessory pigments?

**Ans.** Chlorophyll is the major pigment responsible for trapping light. Other thylakoid pigments like chlorophyll-*b*, xanthophylls and carotenoids, which are called accessory pigments, also absorb light and transfer the energy to chlorophyll-*a*. Indeed, they not only enable a wider range of wavelength of incoming light to be utilised for photosynthesis, but also, protect chlorophyll-*a* from photooxidation.

**43.** Explain briefly.

- Respiration is said to be the reversal of photosynthesis.
- Mention any two adaptations of plants for photosynthesis.
- Name the place where dark reactions occur.

**Ans.** (i) Respiration is a catabolic process while photosynthesis is an anabolic process. During respiration,  $O_2$  is taken and  $CO_2$  is given out while during photosynthesis,  $CO_2$  is taken and  $O_2$  is given out.

- (a) Large surface area of the leaves.
- (b) Presence of chloroplasts.
- Dark reactions occur in stroma of chloroplast.

[1 × 3]

**44.** If you are planning an experiment to show the effect of light on photosynthesis, then

- Will you select white light or green light? Justify your answer.
- Why would you select a destarched plant?

[2007]

**Ans.** (i) We select white light for photosynthesis but not green, because chlorophyll does not absorb all of white light but it does absorb most of it, other than the green. Photosynthesis does not occur in green light because chloroplasts (contain chlorophyll) absorb light in red and in blue part of spectra and reflect green light. [1½]

- We will select a destarched plant, because destarching ensures that any starch present after the experiment has been formed under experimental conditions. [1½]

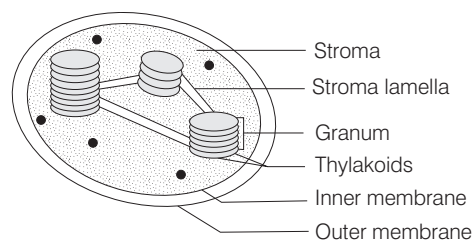
**45.** Name the end products of light reaction of photosynthesis. Mention the fate of each of them.

**Ans.** ATP, NADPH and oxygen are the products of light reaction. ATP and NADPH are used in the reduction step of biosynthetic phase of photosynthesis. Oxygen is liberated into the atmosphere.

**d 4 Marks Questions**

**46.** Explain the structure of chloroplast.

**Ans. Structure of chloroplast** A chloroplast is oval in shape. It is bound by two membranes. The ground substance present in chloroplast is stroma. There are disc-like closed sacs present, that are called thylakoids. Many thylakoids are placed one above the other like a stack of coins, that are called as granum. Extending throughout the stroma a system of membranes is present that is called as lamellae. These are joined to the thylakoids.



**47.** Name the following

- The primary acceptor of atmospheric  $CO_2$  in dark reaction.
- The photosynthetically active wavelength.
- The site of light reaction in the cells of a leaf.
- Carbohydrates in plants are stored in this form.

**Ans.** (i) RuBP  
(ii) 400-700nm  
(iii) Grana (thylakoid)  
(iv) Glucose

[1 × 4]

**48.** Answer the following questions.

- It is said that the work being carried out is divided in the chloroplast. Can you justify this division of labour in the chloroplasts.
- How are the different pigments involved in the process of photosynthesis?

**Ans.** (i) Division of labour appears clearly in the chloroplast, i.e. the membrane system is responsible for the synthesis of ATP and NADH. The dark reactions, i.e. reduction of  $\text{CO}_2$  into carbohydrates and formation of sugar occur in the stroma of chloroplasts, where enzymes are present. [2]

(ii) Various pigments are involved in photosynthesis like chlorophyll-*a* which acts as a chief pigment in photosynthesis and other pigments like chlorophyll-*b*, xanthophyll and carotenoids absorb light and transfer energy to chlorophyll-*a*. These pigments other than chlorophyll-*a* are called accessory pigments, which enable a wider range of wavelength of incoming light to be utilised for photosynthesis. [2]

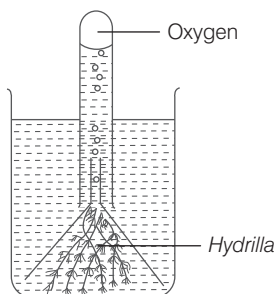
**49.** Six turns of Calvin cycle are required to generate one molecule of glucose. Explain.

**Ans.** Calvin cycle is a series of reactions that lead to the formation of glucose. The steps involve utilisation of 2 molecules of ATP for phosphorylation and molecules of NADPH for reduction per  $\text{CO}_2$  molecule fixed. The fixation of 6 molecules of  $\text{CO}_2$  and six turns of the cycle are required for the removal of one molecule of glucose from the pathway.

Hence, for every  $\text{CO}_2$  molecule entering the Calvin cycle, 3 molecules of ATP and 2 molecules of NADPH are required. It is probably to meet this difference in number of ATP and NADPH, used in the dark reaction for the cyclic phosphorylation takes place. So, to make one molecule of glucose, six turns of the cycle are required.

**50.** Describe an experiment that green plants release oxygen during photosynthesis.

**Ans.** Place some *Hydrilla* plants in a beaker containing water and cover them by a short stemmed funnel. Invert a test tube containing water over the stem of the funnel. Keep the apparatus in the sunlight. After some time bubbles of a gas will collect in the test tube. Introduce a glowing splinter into the test tube. It bursts into flame showing the presence of oxygen.



## e 5 Marks Questions

- 51.** (i) Write the summary of dark reaction by an equation.  
 (ii) In which process, ATP is formed?  
 (iii) How do the raw materials reach the plant cell?

**Ans.** (i)  $6\text{CO}_2 + 12\text{NADPH} + 18\text{ATP} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 12\text{NADP} + 18\text{ADP} + 18\text{Pi} + 6\text{H}_2\text{O}$  [2]

(ii) In photophosphorylation,  
 $\text{ADP} + \text{Pi} \longrightarrow \text{ATP}$  [1]

(iii) Water enters the leaf through midrib and veins from stem and roots.  $\text{CO}_2$  enters through stomata from the atmosphere. [2]

**52.** Briefly explain the answers to the questions, given below.

- Explain the significance of photosynthesis for animals.
- A plant should not be exposed to green light for long.
- Expand the biological abbreviation -RuBP.

**Ans.** (i) The food in the form of starch is stored by plants in different parts of the plant like fruits, grains and leaves, etc. As heterotrophs, all the animals depend on these plant products directly or indirectly. Hence, the photosynthesis in plants is very important for the sustenance of life on earth. [2]

(ii) The green light cannot be absorbed by plants properly and photosynthesis is inhibited in this light, so if plants get long exposure of green light, it may get starved and died. [2]

(iii) RuBP-Ribulose Bisphosphate [1]

**53.** A healthy Croton plant bearing variegated leaves was kept in a dark cupboard to destarch it, after which it was placed in sunlight for a few hours. One of the leaves was then plucked and an outline of the leaf marking the green and the non-green regions was drawn.

The leaf was then tested for starch. Using the above information, answer the following questions.

- State the aim of the above experiment.
- Name the chemical used for testing the presence of starch.
- Why is the leaf boiled in water and alcohol before testing for the presence of starch?

(iv) What change is seen on the leaf after the starch test?

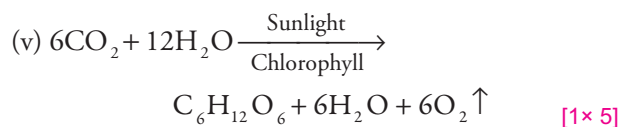
(v) Give the chemical equation to represent the process of starch formation in plants.

**Ans.** (i) The aim of the experiment is to prove that chlorophyll is necessary for photosynthesis.

(ii) Chemical used for testing the presence of starch is iodine solution.

(iii) Leaf is boiled in water to kill the cells and boiled in alcohol to remove chlorophyll.

(iv) The green parts of the leaf turned blue-black, while non-green parts turned brown.



**54.** Enumerate the steps involved in testing a green leaf for the presence of starch. [2005]

**Ans.** For doing starch test, following steps are done

(i) Pluck the leaf and boil it in water for a minute, so that all the cells can be killed.

(ii) Remove the leaf from water and boil it into alcohol to remove its chlorophyll. This will make leaf little hard and brittle.

(iii) Place the same leaf in boiled water again to make it soft.

(iv) Spread the leaf in a tray and add few drops of iodine solution to the boiled leaf.

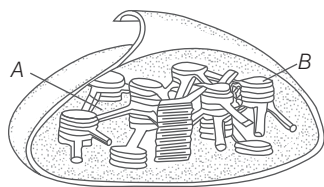
(v) If the blue-black colour is observed on the leaf, it indicates the presence of starch. If the leaf turns brown in colour it shows the absence of starch.

### Diagram Based Questions

**55.** The given diagram is a diagrammatic representation of the internal structure of an organelle, found in a plant cell. Study the same and then answer the questions that follows

(i) Identify the organelle.

(ii) Name the physiological process occurring in this organelle.



(iii) Mention one way, in which this process is beneficial to man.

(iv) Name the phases of the process occurring in the part labelled 'A' and 'B'.

(v) A chemical substance  $\text{NADP}^+$  plays an active part in one of the phases. Give the expanded form of  $\text{NADP}^+$  and state its role in the above process.

(vi) Represent the physiological process mentioned in (ii) above in the form of a chemical equation.

[2008]

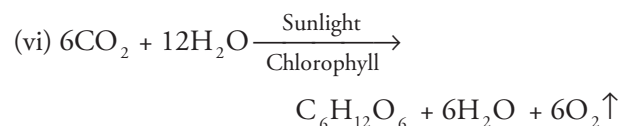
**Ans.** (i) The organelle shown in the diagram is chloroplast.

(ii) The process of photosynthesis occurs in the chloroplast.

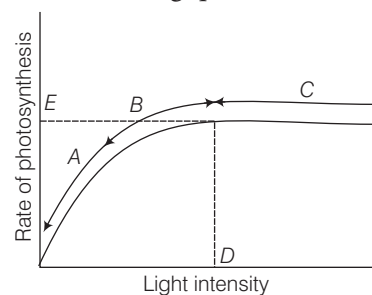
(iii) Photosynthesis gives food and the life saving gas, i.e. oxygen.

(iv) Phases of the process occur in parts labelled are  
Part A – Dark reaction  
Part B – Light reaction.

(v) Nicotinamide Adenine Dinucleotide Phosphate ( $\text{NADP}^+$ ). It picks up hydrogen ion  $[\text{H}^+]$  during photolysis of water in light reaction.



**56.** The following figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following questions



(i) At which point/s (A, B or C) in the curve, light acts as a limiting factor?

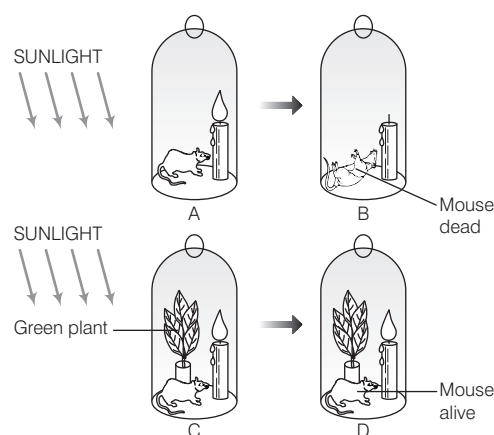
(ii) What could be the limiting factor/s in region A?

(iii) What do C and D represent on the curve?

**Ans.** (i) At points B and C of the curve, the rate did not increase with an increase in its concentration, because light becomes a limiting factor under these conditions.

- (ii) In *A* region, the rate of photosynthesis shows proportionate increase up to a certain  $\text{CO}_2$  concentration. Beyond it the rate again becomes constant.
- (iii) Points *C* and *D* represent that if the light intensity gets doubled,  $\text{CO}_2$  concentration again becomes limiting factor beyond this concentration.

57.

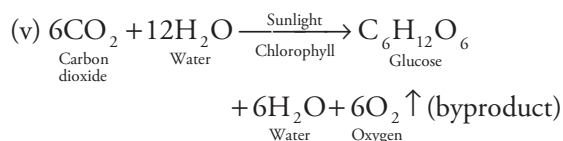


The given diagrams represent the relationship between a mouse and a physiological process that occurs in green plants. Study the diagrams and answer the questions that follows

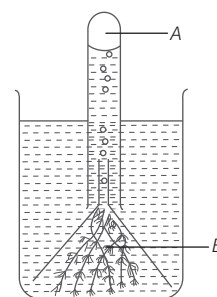
- Name the physiological process occurring in the green plant that has kept the mouse alive.
- Explain the physiological process mentioned above.
- Why did the mouse die in bell jar B?
- What is the significance of the process as stated in (i) for life on earth?
- Represent the above mentioned physiological process in the form of a chemical equation. [2017]

- Ans.**
- Photosynthesis, occurring in the green plant, has kept the mouse alive.
  - Photosynthesis is the process by which plants, some bacteria and some protists use energy from sunlight to produce sugar in the presence of  $\text{CO}_2$  and water with the help of chlorophyll.
  - The oxygen present in the bell jar B was utilised in the burning of candle. Therefore, in the absence of  $\text{O}_2$  mouse died.
  - Photosynthesis is important for supporting life on earth in the following ways
    - It provides food to all organisms through food chain.

- It gives off  $\text{O}_2$  which acts as a life supporting gas.
- It helps in maintaining the balanced level of  $\text{O}_2$  and  $\text{CO}_2$  in the atmosphere.



58. The following diagram demonstrates a physiological process taking place in green plants. The whole set-up was placed in bright sunlight for several hours.

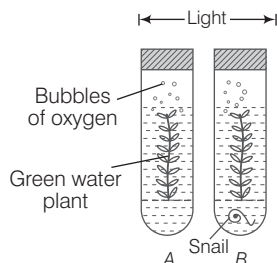


Study the diagram and answer the questions that follows

- What aspect of the physiological process is being examined?
- Explain the physiological process mentioned in (i) above.
- Label the parts *A* and *B* in the diagram.
- Write a well-balanced chemical equation for the physiological process explained in (ii) above.
- What would happen to the rate of bubbling of the gas if a pinch of sodium bicarbonate is added to the water in the beaker? Explain your answer. [2016]

- Ans.**
- Release of  $\text{O}_2$  in photosynthesis.
  - It is the manufacturing of sugar (glucose) and oxygen by plants in the presence of sunlight with the help of chlorophyll,  $\text{H}_2\text{O}$  and  $\text{CO}_2$ .
  - A*—Oxygen in test tube.  
*B*—Green plant *Hydrilla*.
  - $$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$$
  - Addition of  $\text{NaHCO}_3$  will increase the rate of photosynthesis because of increase in  $\text{CO}_2$  available in water.

- 59.** The diagram below shows two test tubes *A* and *B*. Test tube *A* contains a green water plant. Test tube *B* contains both a green water plant and a snail. Both Test tubes are kept in sunlight. Answer the questions that follows

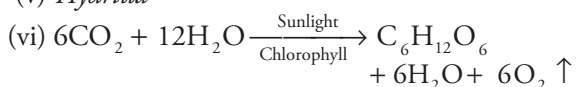


- Name the physiological process that releases the bubbles of oxygen.
- Explain the physiological process as mentioned above in (i).
- What is the purpose of keeping a snail in test tube *B*?
- Why does test tube *B* have more bubbles of oxygen?
- Give an example of a water plant that can be used in the above experiment.
- Write the overall chemical equation for the above process. [2015]

**Ans.** (i) Photosynthesis

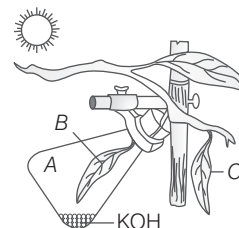
- It is a physiological process by which chlorophyll bearing cells of the plant prepare glucose in the presence of sunlight using  $\text{CO}_2$  and water.  $\text{O}_2$  is released as byproduct during the process.
- Snail while respiring releases carbon dioxide which acts as a precursor for green plant for the process of photosynthesis.
- Test tube *B* have more bubbles of oxygen because the snail which respiring releases carbon dioxide which is used by green plant for the process of photosynthesis and thus due to high rate of photosynthesis, the formation of oxygen will occur more.

(v) *Hydrilla*



- 60.** The figure given below represents an experiment to demonstrate a particular aspect of photosynthesis. The alphabet 'A' represents a certain condition inside the flask. Observe the

diagram and then answer the following questions.



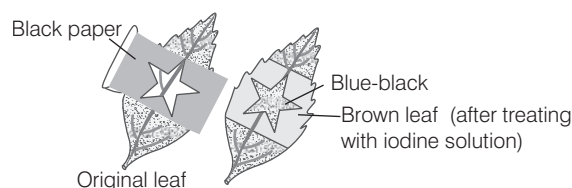
- What is the aim of the experiment ?
- What happens to the leaf when tested with iodine?
- Which chemical can be used as an alternative of KOH?
- What happens to the leaf *A* and leaf *C* at the end of the starch test? [2013]

- Ans.** (i) The aim of experiment is to show that  $\text{CO}_2$  is necessary for photosynthesis.
- The leaf inside the flask does not give blue-black colour when tested with iodine.
  - $\text{NaOH}$  (sodium hydroxide) can be used as an alternative of KOH.
  - Leaf *B* does not turned blue-black, while leaf *C* turned blue-black at the end of the starch test.

- 61.** A student wants to verify that presence of sunlight is essential for photosynthesis. How will he proceed with his experiment? Write the steps and make a well-labelled diagram for this set-up?

**Ans.** The steps taken by the student to proceed with his experiment are as follows

- Take a potted plant and destarch it for 48 hours.
- Cover one of the leaf with black paper (with a star design being cut).



- Keep the pot under the sunlight.
- Remove it after 1 hour and test the covered leaf for the presence of starch by pouring iodine solution on it. It will be observed that uncovered leaves and the part of the leaf, which was able to get light through the cut design will turn into blue-black colour, which indicates the presence of

starch. The portion which was covered with black paper will turn brown colour (showing absence of starch). This experiment thus, proves that the light is an essential requirement for the process of photosynthesis to take place.

- 62.** A potted plant was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hrs. One of the leaves was covered with black paper in the centre. The potted plant was then placed in sunlight for a few hours.

- What aspect of photosynthesis was being tested ?
- Why was the plant placed in the dark before beginning the experiment ?
- During the starch test why was the leaf
  - boiled in water?
  - boiled in methylated spirit ?
- Write a balanced chemical equation to represent the process of photosynthesis.
- Draw a neat diagram of a chloroplast and label its parts.

[2014]

- Ans.** (i) The aspect that is studied is that sunlight is necessary for photosynthesis.
- (ii) Plant is placed in the dark before beginning the experiment to make the leaves free from starch.
- (iii) (a) Leaf is boiled in water to kill the cells.  
(b) Leaf is boiled in methylated spirit to remove the chlorophyll.
- (iv) Refer to ans. 59 (vi).
- (v) Refer to fig. on page 83.

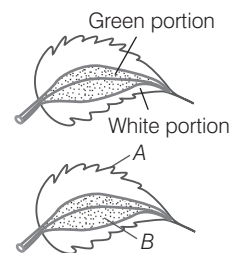
- 63.** The diagram given below is an experiment conducted to study a factor necessary for photosynthesis. Observe the diagrams and then answer the following questions

- What is the aim of the experiment ?
- Name the test performed on the leaf and the solution used for the test.
- What type of leaf was used for the experiment? Give an example.
- What is the expected result of the above test on the parts labelled *A* and *B* ?
- Give a balanced chemical equation to represent the process of photosynthesis.

[2012]

- Ans.** (i) Aim of the given experiment is to show that chlorophyll is necessary for photosynthesis.
- (ii) The test performed on leaf is starch test and the solution used is iodine solution.

- (iii) Variegated leaf/*Coleus* leaf (leaf having non-green and green regions) was used for the experiment.

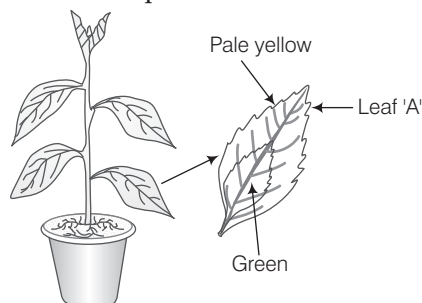


- (iv) After performing starch test  
**Part A** will turn blue-black with iodine solution.

**Part B** will turn brown with iodine solution.

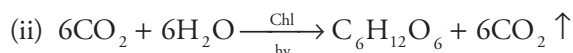
- (v) Refer to ans. 59 (vi).

- 64.** A potted plant with variegated leaves was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hours and then placed in bright sunlight for a few hours. Observe the diagrams and answer the questions



- What aspect of photosynthesis is being tested in the above diagram?
- Represent the process of photosynthesis in the form of a balanced equation.
- Why was the plant kept in the dark before beginning the experiment?
- What will be the result of the starch test performed on leaf 'A' shown in the diagram? Give an example of a plant with variegated leaves.
- Draw a neat labelled diagram of a chloroplast.

- Ans.** (i) To prove that photosynthesis can take place only in presence of chlorophyll, which is present in the green areas of the leaf.



- (iii) The plant was kept in the dark before beginning the experiment to destarch the leaves.
- (iv) When we test the leaf for starch, we observe that only the green areas of leaf will turn into blue black colour showing the presence of starch, while the non-green area will not. Examples of plant with variegated leaves are *Croton*, *coleus*, etc.
- (v) Refer to fig on page no. 83.

# CHAPTER EXERCISE

## Multiple Choice Questions

1. The function of light energy used in photosynthesis is to
  - (a) split  $\text{CO}_2$
  - (b) activate chlorophyll
  - (c) reduce  $\text{CO}_2$
  - (d) None of these
2. The first reaction of photosynthesis is
  - (a) excitation of chlorophyll
  - (b) photolysis of water
  - (c) ATP formation
  - (d)  $\text{CO}_2$  fixation
3. The process of fixation of  $\text{CO}_2$  into a stable organic intermediate occurs by
  - (a) reduction
  - (b) carboxylation
  - (c) regeneration
  - (d) isomerisation
4. Chlorophyll pigment is present in/on
  - (a) the stroma of chloroplast
  - (b) the surface of chloroplast
  - (c) the grana of chloroplast
  - (d) the lamellar membrane
5. Among the following given options, which one should not act as a limiting factor for photosynthesis?
  - (a) Chlorophyll
  - (b)  $\text{CO}_2$
  - (c) Light
  - (d) Oxygen
6. Which chemical absorbs  $\text{CO}_2$  released during the experiment 'CO<sub>2</sub> is essential for photosynthesis'?
  - (a)  $\text{CaCl}_2$
  - (b) KOH
  - (c) KCl
  - (d) NaOH
7. The covered portion of the leaf in the experiment to demonstrate necessity of light during photosynthesis, is observed to remain yellow because it
  - (a) did not receive sunlight
  - (b) lacked starch
  - (c) was destarched
  - (d) All of the above
8. In a variegated leaf like coleus, the chlorophyll pigment is present in
  - (a) green areas
  - (b) non-green area
  - (c) Both (a) and (b)
  - (d) None of these

Ans. 1. (b) 2. (a) 3. (b) 4. (a) 5. (d) 6. (b) 7. (b) 8. (a)

## Fill in the Blanks

9. Fill in the blanks
  - (i) ..... is the secondary pigment present in leaf.
  - (ii) Instead of using KOH, ..... can also be used to detect the presence of  $\text{CO}_2$  during photosynthesis.
  - (iii) The site of light reaction in the cells of a leaf is .....
  - (iv) The  $\text{CO}_2$  present in the atmosphere enters the stomata by .....
  - (v) To decolourise a leaf, it should left .....
  - (vi) Complete the following paragraph by filling the blanks.

Only the ..... portion of leaf receives the sunlight. Hence, these portions prepare ....., the presence of which can be tested by adding a few drops of ..... It will be observed that this portion turns ..... in colour.
  - (vii) When several molecules of glucose form one molecule of starch, the reaction is called .....
  - (viii) A plant that does not perform photosynthesis is .....
  - (ix) Inverted jar experiment is done to test the presence of ..... gas during photosynthesis.

## True-False

10. State whether the given statements are true or false.
  - (i) Plants form the first level of every food chain in the ecosystem, either directly or indirectly.
  - (ii) Presence of chlorophyll can be observed in variegated leaves only.
  - (iii) Destarching of a plant leaf can be done by blocking the sunlight from reaching the leaf surface using black strips.
  - (iv) Plants form glucose as food. Presence of glucose is tested during the experiments on photosynthesis.

## Match the Columns

11. Match the following columns.

Column I	Column II
A. PS-I	1. Orange coloured pigment
B. PS-II	2. Absorbs light energy of 700nm
C. Xanthophyll	3. Absorbs light energy of 680nm
D. Carotene	4. Yellow coloured pigment

## 1 Mark Questions

12. Enumerate the type of chlorophyll known as universal photosynthetic pigment. [2008]
13. Name the following
- The pigment that protects chlorophyll from photooxidation.
  - The process of formation of starch from many molecules of glucose.
14. Give the technical term.  
The process of conversion of ADP to ATP during the first phase of photosynthesis.
15. Mention any one adaptation found in plants (related to stomata) which favours the process of photosynthesis.
16. Without changing the first term, rearrange the remaining terms in logical sequence.  
Destarched plant, iodine added, washed in water, a leaf boiled in alcohol, placed in sunlight (testing the presence of starch).
17. In which experiment associated with factors essential for photosynthesis, a variegated plant has been used?
18. Identify the plant (any one) used to test the presence of chlorophyll in plants.

## 2 Marks Questions

19. Mention the name of the enzyme that catalyses the carboxylation as well as oxygenation reaction. In which cell organelle is this enzyme found?
20. Give the biological terms for following.
- Organisms unable to prepare their own food.
  - A plant with no green leaves have lack of which pigment?

21. Mention any two reasons, which prove that photosynthesis is essential for sustaining life on the earth.

## 3 Marks Questions

22. Answer the following questions.
- The chemical changes that occur during light reaction.
  - State the factors responsible for photosynthesis and the factor that acts as a limiting substrate.
23. What conditions enable RuBisCO to function as an oxygenase? Explain the ensuring process.
24. Cyclic photophosphorylation results in the production of ATPs and not NADPH. Give reasons.

## 4 Marks Questions

25. An aquarium is placed in bright sunlight, the water weeds present in it are releasing bubbles of gases.  
Now answer the following questions with reference to the above paragraph.
- Which process is taking place in the aquarium that results in bubble formation from water weeds?
  - The bubbles are gaseous, made up of which gas?
  - Give the balanced reactions, which summarise and represent this process.
26. A student wants to demonstrate that  $\text{CO}_2$  is an essential raw material required for occurrence of photosynthesis.
- Identify the aim of this experiment.
  - Enumerate all the steps required to achieve your result.
  - Apart from  $\text{CO}_2$ , what other raw materials will be required for photosynthesis?

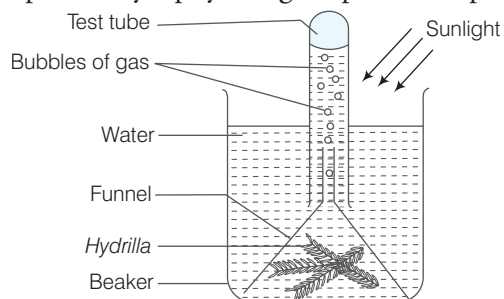
## 5 Marks Questions

27. The entire process of photosynthesis consists of a number of reactions. Where in the cell does each of these take place?
- Synthesis of ATP and NADPH .....
  - Photolysis of water .....
  - Fixation of  $\text{CO}_2$  .....
  - Synthesis of sugar molecule .....
  - Synthesis of starch .....

28. (i) Explain the opening and closing of stomata in plants.  
(ii) Draw a labelled diagram of stomata when guard cells are turgid.
29. Is it correct to say that photosynthesis occurs only in leaves of a plant? Besides leaves, what are the other parts that may be capable of carrying out photosynthesis? Justify.

### Diagram Based Questions

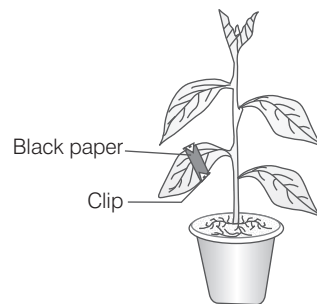
30. The figure given below represents an experimental set-up to study a physiological process in plants.



- (i) Name the physiological process being studied.  
(ii) Explain the process.

- (iii) What is the aim of the experiment?  
(iv) Give a well-balanced equation to represent the process.

31. The diagram given below represents an experiment conducted to prove the importance of a factor in photosynthesis. Study the same and then answer the questions that follows



- (i) Name the factor being studied in this experiment.  
(ii) Why was the plant kept in a dark room before conducting the experiment?  
(iii) What will be observed in the experimental leaf at the end of the starch test?  
(iv) Give a balanced chemical equation to represent the process of photosynthesis. [2009]

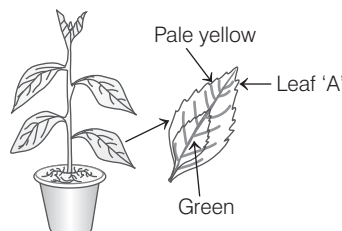
# ARCHIVES\*

## (Last 7 Years)

Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

1. Differentiate between the following pair on the basis of what is indicated in brackets.  
ATP and AIDS (expand the abbreviations) [1]
2. Complete the following paragraph by filling in the blanks (i) to (v) with appropriate words.  
To test a leaf for starch, the leaf is boiled in water to (i) ..... It is then boiled in methylated spirit to (ii) ..... The leaf is dipped in warm water to soften it. It is placed in a petri dish and (iii) ..... solution is added.  
The region of the leaf which contains starch, turns (iv) ..... and the region which does not contain starch, turns (v) ..... [5]
3. A potted plant with variegated leaves was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hours and then placed in bright sunlight for a few hours. Observe the diagram and answer the questions



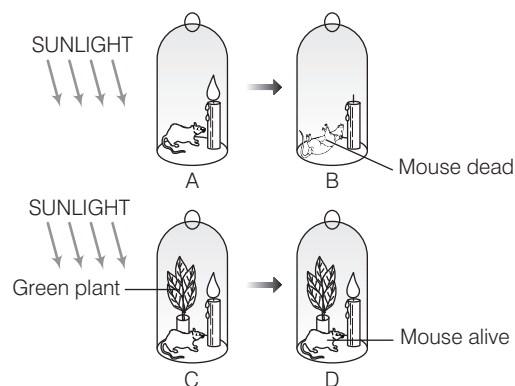
- (i) What aspect of photosynthesis is being tested in the above diagram?
- (ii) Represent the process of photosynthesis in the form of a balanced equation.
- (iii) Why was the plant kept in the dark before beginning the experiment?
- (iv) What will be the result of the starch test performed on leaf 'A' shown in the diagram? Give an example of a plant with variegated leaves.
- (v) Draw a neat labelled diagram of a chloroplast. [5]

### 2017

4. The statement given below is incorrect. Rewrite the correct statement by changing the underlined words of the statement.

The solvent used to dissolve the chlorophyll pigments while testing a leaf for starch is soda lime. [1]

5.



The given diagrams represent the relationship between a mouse and a physiological process that occurs in green plants. Study the diagrams and answer the questions that follows [5]

- (i) Name the physiological process occurring in the green plant that has kept the mouse alive.
- (ii) Explain the physiological process mentioned above.
- (iii) Why did the mouse die in bell jar B?
- (iv) What is the significance of the process as stated in (i) for life on earth?
- (v) Represent the above mentioned physiological process in the form of a chemical equation.

6. Differentiate between the following pairs on the basis of what is mentioned in bracket.

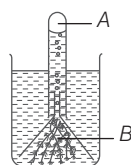
- (i) Stoma and stroma (describe its structure).
- (ii) NADP and ATP (expand the abbreviation). [2]

### 2016

7. The following diagram demonstrates a physiological process taking place in green plants. The whole set-up was placed in bright sunlight for several hours. Study the diagram and answer the questions that follows

- (i) What aspect of the physiological process is being examined?

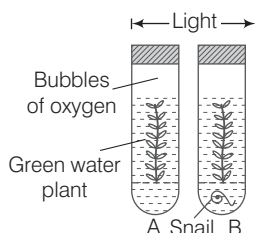
- (ii) Explain the physiological process mentioned in (i) above.
- (iii) Label the parts A and B in the diagram.
- (iv) Write a well-balanced chemical equation for the physiological process explained in (ii) above.
- (v) What would happen to the rate of bubbling of the gas if a pinch of sodium bicarbonate is added to the water in the beaker? Explain your answer. [5]



8. Choose the correct answer from the few options given below. The individual flattened stacks of membranous structures inside the chloroplasts are known as
- (a) grana (b) stroma (c) thylakoids (d) cristae [1]
9. State the main function of guard cells. [1]

## 2015

10. The diagram alongside shows two test tubes A and B. Test tube A contains a green water plant. Test tube B contains both, a green water plant and a snail. Both test tubes are kept in sunlight. Answer the questions that follow



- (i) Name the physiological process that releases the bubbles of oxygen.
- (ii) Explain the physiological process as mentioned above in (i).
- (iii) What is the purpose of keeping a snail in test tube B?
- (iv) Why does test tube B have more bubbles of oxygen?
- (v) Give an example of a water plant, that can be used in the above experiment.
- (vi) Write the overall chemical equation for the above process. [5]

## 2014

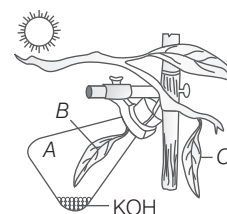
11. Name the process of conversion of ADP into ATP during photosynthesis. [1]
12. Give one example of the following  
An aquatic plant used in the lab to demonstrate  $O_2$  liberation during photosynthesis. [1]
13. A potted plant was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hours. One of the leaves was covered with black paper in the centre. The potted plant was then placed in sunlight for a few hours.
- (i) What aspect of photosynthesis was being tested?
- (ii) Why was the plant placed in the dark, before beginning the experiment?

- (iii) During the starch test, why was the leaf
- (a) boiled in water? (b) boiled in methylated spirit?
- (iv) Write a balanced chemical equation to represent the process of photosynthesis.
- (v) Draw a neat diagram of a chloroplast and label its parts. [5]

## 2013

14. State the exact location of the chloroplast. [1]
15. Differentiate between the following pair on the basis of what is mentioned in bracket.  
Photolysis and photophosphorylation. (definition) [1]
16. Expand the following biological abbreviation-NADP. [1]
17. Choose the correct answer from the four options given below in the statement. A plant is kept in a dark cupboard for about 48 hours, before conducting any experiment on photosynthesis to [1]
- (a) remove chlorophyll from the leaves
- (b) remove starch from the plant
- (c) ensure that no photosynthesis occurs
- (d) ensure that the leaves are free from starch

18. The figure given alongside represents an experiment to demonstrate a particular aspect of photosynthesis. The alphabet 'A' represents a certain condition inside the flask. Observe the diagram and then answer the following questions.



- (i) What is the aim of the experiment?
- (ii) What happens to the leaf when tested with iodine?
- (iii) Which chemical can be used as an alternative of KOH?
- (iv) What happens to the leaf A and leaf C at the end of the starch test? [5]

## 2012

19. State the main function of thylakoids. [1]
20. Differentiate between the following pair on the basis of what is mentioned in bracket.  
Stoma and stroma (describe its structure) [1]
21. NADP is expanded as [1]
- (a) Nicotinamide Adenosine Dinucleoside Phosphate
- (b) Nicotinamide Adenosine Dinucleotide Phosphate
- (c) Nicotinamide Adenosine Dinucleolus Phosphate
- (d) Nicotinamide Adenine Dinucleolus Phosphate

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

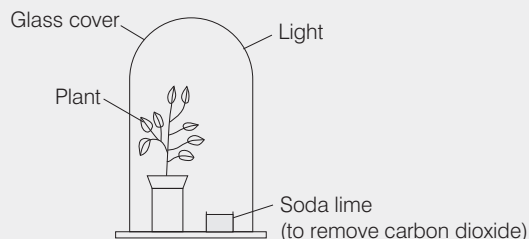
- 1 Match term in column II with suitable idea given in column I.

Column I		Column II	
A.	Grana	1.	End product
B.	Cells in leaf	2.	Light reaction
C.	Oxygen and water	3.	Mesophyll cells
D.	Sunlight	4.	Raw material
E.	CO <sub>2</sub> and water	5.	Pile of thylakoids

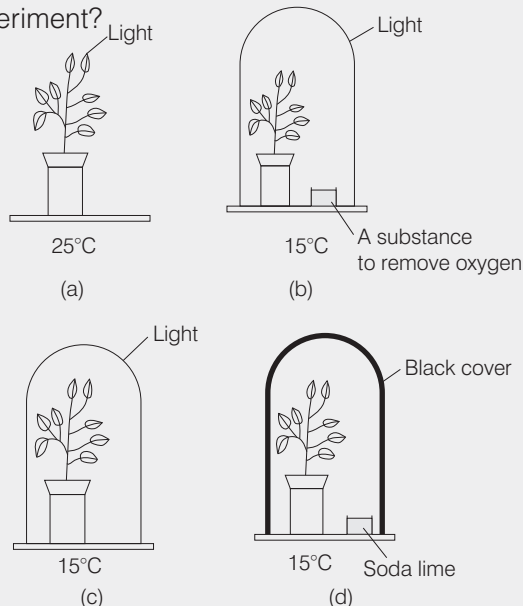
Choose the correct option.

- |       |   |   |   |   |       |   |   |   |   |
|-------|---|---|---|---|-------|---|---|---|---|
| A     | B | C | D | E | A     | B | C | D | E |
| (a) 1 | 2 | 3 | 4 | 5 | (b) 5 | 3 | 1 | 2 | 4 |
| (c) 2 | 5 | 3 | 1 | 4 | (d) 3 | 4 | 5 | 2 | 1 |

- 2 The given diagram shows an experiment to find out whether carbon dioxide is needed for photosynthesis.



Which is the most suitable control for this experiment?



- 3 Photosystem-II features are  
 (i) Absorbs 680 nm wavelength light  
 (ii) Supplies electron to cytochrome centre  
 (iii) Supplies electron to NADP<sup>+</sup>

Choose the correct statement

- (a) (i) and (iii)  
 (b) (i), (ii) and (iii)  
 (c) (i) and (ii)  
 (d) (ii) and (iii)

- 4 Find out the mismatched pair.

- (a) C<sub>4</sub>-plants – Kranz anatomy  
 (b) Primary CO<sub>2</sub> fixation product – OAA of C<sub>4</sub>-plants  
 (c) Primary CO<sub>2</sub> acceptor of C<sub>3</sub>-plants– RuBP  
 (d) Calvin pathway of C<sub>4</sub>-plants occurs in – Bundle sheath

- 5 Does dark reaction occur in dark or night?  
 Does it not require light?

- 6 Plants have several pigments that can catch light energy. Two of these are chlorophyll-a and chlorophyll-b, which harness light of different wavelengths. What advantage does a plant obtain by having molecules that act at different wavelengths?

- 7 What will happen to the rate of photosynthesis, if sodium bicarbonate is added in the water having *Hydrilla* plant in a beaker?

- 8 I. 'A' is utilised for providing energy to the plant. If it is not utilised immediately, it gets stored in the form of 'B', which acts as internal energy reserve.  
 II. In the process of photosynthesis, C is reduced to 'A'.

Consider the above statements and pick out the correct labelling for A, B, C from the options given below.

- (a) A–Protein, B–Sugar, C–Sunlight  
 (b) A–Carbohydrate, B–Protein, C–Carbon dioxide  
 (c) A–Carbohydrate, B–Starch, C–Carbon dioxide  
 (d) A–Carbohydrate, B–Starch, C–Oxygen

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Chemical Coordination in Plants

All living organisms (plants or animals) respond and react to changes that occur in their environment by showing certain movements of their body parts. These responses to external stimuli are produced by working of various organs in a systematic and controlled manner which is known as **coordination**.

For control and coordination, animals have both the nervous system and hormones. However, the plants respond to stimuli and coordinate *via* the **hormones** only.

In this chapter, we will study about plant hormones and movement in plants.

## Plant Hormones

Cells cannot continuously create and transmit electrical impulses. Thus, most multicellular organisms use another means of communication between different cells that is called the **chemical coordination**. The chemicals used in such communication are known as **hormones**.

The term hormone was first used by **William Bayliss** and **Ernest Starting** in 1902. The term **phytohormone** (for plants) was coined for distinguishing the plant hormones from the animal hormones. The hormones work as messengers (as in animals) to control and coordinate plant movements. They are produced at one location and transported across the plant body for functioning. Plants respond to production of these hormones by growth. However in certain cases, hormones also negatively affect the plant growth. In this section, we will study about major plant hormones, their discovery and their physiological functions in plants.

## Auxin

It was the first plant growth regulator to be discovered. Auxins are produced in the actively growing regions of plants, i.e. stem and root apices. From here they migrate to other sites as and when required. In plants, the first auxin was isolated from coleoptile tips of oat seedlings by **FW Went**. Auxins are indole compounds. IAA (Indole Acetic Acid) is the main natural auxin in plants.

## Chapter Objective

- Plant Hormones
- Auxin
- Gibberellins
- Cytokinin
- Ethylene
- Absciscic Acid
- Plant Movements

## Physiological Effects of Auxin

The physiological effects of auxin in plants are as follows

1. **Root initiation** Auxin inhibits the elongation of primary root. But, it can stimulate the initiation of lateral and adventitious roots. Auxins are used to induce formation of roots on stem cutting. NAA and IBA are often used for rooting.
2. **Flowering** NAA and 2, 4-D are often employed for inducing flowering in litchi and pineapple.
3. **Parthenocarp** Auxins can induce the formation of fruits without involving fertilisation, e.g. banana, tomatoes, etc.
4. **Cell elongation** It stimulates the elongation of cell in the shoot and promotes cell enlargement.
5. **Apical dominance** It is a phenomenon in which apical buds inhibit the growth of lateral buds. Apical buds accomplish this by producing auxins. It inhibits the growth of lateral buds.
6. **Cell division** Auxin initiates and promotes cell division in vascular cambium, e.g. NAA.

## Gibberellins

These were first discovered in Japan from a fungus *Gibberella fujikuroi*. This fungus causes foolish seedling disease of rice (Bakanae disease). Almost 100 types of gibberellins have been reported till now. These are denoted as  $GA_1$ ,  $GA_2$ ,  $GA_3$  and so on.  $GA_3$  ( $C_{19}H_{26}O_6$ ) is the first discovered and most studied gibberellin.

## Physiological Effects of Gibberellins

The physiological effects of gibberellins are as follows

1. **Fruit growth** Gibberellins promote growth of fruits. Like it increases length of bunches of grapes.
2. **Malting** Gibberellins ( $GA_3$ ) are used in breweries. It increases malt production in barley grains.
3. **Delayed ripening** Gibberellins cause delay in ripening of citrus fruits.
4. **Rapid maturity** Gibberellins cause quicker growth in conifers. Thus, it is used to obtain economically important seeds.
5. **Breaking seed dormancy** Gibberellin causes mobilisation of food. Due to this, seed and bud dormancy is broken.
6. **Elongation of dwarfs** Gibberellins enhance the longitudinal growth of internodes in dwarf plants.
7. **Parthenocarp** Gibberellins are considered more efficient than auxins to produce parthenocarpic fruits.

8. **Stem and leaf growth** Gibberellins can stimulate stem elongation, e.g. in sugarcane it elongates stem size.
9. **Seed germination** Gibberellins promote seed germination. They stimulate the synthesis of hydrolytic enzymes like amylases, proteases, etc.

## Cytokinin

It was discovered by **Skoog and Miller** in 1955. These are widely distributed in plants.

## Physiological Effects of Cytokinins

The physiological effects of cytokinins are as follows

1. **Flowering** Cytokinin induces flowering in plants like in *Lemna* and *Wolffia*. It is also responsible for breaking dormancy.
2. **Promotes cell division and organ formation** Cytokinins are essential for cell division.  
High auxin to cytokinin ratio favours root development. High cytokinin to auxin ratio favours shoot development.
3. **Promotes lateral-bud development in dicots** Cytokinins counter act apical dominance. They promote lateral bud formation even in the presence of apical buds.
4. **Development of chloroplast** Cytokinins promote chloroplast formation. They also increase the rate of chlorophyll formation.

## Ethylene

It is the only gaseous plant hormone. It causes fruit ripening. All parts of seed plants produce ethylene. Maximum synthesis of ethylene occurs during the ripening of fruits and tissues undergoing senescence. It is widely utilised in agriculture practices.

## Physiological Effects of Ethylene

The physiological effects of ethylene are as follows

1. **Fruit ripening** Ethylene stimulates ripening of fruits such as tomatoes, lemons, oranges, etc. It also increases the rate of respiration. It causes dehiscence of dry fruits.
2. **Abscission and senescence** It enhances abscission and senescence of leaves, fruits and flowers.
3. **Breaking dormancy** Ethylene is responsible for breaking dormancy of different plant organs, but not of lateral buds.

4. **Root and root hair initiation** Ethylene in low concentration promotes growth of roots. It can initiate root hair formation also.
5. **Flowering** Ethylene usually inhibits flowering. But in some plants (e.g. pineapple and mango), it induces flowering.

## Abscisic Acid (ABA)

It is also a growth retarding hormone. ABA is produced when a plant is exposed to stress hence, is also known as **stress hormone**.

The common stresses include lack of water, saline soils, cold temperature and frost.

## Physiological Effects of ABA

The physiological effects of ABA are as follows

1. **Induces stomatal closure** ABA causes stomata to close during stress conditions.
2. **Bud dormancy** ABA induces axillary buds to become dormant during winters.
3. **Abscission** It causes abscission in leaves, flowers and fruits.
4. **Geotropism in roots** Application of ABA on root results in geotropism.
5. ABA is applied to green-oranges. It is done to turn them yellow.
6. ABA in most cases acts in opposition to gibberellins.

### CHECK POINT 01

- 1 Which hormone is present in actively growing regions like shoot and root apex?
- 2 Name the hormones capable of inducing parthenocarpy.
- 3 The hormone synthesised in senescent leaves and flowers, germinating seeds and ripening fruits is .....
- 4 Mention any one physiological effect of ABA on plants
- 5 Stomatal closing is induced by which hormone?
- 6 Identify the hormones which inhibits growth in plants- Auxin, abscisic acid, gibberellin and cytokinin.

## Plant Movements

These are changes in the position of plants or their parts. The movements occur in response to some stimulus. Stimulus may be defined as any change in the external environment. The movement of plants is broadly classified into two main types

1. **Movement independent of growth** This type of movement does not involve growth of the plant, e.g. the 'sensitive' or 'touch-me-not' (chhui-mui) plant

(*Mimosa pudica*) shows peculiar response to touch. The leaves of this plant begin to fold up and droop in response to touch.

2. **Movement dependent on growth** This type of movement involves the growth of the plant, e.g. when a seed germinates, the root goes down, the stem comes up into the air always. If we prevent the plant from growing, it will not show any movement, e.g. tropic movements.

### Immediate Response to Stimulus

Sensitive plants give immediate response to the stimulus. Movement of part of plant occurs at a point different from the point of touch.

So, plant must communicate the information that a touch has occurred. This is done in the following manner

- (i) Plants use electrical-chemical means to convey the information from cell to cell.
- (ii) Plant cells change their shape by changing the amount of water in them, resulting in either swelling or shrinking of cell.

## Tropic Movements

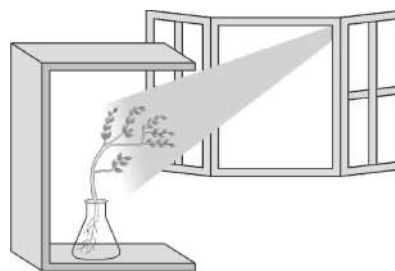
When the stimulus has a particular direction and movement of plant occurs in the direction of the stimulus (either towards the stimulus or in the opposite direction), the movement is called as **tropic movement**.

## Types of Tropic Movements

The types of tropic movements are based on environmental triggers like light, gravity of earth, water and certain chemicals.

- (i) **Phototropic movement** (stimulus- light) The movement of the plant part in response to light is called phototropic movement and the phenomenon involved is called **phototropism**.

As the shoot grows towards light, it is known as **positive phototropism** and growth of root away from the light is called **negative phototropism**, e.g. if a plant gets unilateral light, its shoot will bend in the same direction.

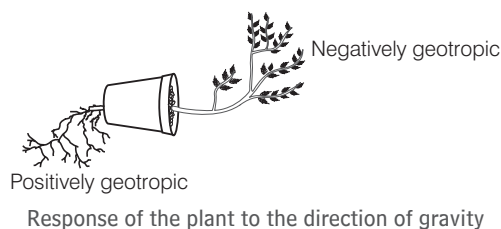


Response of the plant to the direction of light

- (ii) **Geotropic movement** (stimulus-gravity) The movement of plant part in response to gravity is called geotropic movement and the phenomenon involved is called **geotropism**.

When the tip of the stem grows away from the earth's gravitational force, it is known as **negative geotropism** and when the root tips grow towards gravity, it is known as **positive geotropism**.

Roots always move towards centre of gravity (downward). For example, when bean or gram seed sown in moist soil. After a few days the stem growing away from the force of gravity and the root growing towards the force of gravity.



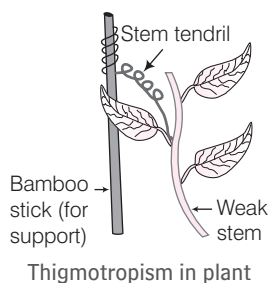
- (iii) **Hydrotropic movement** (stimulus- water) It is the growth of the plant in response to water. The phenomenon involved in this is called **hydrotropism**. When the plant grows towards the source of water (moisture), the movement is **positively hydrotropic** (e.g. root). This ensures the availability of water to roots.

When the plant grows away from the source of water (moisture), it is known as **negatively hydrotropic** (e.g. shoot). For example, during seed germination, the roots grow towards the moist soil (upwards) where water is abundantly present.

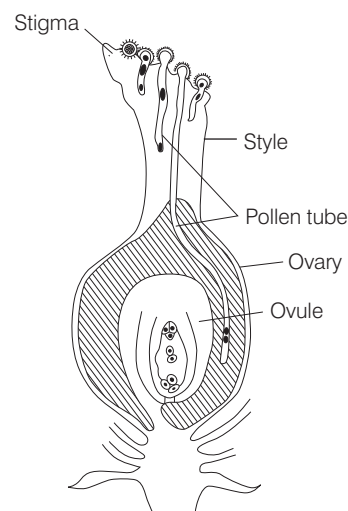
- (iv) **Thigmotropic movement** (stimulus-touch) In thigmotropism, the growth or movement of plants occurs in response to touch.

For example, the tendrils of plants like sweet pea, grapes, *Cuscuta* are sensitive to touch. When these tendrils come in contact with any support, the part of tendril in contact with the object does not grow as rapidly as

other parts of the plant. The tendrils then start to circle around the object, and cling to the available support.



- (v) **Chemotropic movement** (stimulus-chemical) The growth of the plant in response to a chemical stimulus and the phenomenon involved is called **chemotropism**, e.g. growth of pollen tube towards ovules during fertilisation.



Chemotropism in plant tube

## Nastic Movements

In nastic movement, the direction of response to stimuli has **no fixed direction**. Stimuli has diffused impact due to which the movement of plants occurs irrespective of the direction of the stimuli. In this condition, the whole plant gets affected and shows movement.

## Types of Nastic Movements

These are **photonasty** (stimulus - light), **thigmonasty** (stimulus- contact of insect), **thermonasty** (stimulus - change in temperature) and **seismonasty** (stimulus - touch).

## CHECK POINT 02

- 1 The roots of a plant show what kind of tropism in response to light?
- 2 When the tip of stems grows away from the earth's gravitational force, it is identified as ..... movement.
- 3 Identify the stimulus in the following movements  
(i) Phototropism (ii) Geotropism
- 4 Negative hydrotropism is shown by which part of a plant?
- 5 Identify the movement which is common in plants like pea, pumpkin and cucumber?

# SUMMARY

- In plants, control and coordination is carried out by chemical substances called hormones (phytohormones).
- Plant hormones are the chemical substances naturally produced in plants for regulation of growth and development, responses, etc.
- Growth promoters are chemical substances that perform growth promoting activities like cell enlargement, cell division, seed formation, flowering and fruiting, etc.
- Auxins are indole derivatives. They help in cell elongation and division, parthenocarpy, etc.
- Gibberellins help in stems and flower growth breaking dormancy, etc.
- Cytokinins promote cell division development of shoots and delay ageing of leaves.
- Growth inhibitors that perform growth inhibiting activities like dormancy and abscission.
- Absciscic acid inhibits growth, promotes senescence, induces stomatal closure, etc.
- Ethylene is a gaseous, fruit ripening hormone.
- Plant movements occur in response to a stimuli, can be of two types, i.e. tropic or nastic.
- Tropic movements The movement of plant occurs in the direction of stimulus, e.g. phototropism, geotropism, hydrotropism, chemotropism and thigmotropism.
- Phototropism is growth, movement of plant in response to light.
- Geotropism is growth movement of plants in response to the force exerted by the earth (gravity).
- Hydrotropism is the movement of plant parts towards the source of water.
- Thigmotropism is the movement of plant parts in response to touch.
- Chemotropism is the movement of plant parts in response to chemical substances.

# EXAM PRACTICE

## Multiple Choice Questions

1. Which of the following is a plant hormone?  
 (a) Adrenaline (b) Cytokinin  
 (c) Glucagon (d) Oxytocin

**Ans.** (b)

2. Plant hormones, which promote growth are  
 (a) gibberellins and ethylene  
 (b) auxin and ethylene  
 (c) auxin, cytokinin and gibberellins  
 (d) cytokinin and abscisic acid

**Ans.** (c)

3. Auxin inhibits the growth of  
 (a) apical buds  
 (b) lateral axillary buds  
 (c) root on stem cuttings  
 (d) parthenocarpic development of fruits

**Ans.** (b)

4. The plant hormone used to speed up the malting process in brewing industry is  
 (a) GA<sub>3</sub> (b) ethylene  
 (c) auxin (d) cytokinin

**Ans.** (a)

5. A plant hormone responsible for inducing morphogenesis during plant tissue culture is  
 (a) ethylene  
 (b) gibberellin  
 (c) cytokinin  
 (d) abscisic acid

**Ans.** (c)

6. High auxin to cytokinin ratio favours the  
 (a) root development  
 (b) shoot development  
 (c) formation of undifferentiated cells  
 (d) None of the above

**Ans.** (a)

7. The plant hormone triggering the fall of mature leaves and fruits from plants is  
 (a) auxin (b) gibberellin  
 (c) abscisic acid (d) kinetin

**Ans.** (c)

8. The stress hormone is  
 (a) auxin (b) cytokinin  
 (c) ethylene (d) abscisic acid

**Ans.** (d)

9. Both ethylene and ABA are responsible for  
 (a) promoting abscission of leaves and fruits  
 (b) inducing dormancy of seeds  
 (c) stimulation of apical dominance  
 (d) ripening of fruits

**Ans.** (a)

10. A plant's response to light is known as  
 (a) geotropism (b) hydrotropism  
 (c) photonasty (d) phototropism

**Ans.** (d)

11. Which one of the following plant hormones is responsible for phototropism in plants?  
 (a) Cytokinin (b) Gibberellins  
 (c) Ethylene (d) Auxin

**Ans.** (d)

12. The roots of a plant are  
 (a) positively phototropic but negatively geotropic  
 (b) positively geotropic but negatively phototropic  
 (c) negatively hydrotropic but positively phototropic  
 (d) positively phototropic but negatively geotropic

**Ans.** (b)

13. When roots of a plant always move towards water, even if it means going against the pull of gravity. This indicates  
 (a) geotropism  
 (b) negative geotropism  
 (c) hydrotropism  
 (d) positive geotropism

**Ans.** (c)

14. The climbing organs of plants like tendrils grow towards any support which they come in contact of and wind around them for support. This is an example of  
 (a) thigmotropism (b) nastic movements  
 (c) geotropism (d) chemotropism

**Ans.** (a)

15. Which of the following are not tropism?
- Growth of pollen tube towards sugary substance
  - Folding up of the leaves of *Mimosa pudica* when touched
  - Twining of tendrils around a support in response to touch
  - None of the above

Ans. (b)

### Fill in the Blanks

16. (i) A naturally occurring auxin in plants is .....  
 (ii) ..... helps in breaking the seed and bud dormancy.  
 (iii) High ..... ratio promotes shoot development.  
 (iv) Ethylene is a ..... plant hormone causing fruit ripening.  
 (v) Stomatal closure is induced by ..... hormone.  
 (vi) The stem and the leaves of a plant are .....  
 (vii) A root of plant grows downward, this is called .....  
 (viii) When the stimulus responsible for plant movement is a chemical, it is known as .....

- Ans. (i) IAA  
 (ii) Gibberellins  
 (iii) cytokinin  
 (iv) gaseous  
 (v) ABA  
 (vi) positively phototropic  
 (vii) positive geotropism  
 (viii) chemotropism

### True-False

17. (i) Ascorbic acid is a naturally occurring plant hormone.  
 (ii) The seed dormancy is due to abscisic acid.  
 (iii) The bending of plant stem towards light is caused by cytokinin hormone.  
 (iv) The roots are negatively hydrotropic, when they move against the pull of gravity towards water source.  
 (v) The stimulus in thigmotropism is touch.

- Ans. (i) False  
 (ii) True  
 (iii) False  
 (iv) False  
 (v) True

### Match the Columns

18. Match the following columns.

Column I	Column II
A. IAA	1. Elongation of dwarfs
B. Cytokinin	2. Flowering in pineapple
C. Gibberellic acid	3. Cell division
D. Ethylene	4. Cell wall elongation

Ans. A-4, B-3, C-1, D-2

19. Match the following columns.

Column I	Column II
A. Light	1. Thigmotropism
B. Touch	2. Phototropism
C. Gravity	3. Thigmonasty
D. Sugar	4. Geotropism
	5. Chemotropism

Ans. A-2, B-1, C-4, D-5

### 1 Mark Questions

20. Mention any one function of cytokinin hormone in plants.

Ans. Cytokinin promotes flowering in plants, e.g. *Lemna* and *Wolffia*.

21. Name the following

- A hormone which delays fall of leaves.
- A hormone which prevents ageing of plant parts.

Ans. (i) Auxin  
 (ii) Cytokinin

22. Name one plant growth hormone, which retards growth during extremely dry season.

Ans. Absciscic acid makes the seed dormant in extremely dry season.

23. Name the plant hormones responsible for the following.

- Elongation of cells
- Growth of stem
- Promotion of cell division
- Falling of senescent leaves

Ans. (i) Auxin (ii) Gibberellin  
 (iii) Cytokinin (iv) Absciscic acid

**24.** What do we call the movement of shoot towards light?

**Ans.** The movement of shoot towards light is called positive phototropism.

**25.** A young green plant receives sunlight from one direction only. What will happen to its shoot and roots?

**Ans.** The shoot of the plant bends towards the light, whereas roots bend away from the light.

**26.** Why are roots known as positively geotropic?

**Ans.** The roots always grow towards the gravity of the earth, that is why they are positively geotropic.

**27.** Name any two types of tropic movements.

**Ans.** The types of tropic movements are

- (i) **Geotropism**, i.e. response to gravity.
- (ii) **Chemotropism**, i.e. response to chemical substances.

**28.** In what way tropic movements are different from other types of movements.

**Ans.** The tropic movements are directional with respect to the stimulus received.

**29.** Give technical terms for following events.

- (i) The movement of roots in response to presence of water/moisture nearby.
- (ii) The movement of plant parts towards a chemical substance.

**Ans.** (i) Hydrotropism  
(ii) Chemotropism

## **b** 2 Marks Questions

**30.** The electrical-chemical signals are not considered an efficient means of communication in plants? Give reason.

**Ans.** Unlike animals, where there is a nervous system for conduction of nerve impulses and circulatory system for conduction of hormones, there are no specialised tissues in plants. So, the electrical-chemical signals are not an effective means of communication in plants.

**31.** How control and coordination is carried out in plants?

**Ans.** In plants, control and coordination is brought about by means of chemical substances called phytohormones. In addition, environmental factors like water, temperature and light control growth and development.

**32.** What are plant hormones? Write two important functions of auxin.

**Ans.** Plant hormones are chemical substances produced naturally in plants. These are capable of translocation and regulation of one or more physiological processes when present in low concentration. Two important functions of auxin hormone are-it promotes cell elongation, root formation, cell division, etc.

**33.** Mention any two functions of plant hormone gibberellins.

**Ans.** (i) Elongation of dwarf plants.  
(ii) It helps in overcoming natural dormancy of buds, seeds, etc, and helps them to grow. [1 × 2]

**34.** How does spraying of sugarcane plants with gibberellins increase the yield of sugar?

**Ans.** Spraying of sugar plants with gibberellin can increase the yield of sugar. Spraying increases the length of internode's and increased or lengthy internodes will produce more sugar.

**35.** In an experiment, the callus produced from internode's segments did not proliferate until a substance was added to it. Identify this substance and its role in the experiment.

**Ans.** Callus is an undifferentiated mass of cells. It proliferates only when nutrient medium containing auxin was supplemented with cytokinin hormone because it stimulates growth of plant tissues.

**36.** Name the plant growth regulators which can be used when you are asked to

- (i) induce rooting in a twig
- (ii) quickly ripen a fruit
- (iii) delay leaf senescence
- (iv) induce growth in axillary buds

**Ans.** (i) Auxins (like IAA) (ii) Ethylene  
(iii) Cytokinin (iv) Cytokinin [½ × 4]

**37.** Complete the table given below by filling the blanks present.

Plant hormone	Site of synthesis	Functions
Auxins	A	Promote cell elongation.
Gibberellin	Apical buds and roots.	B
C	In green fruits and seeds at the beginning of wintering season.	D

**Ans.** A – Synthesised primarily in shoot, apical meristems and young leaves.

B – Help in stem elongation.

C – Absciscic acid

D – Induces dormancy of buds and seeds.

**38.** By giving an example, explain how does a plant respond to an external stimuli?

**Ans.** Take a healthy potted plant. Keep this plant inside a dark room by the side of an open window. After a few days, it is observed that the plant bends towards the open window (that is, towards light). The plant shows a positive response to light, known as positive phototropism.

**39.** List the sequence of events that occur when a plant is exposed to unidirectional light, leading to bending of a growing shoot. Also name the hormone and the type of movement.

**Ans.** A plant placed in unidirectional light shows bending towards the light source. This is known as phototropism.

This movement is facilitated by auxin hormone which diffuses towards the shady side. This causes elongation of shoot on shady side.

**40.** Which of the following movements are tropic, identify along with names.

- (i) Opening of flower.
- (ii) Roots moving downwards.
- (iii) Shoots moving towards light.
- (iv) Twirling of a tendril.

**Ans.** Tropic movements are

- (i) Opening of a flower is not tropic movement
- (ii) Roots moving downwards – Geotropism
- (iii) Shoots moving towards light – Phototropism
- (iv) Twirling of a tendril – Thigmotropism

**41.** (i) State the function of the following plant hormones

- (a) Absciscic acid
- (b) Cytokinin

(ii) Define chemotropism.

**Ans.** (i) (a) Absciscic acid

- inhibits growth.
- causes dormancy of seeds, wilting of leaves.
- causes stomatal closure.

(b) Cytokinin

- promotes cell division.
- delays ageing in leaves.
- reduces apical dominance.

(ii) Chemotropic movement is the growth in response to a chemical stimulus, e.g. growth of pollen tube towards ovules during fertilisation.

[1 × 2]

### **C** 3 Marks Questions

**42.** List five main natural plant growth regulators. Write a note on discovery, physiological functions and agricultural /horticultural applications of any one of them.

**Ans.** Five main natural plant growth regulators are auxins, gibberellins, ethylene, cytokinins and ABA.

#### **Auxins**

(i) **Discovery** It was first isolated from human urine. They are generally produced by the growing apices of the stems and roots of plants.

(ii) **Physiological functions** They help to initiate rooting in stem cuttings, an application widely used for plant propagation. Auxins promote flowering, i.e. in pineapples.

They help to prevent fruit and leaf drop at early stages, but promote the abscission of older mature leaves and fruits.

(iii) **Agricultural/horticultural applications** Auxins also induce parthenocarpy, e.g. in tomatoes. They are widely used as herbicides 2, 4-D and are used to kill dicotyledonous seeds. It also controls xylem differentiation and helps in cell division.

**43.** Which parts of the plants produce gibberellins? State two functions of this hormone and mention why it was named gibberellin.

**Ans.** The major sites of gibberellin production in plants are embryos, roots and young leaves near the shoot tip.

The functions of gibberellins are

[1]

(i) They are used in process of malting in brewing industry to speed up the process.

(ii) Gibberellins delay senescence in plants.

It was named after the fungus, which is the source of it, i.e. *Gibberella fujikuroi*.

[2]

**44.** How are gibberellins useful in agriculture to improve productivity? Give any three points in support of your answer.

**Ans.** Gibberellins are useful in agriculture in the following ways

(i) Application of gibberellins increases the length of the stem and increases the yield of sugar in sugarcane.

(ii) Gibberellins promotes seed germination.

- (iii) It can cause fruits like apple to elongate and improve in shape. [1 × 3]

- 45.** (i) Which plant hormone is present in greater concentration in the areas of rapid cell division?  
(ii) Give one example of a plant growth promoter and a plant growth inhibition.

**Ans.** (i) Cytokinin is present in greater concentration in the areas of rapid cell division.  
(ii) An example of a plant growth promoter is gibberellins and example of a plant growth inhibition is abscisic acid. [1½ × 2]

- 46.** The role of ethylene and abscisic acid is both positive and negative. Justify the statement.

**Ans.** The role of ethylene and abscisic acid is both positive and negative. Ethylene is a simple gaseous PGR. It is synthesised in large amount by tissues undergoing senescence and ripening. It also promotes senescence and abscission of plant organs especially of leaves and flowers. This is its negative effect. As it is positive effect, ethylene breaks seed and bud dormancy, initiates germination in peanut seeds, sprouting of potato tubers. It promotes internode/petiole elongation in deep water rice plants. It helps leaves/ inner parts of the shoot to remain above water.

- 47.** The growth inhibiting hormones become important for survival of plants in naturally adverse conditions. Suggest certain situations for the same.

**Ans.** Inhibitors are important to the survival of higher plants in temperate zones where extreme variation in weather conditions prevails. The plants become dormant during harsh winter period and become active on arrival of favourable conditions. Seeds often do not germinate until they have been exposed to cold. The breaking of dormancy and the beginning of growth depend on the presence of these inhibiting hormones.

- 48.** Name the categories of plant hormones concerned with each of the following and describe one other function of each of the three categories of plant hormones

- Inhibition of seed germination
- Promote flowering
- Cell division promoting activity.

**Ans.** (i) **Absciscic acid** Give signals for closure of stomata in plants to prevent water loss during water stress.  
(ii) **Auxin**, controls cell division and xylem differentiation.

- (iii) **Cytokinin** helps in the growth of lateral buds and overcome apical dominance. [1 × 3]

- 49.** Justify by giving any three examples that even plants respond to stimuli.

**Ans.** Plants also respond to external stimulus perceived by them. They show certain movements of plant parts in response to stimuli like light, gravity, water, etc.

- Roots of plants move downwards in response to gravitational force.
- Movement of shoots in plants towards the light.
- Closing of leaves of *Mimosa pudica* plant when touched. [1 × 3]

### d 4 Marks Questions

- 50.** What is 'phototropism'? How does it occur in plants? Describe an activity to demonstrate phototropism.

**Ans.** **Phototropism** is the directional growth movement of curvature of plant organs in response to unidirectional exposure to light.

**Phototropism in plants** Plants bend towards light when they are exposed to it. The aerial shoots usually grow towards light, while some aerial roots grow away from light. This response is controlled by the differential distribution of the plant growth substance auxin in the illuminated part which causes differential growth of the shoot or root.

**Activity to demonstrate phototropism** A conical flask with water is taken and neck of which is covered by a wire mesh. 2 or 3 freshly germinated bean seeds are kept on the wire mesh.

A cardboard box is taken with one side open, the flask is kept inside the box so that open side of the box receives light from a window.

After 2-3 days, it will be seen that shoots bend towards light and roots away from light.

- 51.** Why do tendrils coil around hard rough objects they come in contact with?

**Ans.** The growth movement of tendril in response to unilateral stimulus of touch is called thigmotropism. Tendrils of loughi, tori, karela and sweet pea plants coil around hard objects when they come in their contact. It occurs due to unequal growth of two sides of a tendril. The growth of the surface which comes in contact of the support is retarded, while it remains normal or increased on the other side, due to which tendril coils around the support.

**52.** Why does root grow downward into the soil? What is chemotropism? Give one example.

**Ans.** Roots are negatively phototropic but positively geotropic, hence they grow into downwards the soil. Chemotropism is the movement of a part of the plant in response to a chemical stimulus. It can be positive chemotropism or negative chemotropism.

**Example** The growth of pollen tube towards a chemicals which is produced by an ovule during the process of fertilisation in a flower.

### e 5 Marks Questions

**53.** 'Plants also perform chemical coordination'. Elaborate.

**Ans.** Plants also perform chemical coordination for various activities with the help of hormones. These are the chemical compounds released by stimulated cells that diffuse to various locations in plants performing different functions. These hormones produced by plants are also called as phytohormones. Different types of hormones produced by plants are

Plant hormone	Physiological effect
Auxin	Synthesised in the young tip of roots and shoots. It diffuses towards the shady side of plant, which stimulates the cells to grow longer, resulting in bending of shoot towards light.
	Promotes cell elongation and division.
	Plays important role in formation of roots and seedless fruits.
Gibberellin	Helps in growth of stem and flower.
	Helps in germination of seeds.
Cytokinins	Promote cell division and delay leaf ageing.
	Also stimulate leaf expansion.
Absciscic acid	Growth inhibitor.
	Reverses the growth promoting effects of auxins and gibberellins.
Ethylene	Promotes transverse growth.
	Essential for fruit ripening, promotes senescence and abscission of leaves.

**54.** Name a hormone which

- is gaseous in nature
- is responsible for phototropism
- breaks apical dominance
- is used for killing weeds (dicots)
- induces flowering in long day plants

- Ans.** (i) Ethylene  
(ii) Auxin hormone  
(iii) Cytokinin hormone  
(iv) 2, 4-D (Auxin)  
(v) Gibberellin hormone.

[1 × 5]

**55.** What is ethylene? Give its functions.

Or

Name the only gaseous natural plant growth regulator. Mention any two of its effects on plants in detail.

**Ans.** Refer to text on page 108.

**56.** Write in detail about abscisic acid.

**Ans.** Refer to text on page 109.

**57.** Mention the factors which prove that phytohormones act together opposite to each other.

**Ans.** The factors which prove the phytohormones act together or oppositely are

- Cell division is promoted by both auxins and cytokinins acting together.
- Auxins and cytokinins interact to control the differentiation of shoot and root. When auxin is in excess of cytokinins, it promotes shoot bud formation.
- Auxins and cytokinins act against each other controlling apical dominance. Auxins cause apical dominance, while cytokinins overcome the same.
- Senescence is prevented by auxins and cytokinins while it is stimulated by abscisic acid.
- The activity of cambium and fruit growth seems to be promoted by auxins, gibberellins and cytokinins, the same is inhibited by abscisic acid.
- The dormancy of seeds and buds is mostly due to abscisic acid and the same is broken by gibberellins.
- Cytokinins cause opening of stomata, while abscisic acid results in their closure.

**58.** What is meant by tropisms. Mention the type of tropic movements observed in plants along with examples.

**Ans.** Tropic movements are growth related movements. Refer to text on page 109-110 for types of tropic movement.

- 59.** (i) Define phototropism. Give one example.  
(ii) What is meant by positive and negative phototropism?

- (iii) What does a plant do in response to water?  
Identify this phenomenon. Give an example.

**Ans.** (i) Phototropism is the growth movement shown by plants in response to light, e.g. bending of plant stem placed in a dark room, towards the light source. [1]

(ii) **Positive phototropism** When the plant shows growth movement by bending towards the light source, it is positive phototropism. [2]

**Negative phototropism** When the plant or its parts (like roots) respond to light by growing away from it is negative phototropism.

(iii) A plant when comes in contact with a water source, shows the growth movement towards it.  
This phenomenon is known as hydrotropism, e.g. the roots of plants always go towards the water, even if it means going against the pull of gravity. [2]

**60.** The response of a plant when gravity is the external stimulus is called as geotropism. How are plant parts sensitive to gravity? Explain.

**Ans.** Gravity is the force applied by earth to pull all things downward. The response of plants to this gravity is called **geotropism**. The roots of plants always tend to grow downward in response to gravity. This ensures that they will have soil and water availability (positive geotropism).

The stems of plants always grow upwards (negative geotropism). This ensures the availability of light. Both these movements of plants are considered as geotropism.

## Diagram Based Questions

- 61.** (i) What are phototropism and geotropism?  
(ii) With labelled diagrams, describe an activity to show that light and gravity change the direction that the plant parts grow in.

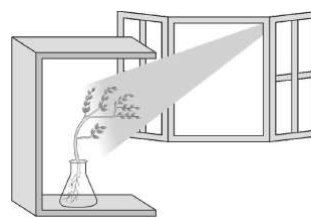
**Ans.** (i) (a) **Phototropism** is the movement of a part of the plant in response to light.  
(b) **Geotropism** is the upward and downward growth of shoots and roots in response to the pull of earth or gravity.

(ii) **Activity** To show that light and gravity change the direction that plant's parts grown in.  
A conical flask is filled with water and the neck of the flask is covered with a wire mesh. Then two or three freshly germinated bean seeds are kept on the wire mesh. A cardboard box opened from one side is taken.

The flask is kept in the box in such a way that the open side of the box faces the light coming from a window.

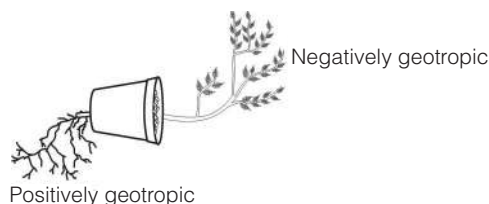
After two or three days, it is noticed that the shoots bend towards light and upwards while the roots away from light and downwards.

Now, the flask is turned so that the shoots are away from light and the roots towards light and this condition is left undisturbed for a few days.



Response of the plant to the direction of light

Thus, it is seen that light or gravity will change the directions that plant parts grow. These tropic movements can be either towards the stimulus or away from it. So, in two different kinds of phototropic movement, shoots respond by bending towards light while roots respond by bending away from it.



Positively geotropic

Plant showing geotropism

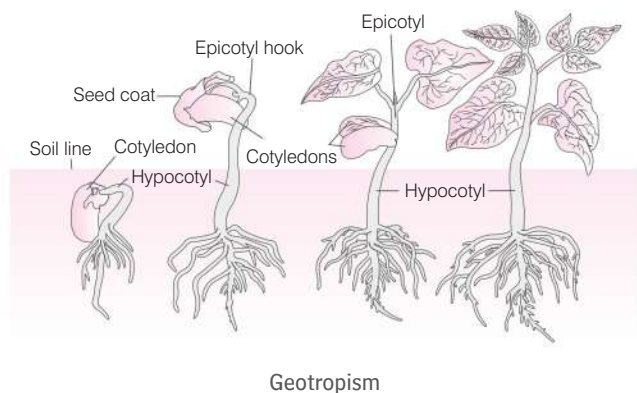
Plants also show tropism in response to other stimuli as well. The roots of a plant always grow downwards while the shoots usually grow upwards and away from the earth.

This direction of growth in response to gravity is termed **geotropic**, growth of the plant towards the centre of the earth is **positively geotropic** (i.e. main roots) and growth away from the centre of earth is **negatively geotropic** (i.e. main stems).

- 62.** Demonstrate using an activity the geotropism in plants.

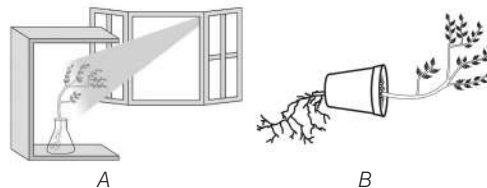
**Ans.** Take a few seeds of bean or gram and sow them in moist soil in a glass beaker. In three or four days, the seeds will sprout. Each seed will give rise to a tiny seedling. Water the seedlings regularly. Observe their growth for 8-9 days.

Notice the increase in the length of the stem growing away from the force of gravity and that of the roots growing towards the force of gravity. The growth in the stem shows negative (away) response to gravity, while the root shows positive (towards) response to gravity.



- 63.** A tropism is a plant movement that is determined by the direction of an environmental stimulus. When the stimulus is received by the plant, specific part of the plant shows response in the form of growth movements. This is due to unequal growth on its two sides by the action of phytohormone. Two pictures *A* and *B* given below are showing

different kinds of tropic movements. Select the correct option.



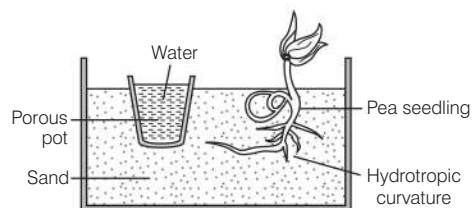
- (a) A – Thigmotropism      B – Hydrotropism  
 (b) A – Phototropism      B – Geotropism  
 (c) A – Phototropism      B – Thigmotropism  
 (d) A – Chemotropism      B – Chemotropism

**Ans.** (b) A – Phototropism, because it shows the response of a plant towards light.

B – Geotropism. It shows the growth movement of roots towards earth and shoots in air.

- 64.** Through an experimental set-up, demonstrate how hydrotropism occurs in plants.

**Ans.** The growth of plant parts towards or away from water is called hydrotropism. It is shown in the diagram given below.



# CHAPTER EXERCISE

## Multiple Choice Questions

1. Application of *A* may induce parthenocarpy. Here, *A* can be
  - (a) auxin
  - (b) cytokinin
  - (c) gibberellin
  - (d) Both (a) and (c)
2. A plant's response to light is known as
  - (a) geotropism
  - (b) hydrotropism
  - (c) phototropism
  - (d) photonasty
3. The movement of a plant part in response to the force of attraction exerted by the earth is
  - (a) hydrotropism
  - (b) geotropism
  - (c) chemotropism
  - (d) phototropism

## Answers

1. (a) 2. (c) 3. (b)

## Fill in the Blanks

4. (i) A phytohormone not associated with plant growth is .....  
(ii) ..... is present in greater concentration in young fruits and seeds.  
(iii) The movement of plant in response to effect of water is .....

## True-False

5. (i) Artificial ripening of fruits is carried out by gibberellins.  
(ii) Spraying sugarcane with ethylene hormone increases the length of plants and thereby the yield.  
(iii) To reduce transpiration in plants, the stomatal closure is induced by ABA.  
(iv) Stems are positively geotropic while roots are negatively geotropic.

## Match the Columns

6. Match the following columns.

Column I	Column II
A. Auxin	1. Apical dominance
B. Cytokinin	2. Shoot development
C. Gibberellin	3. Dormin
D. Absciscic acid	4. Pathenocarpy

## 1 Mark Questions

7. What are the chemical substance that perform control and coordination in plants called?
8. Write an example of plant hormone that promotes growth.
9. How does absciscic acid work against growth promoting hormones?
10. How is geotropism necessary for plant?

## 2 Marks Questions

11. Mention any two differences between auxins and gibberellins.
12. Write the main difference between auxins and cytokinins.
13. Why do the stems and roots of a plant show unilateral growth towards light and gravity of the earth respectively?
14. (i) Roots are called as positively hydrotropic. Give reason.  
(ii) Application of which hormone induces geotropism in roots?
15. How does the following affect plant movements?
  - (i) Chemicals
  - (ii) Absciscic acid

## 3/4 Marks Questions

16. Identify the hormones involved in
  - (i) Development of chloroplast in plants
  - (ii) Promoting senescence in plants
  - (iii) Production of parthenocarpic fruits

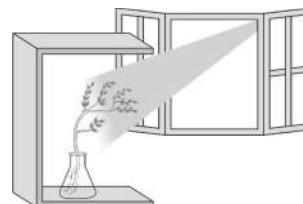
17. Name any four plant hormones involved in control and coordination in plants. [4]
18. In a plant body, where are auxins synthesised? Briefly explain how auxins help in bending of a plant stem towards light. [4]
19. (i) How does a stem respond in presence of light?  
(ii) How does a stem respond to gravity? Also, name the phenomenon for both (i) and (ii). [4]
20. What causes a tendril to encircle or coil around the object it comes in contact with? Explain the process involved. [4]

### 5 Marks Questions

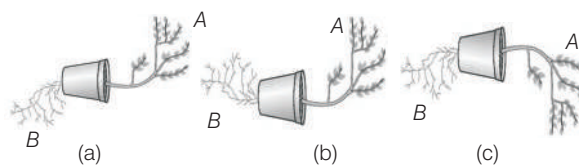
21. State any five functions performed by plant hormones.
22. (i) Define geotropism. Give one example of geotropism.  
(ii) What is meant by 'positive geotropism' and 'negative geotropism'? Give one example of each type. Draw a labelled diagram to illustrate your answer indicating the plant part which shows positive geotropism and the plant part which shows negative geotropism.
23. Elaborate how external stimuli provided by touch can lead to growth movement in plants.

### Diagram Based Questions

24. State the objective of the experiment for which experimental set-up is shown in the given diagram.



25. A potted plant is kept horizontally for a considerable time. The three positions of the parts A and B of the potted plant are shown in the following figures



- (i) Which figure shows the correct position taken by the parts A and B of the plant?  
(ii) What type of phenomenon is exhibited by the figure chosen in (i) above?

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 A list of hormones, their production site and effective sites are given below, in which some are missing. Consider the list carefully and select the correct option.

Hormone	Where produced	Effective site
Auxins	Shoot tip (meristem)	A
B	Fruits, seeds, growing buds and elongating stems	Whole plant
Cytokinins	Roots and developing fruits	C
Abscisic acid	D	Gene expression in nuclei

- 2 Nastic movements differ from tropic movements in being

- A. directional with respect to stimulus      B. non-directional with respect to stimulus  
C. controlled by turgor pressure      D. controlled by chemicals

Choose the correct option

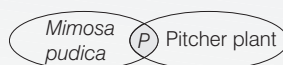
- (a) A and C      (b) B and D      (c) Only B      (d) None of these

- 3 Plant hormones show various actions and visible effects on plants. They also help in conduction of various vital activities of plants like phototropism, negative geotropism, growth, ripening of fruits, etc. Each hormone shows particular action and visible effects on plants. Consider the given action and visible effects of hormones on plants and select the specific hormone responsible for these activities.

Hormone	Action	Visible effects
A	Cells elongated under turgor pressure	Tip bends towards light.
B	Growth of cells	Growth of plant, germination of seeds, flowering and fruit enlargement.
C	Antagonises auxins on leaf buds, promotes cell division and differentiation	Growth of lateral branches.
D	Growth inhibition	Seed dormancy, vernalisation and drought-tolerance.
E	Fruit ripening and leaf drop	Increased sugar in fruit, leaf and fruit drop.

	A	B	C	D	E
(a)	Gibberellin	Auxin	Ethylene	Abscisic acid	Cytokinin
(b)	Auxin	Gibberellin	Cytokinin	Abscisic acid	Ethylene
(c)	Cytokinin	Auxin	Gibberellin	Ethylene	Abscisic acid
(d)	Abscisic acid	Gibberellin	Cytokinin	Auxin	Ethylene

- 4 According to the given diagram, both plants respond to a particular stimulus, i.e.



- (a) *Mimosa pudica*      (b) Pitcher plant

What process does P represent in the diagram?

- 5 'Tropism is directional whereas nastic movement is non-directional'. Justify this statement.

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Circulatory System

All living cells require nutrients, oxygen and other essential materials for their growth and survival. These substances take part in various metabolic processes of the cell. Various toxic substances are also formed during these processes which needs to be eliminated. It is therefore, essential to have an efficient mechanism for the movement of these substances to and from the cells. In higher organisms like humans, these substances are carried through special body fluids called **blood** and **lymph**.

The flow of these fluids inside the body is known as **circulation** and the organs involved in this process together constitute the **circulatory system**. Thus, circulatory system is defined as a vast network of organs and vessels that is responsible for the flow of blood, nutrients, hormones, oxygen and other gases to and from the cells.

## Circulatory System

Depending upon the circulatory patterns, the circulatory systems are of following two types

### Open Circulatory System

In this type of circulatory system, blood pumped by the heart is passed through a vessel into the spaces or body cavities known as **sinuses**, e.g. arthropods, molluscs, protochordates, etc. Capillary system (i.e. interconnecting vessels) is not found in this type thus, called open type of circulatory system.

### Closed Circulatory System

In this type of circulatory system, the blood pumped by the heart is always circulated inside the vessels (i.e. it is never present in large spaces or sinuses). Evolutionarily, this pattern is considered to be most advantageous as it supplies blood to the deepest tissues of the body. It is found in annelids and chordates (including humans).

## Human Circulatory System

Circulatory system in humans is divided into two parts

1. Blood circulatory system
2. Lymphatic system

### Chapter Objective

- Circulatory System
- Human Circulatory System
- Blood Circulatory System
- Blood
- Blood Groups
- Blood Coagulation
- The Heart
- Cardiac Cycle
- Double Circulation
- Portal System
- Lymphatic System

## Blood Circulatory System

It includes blood, heart and blood vessels.

### Blood

It is a fluid connective tissue, found circulating inside the body. The blood is bright red in colour, when taken from an artery (contains oxygenated blood) and its colour is dark red when taken from a vein (contains deoxygenated blood). Its pH is 7.3-7.5, i.e. slightly alkaline in nature. The amount of blood present in an average adult human is 4-6 litres.

### Composition of Blood

The blood is composed of following two main components

#### 1. Plasma

It is the liquid portion of the blood without corpuscles which is slightly yellow in colour (straw coloured). It constitutes about 50-60% of the total blood. Plasma mainly consists of water (90-92%), proteins (7-8%), inorganic salts (1%) and other substances such as glucose, urea, hormones, etc.

#### Plasma Proteins

Proteins provide viscosity to the plasma. Major proteins found in plasma are fibrinogen serum, globulins serum and albumins.

#### Functions of Plasma

Various functions performed by plasma are as follows

- (i) Helps in the transport and uniform distribution of heat all over the body.
- (ii) Provides body immunity.
- (iii) Maintenance of blood pH.
- (iv) Helps in the prevention of blood loss.
- (v) Fibrinogen helps in blood clotting, globulin helps in defence mechanism and albumin maintains the osmotic balance.

**Note** Serum is the left out liquid part when the fibrinogen proteins are removed from the plasma.

### 2. Blood Corpuscles (Formed Elements)

These elements of the blood constituting about 45% of the blood. These include erythrocytes (RBCs), leucocytes (WBCs) and thrombocytes (platelets).

- (i) **Erythrocytes (RBCs)** They are the most abundant type of cells found in the blood. RBCs are biconcave disc-like structures. Sometimes, due to an

abnormality (mutation), RBCs become fragile and sickle-shaped.

This condition is called **sickle-cell anaemia**. Erythrocytes are extremely small in size (of about 7  $\mu\text{m}$ ). Due to this, they can move easily through the capillaries in the body.

Humans have 4-6 million/ $\text{mm}^3$  RBCs in blood. Mature RBCs in mammals are enucleated, i.e. they **lack nucleus** which makes them biconcave, thus increasing their surface area to volume ratio for carrying more oxygen.

RBCs of mammals also **lack endoplasmic reticulum** and **mitochondria**. It means that these cells have increased flexibility for their movement and cannot use oxygen by themselves (cellular respiration occurs in mitochondria).

Thus, all the oxygen absorbed from the lungs is transported to other tissues. RBCs are red in colour due to the presence of a red coloured pigment called **haemoglobin**, which acts as an oxygen carrier molecule.

The average lifespan of a mature RBC is only 120 days, after which it gets destroyed in the spleen (**graveyard of RBCs**).

A person living at high altitude has high number of RBC count. It is because of the low concentration of  $\text{O}_2$  at high altitudes and less  $\text{O}_2$  binding capacity of the haemoglobin.

**Function** The major function of RBCs is to transport respiratory gases to the tissues.

**Note** ■ The process of RBC formation is called **haemopoiesis** or **erythropoiesis**. RBC forms in the bone marrow (cradle of RBCs).  
■ Camel and Llama (camelid) are exceptional among mammals in having oval RBCs.

- (ii) **Leucocytes (WBCs)** These are the most active and motile constituents of blood. They differ from RBCs as they are nucleated (have nucleus) and lack the coloured pigment haemoglobin. WBCs are irregular in shape and are generally short lived, i.e. only 12-14 days.

Leucocytes also show the property of **diapedesis**, i.e. oozing out, as they have the ability to move out of capillaries into the tissues.

They comprise 5000-9000  $\text{mm}^3$  of human blood.

Increase in the number of WBCs at the cost of RBCs results in a disease called **leukaemia**. Decrease in the number of WBCs causes a disease called **leucopenia**.

Leucocytes are of following two major types

(a) **Granulocytes** They have regularly lobed nucleus and are called **granulated**, as they contain numerous granules in their cytoplasm. They are further divided as neutrophil, basophil and eosinophil on the basis of the dyes with which they are stained.

(b) **Agranulocytes** They are not granulated, i.e. cytoplasm is not granular and are divided into lymphocytes and monocytes.

### Different Types of White Blood Cells (leucocytes) after Staining

Two major categories of WBCs	Cell type	Distinguishing features	Functions
Granular	Neutrophils (62%)	Nucleus with 3-4 lobes. Granules stain with neutral dyes.	Engulf bacteria. (phagocytosis)
	Eosinophils (2.3%) (count increases during allergic reactions)	Nucleus with 2 lobes. Granules stain dark red with eosin (acid dye).	Engulf bacteria. Secrete antitoxins, is associated with allergy.
	Basophils (0.4%)	Nucleus large indistinctly lobed. Granules stain with basic dyes, i.e. methylene blue.	Release chemicals (such as histamine) for inflammation which dilate blood vessels.
Agranular	Lymphocytes (30%)	Smallest type of WBC. It has single large nucleus.	Produce antibodies.
	Monocytes (5.3%)	Large kidney-shaped nucleus. Transform into macrophages at the site of infection.	Ingest germs.

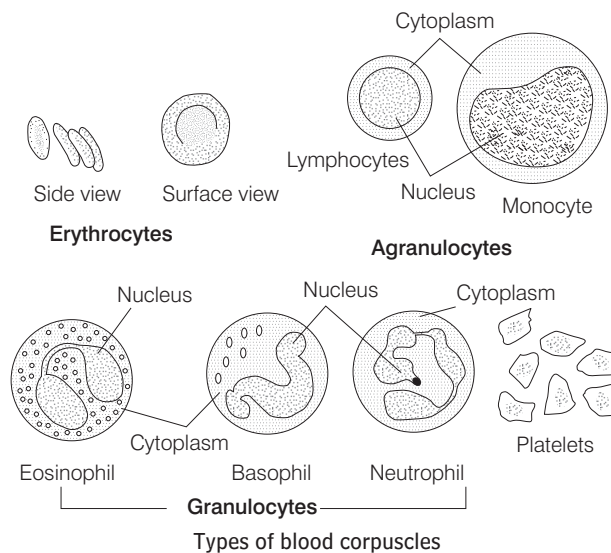
**Functions** The major function of leucocytes is to provide defence mechanism for body. They have the ability of phagocytosis or engulfing the foreign particles, e.g. neutrophils. Some types of WBCs help in reducing inflammation caused by injury or trauma (e.g. monocytes, neutrophils).

WBCs also produce antibodies that provide immunity and help in killing foreign particles, e.g. lymphocytes.

(iii) **Thrombocytes** (Blood Platelets) These are cell fragments produced from megakaryocytes, (i.e. the special cells found in the bone marrow). They are minute, oval or round, enucleated structures found floating in the blood.

They are  $20000-400000/\text{mm}^3$  in blood. Their lifespan is about 3-5 days after which they get destroyed in the spleen along with RBCs.

**Function** Their main function is to help in clotting or coagulation of blood.



## Functions of Blood

Blood performs the following important functions

- Helps in the transportation of respiratory gases (i.e.  $\text{O}_2$ ,  $\text{CO}_2$ , etc).
- Helps in healing the wounds.
- Maintains body pH, water and ionic balance.
- Fights against infections by forming body immunity.
- Helps in transportation of hormones from endocrine glands to target organs.
- Coagulation of blood.
- Helps in transportation of body wastes from different body parts to kidneys.
- Maintains normal body temperature.

### CHECK POINT 01

- Which circulatory system is found in humans?
- Name the constituents of plasma.
- Which organ is called graveyard of RBCs?
- Name one animal which have oval RBCs.
- Name the disease caused due to an abnormal decrease in RBCs count.
- How lymphocytes provide immunity to the body?
- Name the blood corpuscles involved in coagulation of blood.

## Blood Groups

Although blood of every human being appears similar but it differs in certain aspects. The plasma membrane of RBCs contains certain glycoproteinaceous molecules known as **antigens**. They differ in different individuals thus, providing them a characteristic blood group.

Two common types of blood grouping systems found in human beings are as follows

### 1. ABO System

It was reported by **Karl Landsteiner** in 1900 and is based on the presence or absence of antigen A or antigen B on the surface of RBCs (chemicals that can induce immune response). Similarly, the plasma of different individuals contains two natural antibodies or agglutinins. These are the proteins produced in response to antigens.

Person with blood group A have antigen A on the surface of their RBCs and have antibodies against antigen B in their plasma, while in person having blood group B, the case is *vice-versa* to blood group A.

Person with blood group AB have both antigen A and B on the surface of RBCs and no antibodies for either of the antigens in their plasma. Persons with blood group O do not contain any antigen but they have antibodies against both the antigens, A and B.

It can be well-explained through the table given below

**Blood Groups and Donor Compatibility**

Blood group	Antigens on RBCs	Antibodies in plasma	Donor's group	Recipient group
A	A	Anti-B	A, O	A, AB
B	B	Anti-A	B, O	B, AB
AB	A, B	Nil	AB, A, B, O	AB
O	Nil	Anti-A, B	O	A, B, AB, O

### Blood Transfusion

It is a mechanism of injecting blood into the body of the patients (undergoing operation or any other injury) from a healthy person. The person who gives blood is known as **donor**, while a person receiving blood from a healthy person is known as **recipient**.

A person with blood group 'O' is known as **universal donor** (as it lacks antigen) and can donate blood to the person with any blood group, i.e. A, B, AB or O, while a person with blood group 'AB' is known as **universal recipient** as it has both antigens but no antibody.

In blood transfusion, the corpuscle factor or antigen of the donor should be compatible with the plasma factor or

antibody of the recipient, otherwise the corpuscles of donated blood become agglutinated and block the blood vessels and may prove fatal.

### 2. Rhesus (Rh) System

It is another type of blood group system found in human beings. The blood of most people contains a unique factor known as Rh-factor (it was named after it was first discovered in **Rhesus monkey**).

Rh-factor is based on the presence of an antigen on the surface of RBCs. Thus, the person having Rh-antigen on their RBCs are called **Rh-positive** ( $Rh^+$ ), while person who does not have Rh-antigen on their RBCs are called **Rh-negative** ( $Rh^-$ ).

It is also necessary to test Rh-factor before transfusing blood as if a  $Rh^+$  blood is transfused into  $Rh^-$  person, the recipient will develop an antibody response for Rh-antigen.

Due to this, during second transfusion, the antibody produced by first transfusion will cause a reaction with the transfused blood, which may even cause death of that individual.

### Rh Incompatibility

**During pregnancy** It is seen that when father's blood is  $Rh^+$  and mother's blood is  $Rh^-$ ,  $Rh^+$  being a dominant character expresses in the foetus and causes a serious problem. The first child of  $Rh^-$  mother will not suffer, but blood of foetus ( $Rh^+$ ) stimulates the formation of anti- $Rh^+$  factors in the mother's blood.

In the subsequent pregnancies the anti-Rh antibodies in the mother's blood destroy the foetal RBCs and results in Haemolytic Disease of the Newborn (HDN) or **erythroblastosis foetalis** or rhesus baby syndrome.

**During blood transfusion** The first transfusion between  $Rh^+$  and  $Rh^-$  blood causes no harm because  $Rh^-$  person develops anti-Rh antibodies in his blood. But, in the second transfusion of  $Rh^+$  blood to  $Rh^-$  blood, the anti-Rh antibodies in the later's blood destroy the RBCs of the donor.

### Blood Coagulation

It is a mechanism of formation of a clot when an injury or trauma occurs. It has been seen that when a blood vessel is cut during an injury, blood does not continue to flow for a longer time, instead it stops flowing after some time.

If somebody fails to exhibit this property of clotting, that person will continue to bleed when gets injured as he/she may lack one or the other factor that normally controls clotting of blood.

This can even lead to the death of that person. Blood clotting is a complex process which involves a series of steps to get completed.

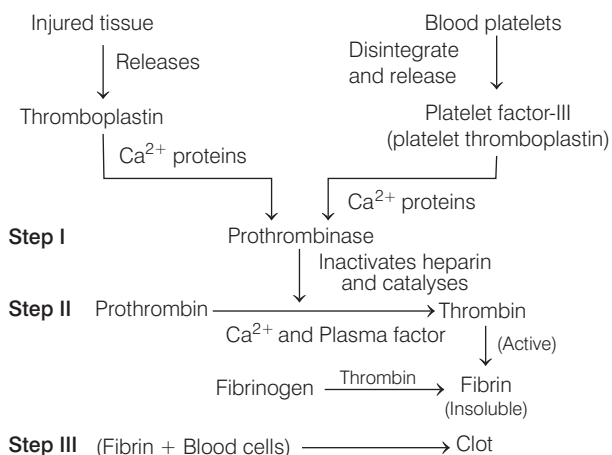
It occurs in following three steps

- (i) When the blood flows out through the wound, the injured cells and blood platelets (thrombocytes) release an enzyme called **thromboplastin** (also called **thrombokinase**).

Thromboplastin helps in the formation of an enzyme prothrombinase (which inactivates heparin) that converts the inactive plasma protein, **prothrombin** into its active form **thrombin** (also called thrombokinase).

- (ii) Thrombin acts as a **proteolytic enzyme** to convert **fibrinogen** molecule (produced from the liver in the presence of vitamin-K) to form insoluble **fibrin** monomer.

This reaction requires **thrombokinase** or **prothrombinase**, an enzyme complex, which is formed by a series of linked enzymatic reactions (cascade process). It involves various factors present in the plasma in their inactive state.



- (iii) These fibrin monomers polymerise to long, sticky fibres called **fibrins**, in which dead and damaged elements of blood are trapped. This finally leads to the formation of a **clot** or **coagulum**. It is a dark reddish-brown **scum** formed over the surface of injury.

Within 2-5 minutes after clot formation, a yellow fluid called **serum** oozes out.

The formation of a blood clot (thrombi) inside a blood vessel, obstructing the flow of blood through the circulatory system is called **thrombosis**. Even when a blood vessel is not injured, blood clots may

form in the body under certain conditions. Thrombosis in coronary artery may result in heart attack. A clot that breaks and begins to travel around the body is known as an **embolus**.

### Anticoagulants

Normally, inside an intact blood vessel, the blood does not coagulate because of the presence of an active anticoagulant, i.e. heparin or antiprothrombins. Apart from this, procoagulants are also present in the blood, but in their inactive forms. Hirudin found in leeches is also an anticoagulant. Sodium oxalate and sodium citrate are used as anticoagulants in labs, blood banks, etc.

**Note** Blood blister is a type of blister that forms when subdermal tissues and blood vessels are damaged by skin trauma, such as forcible pinching.

- **Defibrinated blood** is blood from which fibrin has been removed.
- Insufficient vitamin-K in body leads to inefficient blood clotting.

### CHECK POINT 02

- 1 Who reported ABO blood grouping system for the first time?
- 2 On what basis does the blood group in human decided?
- 3 Give one difference between the blood groups 'O' and 'AB'.
- 4 Which blood group is called universal donor?
- 5 Name an anticoagulant used in blood banks for storing blood.
- 6 What is thrombosis?
- 7 Give the technical term for the clot that breaks and travels around body.

## The Heart

Heart is the main pumping organ found in the thoracic cavity in human beings, i.e. between the two lungs and above the diaphragm.

It is independent from the control of both nervous system and hormonal system. It is made up of cardiac muscles having unique features like automatic contraction and they do not get fatigued whole life.

### External Structure

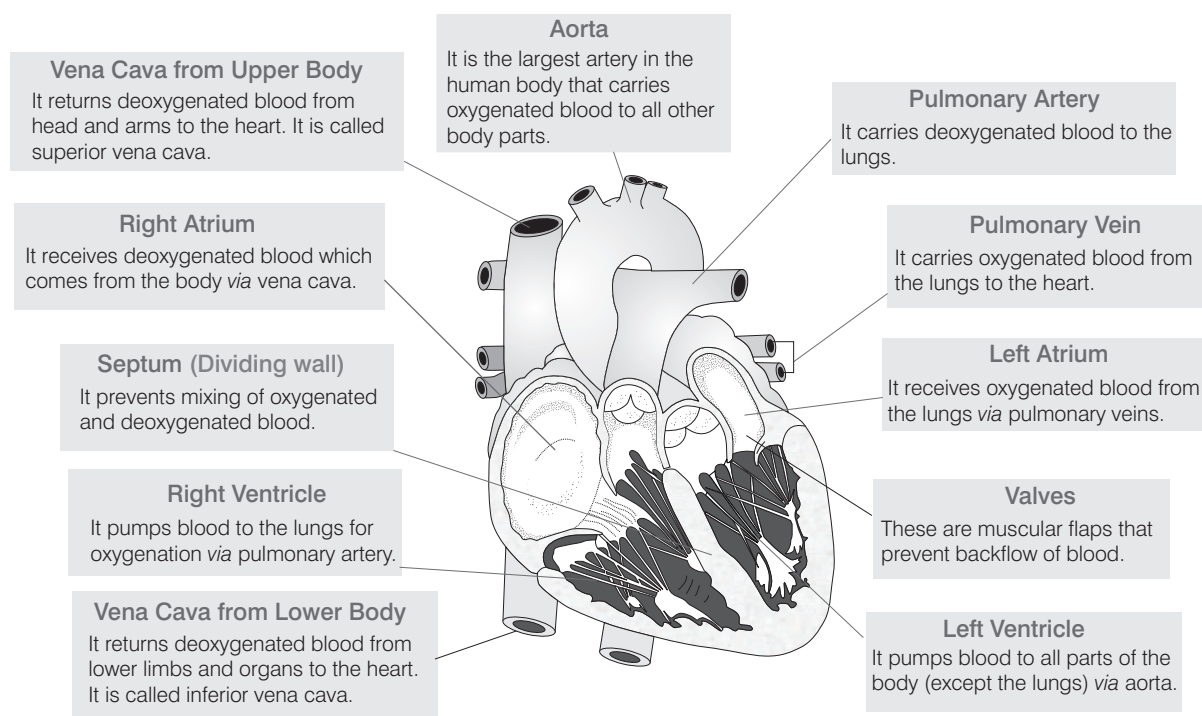
It is about the size of our close fist and is protected by a double membranous covering known as **pericardium**. The space between the two pericardial membranes is filled with **pericardial fluid**, which protects the heart from any mechanical injury and shocks and also helps in reducing friction.

Human heart is comprised of four main chambers, i.e. two relatively small upper chambers called **auricles** (sing. atria) and two larger lower chambers called **ventricles**. The right atrium is slightly larger than the left atrium. Both these atria are meant to receive blood from different body parts.

## Internal Structure

Internally, the chambers of heart, i.e. two auricles (atria) and two ventricles are separated by different septa and valves. The chambers of heart are discussed below

1. **Auricles** These are the upper two thin-walled and smaller chambers. They serve to receive the blood, therefore are called **receiving chambers** (right atrium and left atrium). Both the right and left atria are separated by a thin, muscular wall known as **interatrial septum**.
  - (i) **Right atrium** This right chamber deals with only **impure** (deoxygenated) blood. It receives impure blood from various parts of the body, through two major veins, i.e. superior and inferior vena cana. It also receives blood from the walls of the heart itself (through a coronary sinus).
  - (ii) **Left atrium** This chamber is meant to deal with only **pure** (oxygenated) blood. It receives blood (pure) from lungs through two **pulmonary veins** (i.e. one from the each lung).



Human heart with different vessels and their functions

2. **Ventricles** These are lower two chambers of the heart, that pumps the blood away from the heart. This functions as **pumping chambers**. Both right and left ventricles are separated by the **inter-ventricular septum**. The atrium and the ventricle of the same side are also separated by another septum, a thick fibrous tissue called **Atrio-Ventricular septum** (i.e. AV septum).
  - (i) **Right ventricle** It receives impure blood from right atrium and pumps blood into **pulmonary artery**, which further takes this blood to lungs for purification.
  - (ii) **Left ventricle** It receives pure (oxygenated) blood from left atrium and pumps its pure blood to **aorta** (largest artery in the pathway), which in turn takes this blood to whole body and organs.

At the corner of right auricle near the opening of vena cava, a band of muscles is present known as Sino-Atrial node (**SA node**), which generates impulse that spreads in all directions. It is also called as **pacemaker**. Another band of muscular tissue called Atrio-Ventricular node (**AV node**) is also present in the lower side of right atrium which strengthens the signals generated by SA node. It is also called **pacesetter**. A bundle of muscle fibres called bundle of His originates from AV node. Bundle of His consists of branches of fibres running along the ventricle's walls, called **Purkinje fibres**.

## Heart Valves

Heart valves are the muscular flaps that prevent the backflow of blood, and hence, maintain unidirectional flow. There are different valves present in the heart, which are described in the table below

Valves of Human Heart

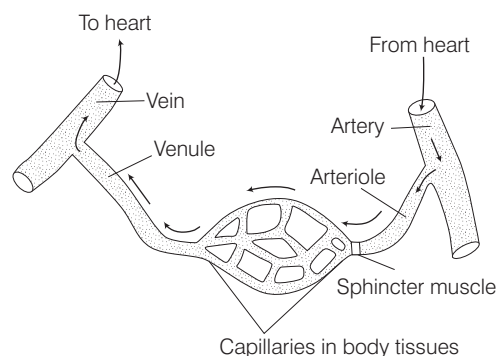
Heart Valve	Location	Action
Tricuspid valve (Right atrio-ventricular valve)	Between right atrium and right ventricle	During ventricular contraction, it prevents blood to move from right ventricle into right atrium
Pulmonary semilunar valve	At entrance to pulmonary artery	During ventricular relaxation, it prevents blood to move from pulmonary trunk into right ventricle
Mitral (bicuspid or left atrio-ventricular valve)	Between left atrium and left ventricle	During ventricular contraction, it prevents blood to move from left ventricle into left atrium
Aortic semilunar valve	At entrance to aorta	During ventricular relaxation, it prevents blood to move from aorta into left ventricle

## Blood Vessels

These are the branched tubes which extend from heart to all parts of the body. There are three main types of blood vessels which carry blood towards and away from the heart. There are three major types of blood vessels are as follows

- (i) **Artery** It is a blood vessel whose function is to carry blood away from the heart and towards any other organ. The flow of blood is in spurts in arteries. An artery is comprised of thick walls and narrow central lumen (core).
- (ii) **Vein** It is a type of blood vessel which carry blood away from the organs and towards the heart. The flow of blood in veins is found to be uniform. It is comprised of thinner walls and a larger central lumen than arteries. Veins contain a thin pocket type valve towards the heart which help them to prevent back flow of blood. Arteriole is the smallest final branch of artery which further breaks up into the capillaries.

- (iii) **Capillary** It is a narrow tube-like blood vessel, comprised of single layer of endothelial cells. Capillaries have the ability of contracting and dialating with the decrease and increase in the blood supply to various body parts.

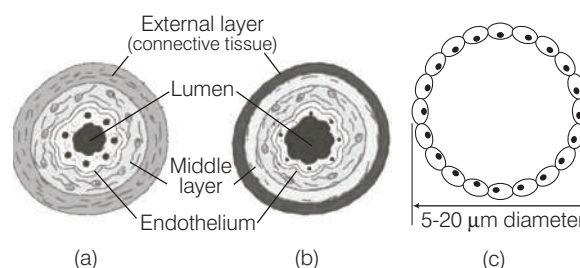


A diagrammatic relationship of artery, capillaries and vein

These are summarised in the table given below

Comparison between Arteries, Veins and Capillaries

Arteries	Veins	Capillaries
Take blood from the heart.	Take blood to the heart.	Take blood from arteries to veins.
Blood flows under high pressure.	Blood flows under low pressure.	Pressure rises then gradually falls down, as blood flows from arteries to veins.
Blood flows in pulses.	No pulse.	Pulse gradually disappears.
Thick muscular walls (upto 2mm).	Thinner walls with connective layer.	Walls are one cell thick, i.e. single-celled.
Small lumen.	Large lumen.	Leaky and red blood cells travel in single file.
No semilunar valves.	Semilunar valves.	No semilunar valves.
Carry oxygenated blood (except pulmonary artery).	Carry deoxygenated blood (except pulmonary vein).	Blood slowly loses its oxygen.



Structural difference between (a) artery, (b) vein and (c) capillary

Different blood vessels entering and leaving the heart, the liver and the kidney are as follows

### 1. Blood Vessels Entering the Heart

- (i) **Anterior (superior) vena cava** brings deoxygenated blood from the upper portion of the body, i.e. from head, chest, arms, etc. into right atrium.
- (ii) **Posterior (inferior) vena cava** brings deoxygenated blood from the lower portion of the body, i.e. from abdomen and legs into the right atrium.
- (iii) **Pulmonary veins** (two from each lung) bring oxygenated blood from lungs to the left atrium.

### 2. Blood Vessels Leaving the Heart

- (i) **Pulmonary artery** carries deoxygenated blood to the lungs for purification (oxygenation). It arises from right ventricle.
- (ii) **The aorta** is the largest artery in human body which carries oxygenated blood to all other body parts. It arises from left ventricle.

### 3. Blood Vessels Entering and Leaving the Liver

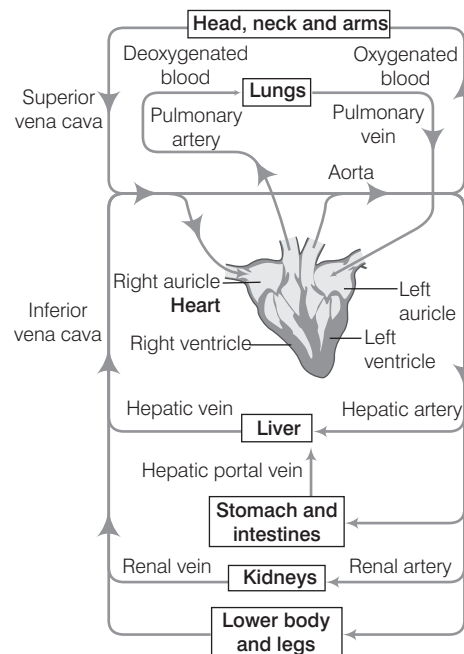
Hepatic artery (from aorta into liver) and hepatic portal vein (from stomach and intestine into liver) are the blood vessels that enter the liver.

Hepatic vein (from the liver into posterior vena cava) leaves the liver.

### 4. Blood Vessels Entering and Leaving the Kidney

Renal artery (from aorta into kidney) enters the kidney. Renal vein (from kidney into posterior vena cava) leaves the kidney.

The left ventricle contracts and the blood goes rushing into the aorta and to other body parts. Within the human body, the blood flows in the following manner



## Functioning of Human Heart : Heartbeat and Pulse

The heart regularly and rhythmically contracts and relaxes at short intervals throughout life without pause and fatigue. This inherent activity of heart is called its **heartbeat**. Each heartbeat has two phases, i.e. contraction phase or **systole** and relaxation phase or **diastole**.

The rate of throbbing felt in arteries due to pumping action of heart (left ventricle) is called **pulse** or **atrial phase**.

The number of pulse is equal to number of heartbeats. It can be felt in the radial artery near the wrist, in neck, and ankles. Pulse rate is about 72 times per minute in men and about 80 times per minute in women.

## Cardiac Cycle

It refers to the repeating pattern of **systole** (contraction) and **diastole** (relaxation) of the heart. Each cycle of atrial and ventricular systole and diastole is of 0.8 second. In auricles systole lasts only for 0.1 sec and diastole remains for 0.7 sec. On the other hand, ventricles have a longer systole, i.e. of 0.3 sec due to their highly muscular walls. Thus, the diastole in ventricles lasts for 0.5 sec only.

### CHECK POINT 03

- 1 Name the type of muscles present in heart.
- 2 Where are the following located?
  - (i) Mitral valve
  - (ii) Tricuspid valve
- 3 Give the difference between arteries, veins and capillaries on the basis of the type of blood they carry.
- 4 What is the function of inferior vena cava?
- 5 Which is the largest artery in the human body?

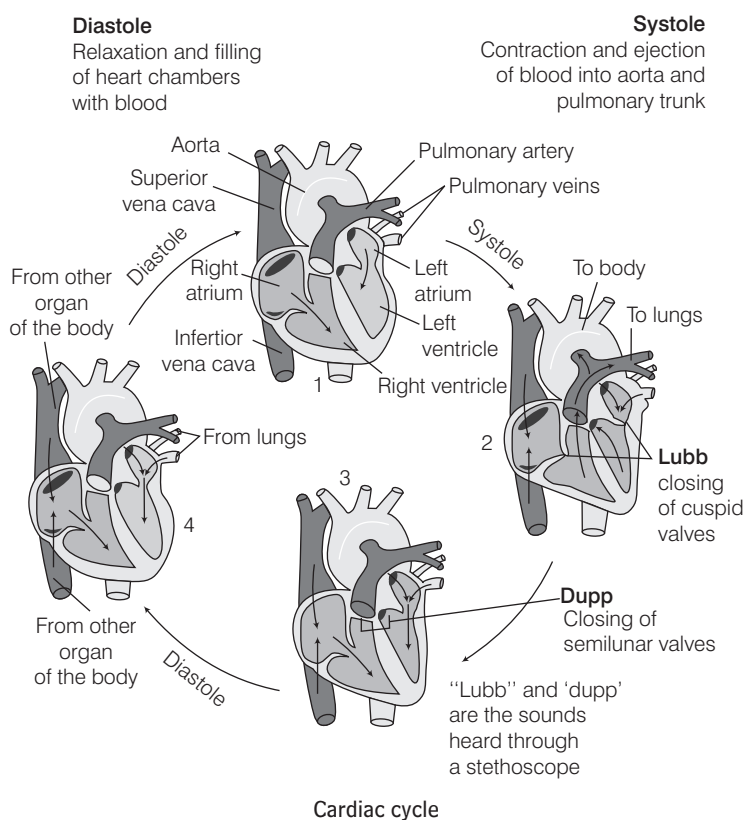
## Pattern of Blood Circulation in Humans

In humans the impure blood from the body parts is brought to the right atrium and then, it passes into the right ventricle. The right ventricle contracts and the blood is forced into the pulmonary artery. This blood travels through lungs.

The blood is purified or oxygenated in the lungs and then it is supplied to the left atrium. Due to the contraction of atrium, the blood falls into the left ventricle.

The successive events of the cardiac cycle are briefly described below

- (i) **In atrial systole**, the atria contract due to the wave of contraction, stimulated by the SA node.  
The blood is forced into the ventricles as the bicuspid and tricuspid valves are open. It takes 0.1 seconds.
- (ii) **Ventricular systole** Both ventricles contract, forcing blood through the capillary artery to the lungs and through the aorta to the rest of the body. It takes 0.3 seconds.
- (iii) **Atrial diastole** The atria relax, although the ventricles are still contracted. Blood enters the atria from the large veins coming from the body. This takes 0.3 seconds.
- (iv) **Ventricular diastole** The ventricular relax, and become ready to fill with blood from the atria as the next cycle begins. This takes about 0.5 seconds.



## Heart Sounds

Heart produces the following two sounds in short succession followed by a small gap: The first sound called **Lubb** is produced due to the sharp closure of tricuspid and mitral valves at the start of ventricular systole. And the second sound called **Dup** is produced due to the closure of aortic semilunar valve and pulmonary semilunar valve at the beginning of ventricular diastole, which prevents the backflow of blood into ventricles.

## Cardiac Output

It is the volume of blood ejected from the left or right ventricle into the aorta (pulmonary trunk) per minute.

It is calculated by the formula Cardiac output

$$= \text{Stroke Volume (SV)} \times \text{Heart Rate (HR)}$$

$$= 70 \text{ mL} \times 75 \text{ per min} = 5250 \text{ mL per min}$$

The stroke volume depends mainly on venous return, i.e. the amount of blood delivered to the heart by the veins.

## Blood Pressure

The pressure exerted by the flow of blood on the elastic wall of arteries is called **blood pressure**. It is greater during systole than during the diastole.

In a normal person, the systolic pressure is 120 mm Hg and diastolic pressure is 80 mm Hg. Blood pressure changes with age and health of the person. It is measured by sphygmomanometer (invented by Samuel Ritter Von Basch in 1881).

Pulse pressure is the difference between systolic and diastolic pressure. It averages 40 mm Hg.

## Double Circulation

Blood in human beings flows twice in the heart before it completes one round. It is comprised of one short flow, i.e. pulmonary circulation and another long flow, i.e. systemic circulation.

Due to this reason, the blood flow in humans is known as **double circulation**. This type of circulation is divided into two phases

- (i) **Pulmonary circulation** The movement of blood from heart to the lungs and back to the heart constitutes the **pulmonary circulation**. Movement of blood in pulmonary circulation occurs in the following way

The deoxygenated blood from the body enters into the right atrium.



As the right atrium contracts, the blood passes into the corresponding lower chamber known as the right ventricle that dilates.



Right ventricle thus, pumps blood to the lungs for oxygenation via pulmonary artery.



Oxygenated blood then comes back to the left auricle of heart through four pulmonary veins, i.e. two from each lung.

- (ii) **Systemic circulation** The circulation of blood from heart to different parts of the body except lungs, and back to the heart constitutes the **systemic circulation**. Movement of blood in systemic circulation occurs in the following way:

As the left atrium of the heart expands, the oxygenated blood from lungs enters into it.

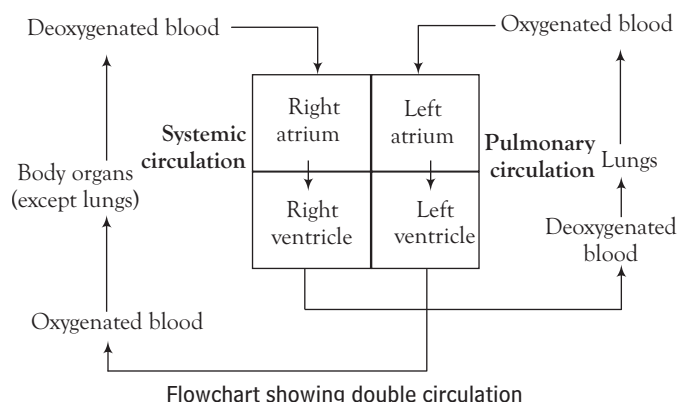


The left atrium then contracts passing the blood to the corresponding expanded left ventricle.



The blood is finally pumped to the whole body via aorta as the muscular left ventricle contracts.

The double circulation of human body can be understanding by following flow chart



## Significance of Double Circulation

Double circulation ensures the complete separation of oxygenated and deoxygenated blood while it enters the heart. In this type of circulation, the blood flows fast with high pressure which provides a higher metabolic rate. It is found in amphibians, reptiles, birds and mammals.

## Portal System

The vein that collects blood from one body part by one set of capillaries and sends blood to another body part by another set of capillaries, instead of sending it to heart is called **portal vein**.

Portal vein together with the capillaries which supply blood to specific parts, makes a portal system. Vertebrates have three portal systems, i.e. renal, hypophyseal and hepatic.

- (i) **Renal portal system** It is present in amphibians and fishes, reduced to some extent in reptiles and birds and absent in mammals.

It transports blood from posterior region of the body to kidneys by renal portal veins. Kidney removes waste products from the blood before it reaches heart. In mammals, blood from the posterior region directly reaches the heart.

- (ii) **Hypophyseal system** It is a small portal system in the pituitary body. It helps the hormones from hypothalamus to reach the anterior pituitary lobe.

- (iii) **Hepatic portal system** The veins from the stomach and intestine instead of carrying blood directly to posterior vena cava, first enter the liver as a combined **hepatic portal vein**, which further breaks up into small capillaries and forms a hepatic vein that joins to the posterior vena cava.

**Functions** Hepatic portal system acts like a store to regulate the quantity of nutrients flowing in the blood, i.e. it helps in storing excess of nutrients in liver and allowing the required amount of nutrients like heparin, fibrinogen, prothrombin and vitamin-A to flow in the blood.

Also, if certain poisons are absorbed through food, the detoxification of food occurs in the liver.

## CHECK POINT 04

- 1 Name the two major circulations of blood in the human body.
- 2 What is the duration of ventricular diastole?
- 3 How much blood is pumped as a stroke volume?
- 4 What is sphygmomanometer?
- 5 Define portal vein.
- 6 Which portal system is absent or lacking in mammals?
- 7 Mention the normal systolic blood pressure of an adult.

## Tissue Fluid (Extracellular Fluid)

As the blood passes through the capillaries of the arterial system into the tissues, some water alongwith many water soluble substances comes out in the spaces between the cells of tissues.

But a very small amount of proteins come out from the capillary with the plasma, leaving the larger proteins and most of the formed elements in the blood vessel. The fluid, thus released out is called **interstitial fluid** (tissue fluid) or **Extracellular Fluid** (ECF).

Distant cells of the body which are not in contact with capillaries, use or absorb  $O_2$  and other substances from this fluid and in turn, give off  $CO_2$  and other wastes back to it. This tissue fluid enters into the lymphatic vessels.

## Lymphatic System

Lymphatic system of human comprises of lymph, lymphatic capillaries, lymphatic vessels, lymphatic ducts and lymphatic nodes. Let us explore them one by one

- (i) **Lymph** Tissue fluid after entering the lymph vessels is known as lymph. It only flows in lymphatic vessels and lymph organs. Both blood and lymph are called as the **fluid connective tissues**.

**Composition of lymph** It is a colourless fluid containing plasma and WBCs (specialised lymphocytes). The overall composition of lymph is similar to blood with the exception of absence of RBCs, platelets and some plasma proteins and in having less calcium and phosphorus than blood.

#### Differences between Blood and Lymph

Blood	Lymph
It is red in colour due to the presence of haemoglobin in red blood cells.	It is colourless as red blood cells are absent.
It consists of plasma, RBCs, WBCs and platelets.	It consists of plasma and less number of WBCs.
Glucose concentration is low.	Glucose concentration is higher than blood.
Clotting of blood is a fast process.	Clotting of lymph is comparatively slow.
It transports materials from one organ to other.	It transports materials from tissue cells into the blood.
Flow of blood is fast.	Lymph flows very slowly.
Its plasma has more contents of proteins, calcium and phosphorus.	Its plasma has less content of protein, calcium and phosphorus.
It moves away from the heart and towards the heart.	It moves in one direction, i.e. from tissues to subclavians.

- (ii) **Lymphatic capillaries** They lie close to the blood capillaries, but differ from them to the extent that they end blindly. The lymphatic capillaries of intestinal regions, which absorb the digested fats are called **lacteals**.
- (iii) **Lymphatic vessels** The lymphatic capillaries unite to form larger lymphatic vessels. They are composed of an outer coat of fibrous tissue, middle coat of muscular tissue and an inner lining of endothelial cells. The lymphatic vessels have numerous valves.
- (iv) **Lymphatic ducts** Lymph vessels of left and right side of the body combines to form a thoracic duct or

left lymphatic duct and right lymphatic duct, respectively.

The thoracic duct discharges its lymph into the left subclavian vein, while the right lymphatic duct discharges its lymph into the right subclavian vein. Thus, the left component of blood reaches back.

- (v) **Lymphatic nodes** These are oval or bean-shaped structures located along the length of lymphatic vessels. They are 1-25 mm long. Lymph filters through the lymph nodes. They contain phagocytic white blood corpuscles and macrophage, which eat harmful microorganisms and foreign particles from the lymph.

#### (vi) Lymphatic Organs and Glands

- The **tonsils** on the sides of the neck are lymph glands.
- The **spleen** is a large lymphatic organ. It is reddish brown in colour. Spleen is found in the abdomen behind the stomach and above the left kidney. It acts as a blood reservoir, produce lymphocytes and destroy worn-out red blood cells.

## Functions of Lymph

Lymph performs the following important functions

- It acts as an important carrier of nutrients, hormones, etc.
- Absorption of fat occurs through lymph in the **lacteals** present in the intestinal villi.
- It helps in the **renewal of ECF**.
- Maturation of lymphocytes, i.e. B-cells and T-cells, occurs with the help of lymph nodes, releasing them into the lymph.
- It helps in keeping tissue cells moist.

### CHECK POINT 05

- What is ECF ?
- Why does the lymph contain much less proteins than the plasma?
- Write one main difference between blood and lymph.
- Which fluid helps to moist tissue cell?
- What is the main function of lymph?

# SUMMARY

- The circulatory system is formed with the carrier a fluid medium that circulates throughout the body.
- Body fluids are the medium of transport in the body. These can be intracellular and extracellular. Blood, lymph and CSF are extracellular fluids.
- Blood is a specialised connective tissue containing fluid matrix, plasma and formed elements (i.e. RBC, WBC and platelets). On the basis of surface antigen on RBC's blood group system are classified as ABO and Rh. Rh incompatibility leads to erythroblastosis foetalis and transfusion reactions. Coagulation is a blood function facilitated by platelets and several clotting factors.
- Lymph a colourless or yellowish extracellular fluid. It is an important component of our body's defence system.
- Circulatory system facilitates circulation of substances via body fluids. Open circulatory system (invertebrates) allows direct contact between blood and tissue cells. In closed circulatory system, there is no direct contact between blood and tissue cells. Also, blood flows through closed vessels, e.g. annelids, some molluscs, etc.
- Human heart is present between the lungs in thoracic cavity, i.e. mediastrium slightly tilted to left. It is covered with pericardium. Heart wall is made of three layers, i.e. epicardium, myocardium and endocardium. Human heart has two auricles separated by interatrial septum; two ventricles separated by interventricular septum. Auricles and ventricles are separated by an auriculoventricular septum.
- Heart valves are tricuspid (between right atrium and ventricle), pulmonary, mitral (between left atrium and ventricle), aortic, eustachian and thebesian valve.
- Blood vessels are vessels carrying blood to and from the heart and body organs. They are arteries (heart to body), veins (body to heart) and capillaries (between arteries and veins).
- Cardiac cycle is the repeating pattern of the systole and diastole of the heart. Each cycle is of 0.8 second.
- Heartbeat is the regular and rhythmic contraction of the heart. Human heartbeats about 75 times/minute. It occurs in two phase systole (contraction) and diastole (relaxation).
- Heart sounds are produced by beating of heart. Lub (first sound) is produced when atrioventricular valves close. Dupp (second sound) is produced by closure of semilunar valves.
- Cardiac output is the volume of blood ejected from left or right ventricle into aorta per minute. It is stroke volume X heart rate. Cardiac output is not constant it varies with physical activities performed.
- Blood pressure is the pressure exerted by blood flow on arterial walls. Normal range is 120 mm Hg (systolic) and 80 mm Hg (diastolic). It can be measured by sphygmomanometre. Another pressure called pulse pressure is the difference between systolic and diastolic pressure (40 mm Hg).
- Portal systems are vascular arrangements where blood from capillaries of one organ is transported to capillaries of another organ. It can be hepatic (between parts of alimentary canal and liver), renal and hypophyseal.
- Human lymphatic system contains lymph capillaries, vessels, lymphatic ducts and nodes. Tonsils, thymus gland, Peyer's patches, liver and spleen are other lymphoid organs which secrete lymph.

# EXAM PRACTICE

## Multiple Choice Questions

1. Blood is a  
 (a) mobile connective tissue  
 (b) liquid connective tissue  
 (c) Both (a) and (b)  
 (d) semi-solid connective tissue

Ans. (c)

2. Human blood consists of  
 (a) fluid matrix (b) plasma  
 (c) formed elements (d) All of these

Ans. (d)

3. The agranulocytes responsible for immune response of the body are  
 (a) basophils (b) neutrophils  
 (c) eosinophils (d) lymphocytes

Ans. (d)

4. Leucocytes are colourless due to  
 (a) lack of water (b) lack of haemoglobin  
 (c) presence of lipid (d) presence of haemoglobin

Ans. (b)

5. Which of the following cells do not exhibit phagocytic activity?  
 (a) Monocytes (b) Neutrophil  
 (c) Basophil (d) Macrophage

Ans. (c)

6. When the right atrium contracts, blood flows from the right atrium into the  
 (a) aorta (b) left atrium  
 (c) pulmonary artery (d) right ventricle

Ans. (d)

7. When two atria contract simultaneously and result in the blood pumping into ventricles, this is called  
 (a) arterial diastole (b) arterial systole  
 (c) ventricular diastole (d) ventricular systole

Ans. (b)

8. The duration of a cardiac cycle is  
 (a) 0.6 second (b) 0.7 second  
 (c) 0.8 second (d) 0.9 second

Ans. (c)

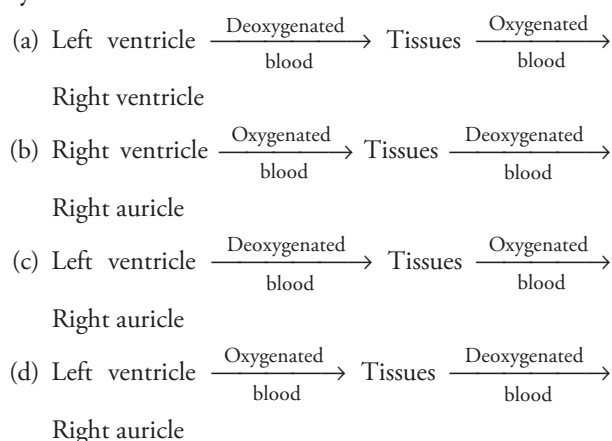
9. How many double circulations are normally completed by the human heart in one minute?  
 (a) 8 (b) 10 (c) 36 (d) 72

Ans. (d)

10. Which of the following chambers of heart first receives blood from the systemic circulation?  
 (a) Right auricle (b) Right ventricle  
 (c) Left auricle (d) Left ventricle

Ans. (a)

11. Systemic circulation is



Ans. (d)

12. Pulse wave is mainly caused by the  
 (a) systole of atria  
 (b) diastole of atria  
 (c) systole of the left ventricle  
 (d) systole of the right ventricle

[2013]

Ans. (c)

13. Hepatic portal system starts from  
 (a) digestive system to liver  
 (b) kidney to liver  
 (c) liver to heart  
 (d) liver to kidney

Ans. (a)

14. The chief function of lymph nodes in mammals is to  
 (a) produce WBCs (b) produce hormones  
 (c) destroy old RBCs (d) destroy pathogen

Ans. (a)

## Fill in the Blanks

15. Fill in the blanks to complete the following statements.

- (i) ..... is the blood plasma from which fibrinogen has been removed.  
 (ii) The red blood corpuscles are ..... and ..... shaped cells without .....

- (iii) The iron pigment ..... gives red colour to the blood.
- (iv) Oxygen combines with haemoglobin present in RBC and forms ..... [2015]
- (v) RBCs are produced in .....
- (vi) ..... and monocytes are phagocytic cells.
- (vii) Thromboplastin is required for ..... in the body.
- (viii) ..... ions play a significant role in clotting.
- (ix) Cells get oxygen and nutrients from ..... fluid.
- (x) The chief function of lymph nodes is to destroy .....
- (xi) The membranous covering of the heart is .....
- (xii) The heart is made up of special muscles, the ..... muscles.
- (xiii) The blood vessel leaving the left ventricle of the mammalian heart is the .....
- (xiv) The chamber of heart which pumps blood into aorta is .....
- (xv) Ventricles have ..... walls when compared with those of auricles.
- (xvi) Ventricles give rise to two large blood vessels called ..... and .....
- (xvii) The pacemaker is present near the opening of the ..... and the atrioventricular node is found near the ..... septum near the tricuspid valve.
- (xviii) The blood vessel which transports blood from heart to an organ is called .....
- (xix) Arteries are ..... walled and the veins are ..... walled blood vessels.
- (xx) ..... are the blood vessels which usually carry oxygenated blood.
- (xxi) The blood vessel that begins and ends in capillaries is ..... [2011]
- (xxii) The sequence of one systole followed by one diastole is termed as the .....

- Ans.**
- |  |                               |
|--|-------------------------------|
| (i) Serum                                  | (ii) biconcave, disc, nucleus |
| (iii) haemoglobin                          | (iv) oxyhaemoglobin           |
| (v) bone marrow                            | (vi) Neutrophils              |
| (vii) blood clotting                       | (viii) Calcium                |
| (ix) tissue                                | (x) pathogens                 |
| (xi) pericardium                           | (xii) cardiac                 |
| (xiii) left aorta                          | (xiv) left ventricle          |
| (xv) thick muscular                        | (xvi) pulmonary artery, aorta |
| (xvii) superior vena cave, inter-auricular |                               |
| (xviii) artery                             | (xix) thick, thin             |
| (xx) Arteries                              | (xxi) portal vein             |
| (xxii) cardiac cycle                       |                               |

## True-False

- 16.** State whether the following statements are true or false.
- (i) The pH of human blood is 4.
  - (ii) The fluid that is left after the removal of fibrinogen protein from plasma is called serum.
  - (iii) The most abundant type of cells found in the blood are WBCs.
  - (iv) Mature RBCs are enucleated.
  - (v) RBCs are red in colour due to the presence of a red coloured pigment called haemoglobin.
  - (vi) The average lifespan of a mature RBC is only 120 days.
  - (vii) The process of RBC formation is called diapedesis.
  - (viii) WBCs have the ability of phagocytosis.
  - (ix) A person with blood group 'O' is known as universal recipient.
  - (x) Internal clotting of the blood is called thrombosis.
  - (xi) In humans, the heart possess 3 chambers.
  - (xii) The aorta and pulmonary artery are guarded by semilunar valves.
  - (xiii) Tricuspid valve prevents the reverse flow of blood from the right ventricle into the right auricle.
  - (xiv) The right atrium opens into the right ventricles through atrio-ventricular aperture.
  - (xv) Oxygenated blood from the lungs comes into the right auricle.
  - (xvi) Blood from the right ventricle goes to the lungs for deoxygenation.
  - (xvii) The capillaries reunite to form a vein.
  - (xviii) Systolic blood pressure in an adult varies from 100-140 mm Hg .
  - (xix) The pulse-beat per minute of a normal human adult is 82.
  - (xx) The blood vessel supplying blood to the kidney is renal artery.
- Ans.**
- (i) False. The pH of blood is about 7.3-7.5.
  - (ii) True.
  - (iii) False. The most abundant type of cells found in the blood are RBCs.
  - (iv) True.
  - (v) True.
  - (vi) True.
  - (vii) False. The process of RBC formation is called erythropoiesis or haemopoiesis.
  - (viii) True.

- (ix) False. A person with blood group 'AB' is known as universal recipient.
- (x) True.
- (xi) False. In humans, heart possess 4 chambers.
- (xii) True.
- (xiii) True.
- (xiv) True.
- (xv) False. Oxygenated blood from the lungs comes into the left auricle.
- (xvi) False. Blood from the right ventricle goes to the lungs for oxygenation.
- (xvii) True.
- (xviii) True.
- (xix) False. The pulse beat per minute of a normal human adult is 72.
- (xx) True.

### Match the Columns

**17.** Match the following columns.

Column I	Column II
A. Basophils	1. Phagocytes
B. Neutrophils	2. Secrete histamine and heparin
C. Eosinophils	3. Allergic reaction
D. Lymphocytes	4. Immunity

**Ans.** A – 2, B – 1, C – 3, D – 4

**18.** Match the following columns.

Column I	Column II
A. SA node	1. 0.8 seconds
B. Muscle fibres located in the heart	2. Pacemaker
C. Cardiac cycle	3. Cardiac muscle
D. Heart muscle	4. Purkinje fibres

**Ans.** A – 2, B – 4, C – 1, D – 3

**19.** Match the following columns.

Column I	Column II
A. Superior vena cava	1. Carries oxygenated blood
B. Inferior vena cava	2. Carries deoxygenated blood
C. Pulmonary artery	3. Brings deoxygenated blood from lower part of the body to the right atrium.
D. Pulmonary vein	4. Brings deoxygenated blood from upper part of the body to the right atrium.

**Ans.** A – 4, B – 3, C – 1, D – 2

**20.** Match the following columns.

Column I	Column II
A. RBC	1. Aortic valve
B. Heart	2. Pacemaker
C. An entrance to aorta	3. Enuclated
D. SA node	4. Myogenic

**Ans.** A – 3, B – 2, C – 1, D – 2

### 1 Mark Questions

**21.** Give the technical term for the fluid portion of blood. [2014]

**Ans.** Plasma is the technical term for the fluid portion of blood.

**22.** Give one reason for the following statement. Erythrocytes are biconcave discs and lack nucleus. [2006]

**Ans.** RBCs/erythrocytes are biconcave, disc-like structures that lack nucleus to provide large surface area to volume ratio for maximum absorption and transport of oxygen.

**23.** Give the biological/technical term for the following. WBCs squeeze through the walls of the capillaries into the surrounding tissue. [2018, 12]

**Ans.** Diapedesis.

**24.** Name the iron containing respiratory pigment in erythrocytes.

**Ans.** Haemoglobin is the iron containing respiratory pigment found in erythrocytes.

**25.** Give appropriate biological/technical term for the following cellular components of blood containing haemoglobin. [2017]

**Ans.** Erythrocyte

**26.** Give reason for the following statement. A matured mammalian erythrocyte lacks nucleus and mitochondria. [2016, 11]

**Ans.** Lack of nucleus and mitochondria helps in providing more surface area for maximum absorption and transport of oxygen.

**27.** Briefly explain the term 'diapedesis'. [2014, 06]

**Ans.** Diapedesis is the process by which white blood cells squeeze out through the walls of capillaries to reach at the site of infection.

**28.** Choose the odd one out from the following sets, giving a reason for your choice.

Basophils, neutrophils, monocytes, eosinophils.

**Ans.** Odd one is monocytes, which is an agranulocyte. The remaining three of the given set are granulocytes.

**29.** Give the technical biological term for the following.

The process by which white blood cells engulf harmful microbes.

[2008]

**Ans.** Phagocytosis is the process by which white blood cells engulf harmful microbes.

**30.** Write down the difference between the following pairs with reference to what is given within the brackets.

Erythrocytes and leucocytes (function). [2011]

<b>Erythrocytes</b>	<b>Leucocytes</b>
Transport respiratory gases.	Produce antibodies and protect the body against from disease causing germs.

**31.** State the main function of lymphocytes of blood.

[2016]

**Ans.** Lymphocytes keep away infection by producing antibodies against foreign particles.

**32.** State the function of thrombocytes. [2011]

**Ans.** Thrombocytes help in blood clotting.

**33.** Name the mineral element essential for the clotting of blood. [2012, 11]

**Ans.** Calcium is the mineral element essential for the clotting of blood.

**34.** Given below are sets of five terms each. Rewrite the terms in correct order in a logical sequence.

Fibrin, Platelets, Thromboplastin, Fibrinogen, Thrombin

[2017]

**Ans.** Platelets → Thromboplastin → Thrombin → Fibrinogen → Fibrin (Mechanism of blood clotting)

**35.** Name the protective covering of the heart. [2014]

**Ans.** Pericardium is the protective covering of heart.

**36.** Why are valves present in heart and veins?

**Ans.** Valves are present in heart and veins to ensure that blood does not flow backward in their respective source chambers.

**37.** State the exact location of the tricuspid valve. [2014]

**Ans.** Tricuspid valve is found between the right auricle and right ventricle.

**38.** All veins carry deoxygenated blood. Do you agree?

**Ans.** No, pulmonary vein is an exception because it carries oxygenated blood from lungs to left atrium.

**39.** Differentiate between the following pair according to what is given in the bracket. Beginning of the ventricular systole and the end of ventricular diastole. (type of heart sound)

[2011, 06]

**Ans.** Heart sound produced at the beginning of the ventricular systole is called lubb and at the other end of ventricular systole is called dupp.

**40.** Give biological reasons for the statement.

The wall of the ventricles is thicker than the auricles. [2013]

**Ans.** Ventricles have thicker walls than auricles because they are meant to pump blood with high pressure so that it reaches to larger distances.

**41.** Name the blood vessel which supplies blood to the liver. [2018]

**Ans.** Hepatic artery is the blood vessel that supplies oxygenated blood to the liver.

**42.** Choose between the two options to answer the question specified in the brackets for the following.

(i) Blood in the renal artery or renal vein (Which one has more urea?) [2018]

(ii) Blood in the pulmonary artery or pulmonary vein (Which one contains less oxyhaemoglobin?) [2018]

**Ans.** (i) Renal artery

(ii) Pulmonary artery

**43.** Choose the odd one out from the following terms given and name the category to which others belong.

Lumen, muscular tissue, connective tissue, pericardium [2018]

**Ans.** **Odd term** Pericardium

**Category** Components of blood vessels

**44.** Differentiate between the following pair on the basis of what is given in the bracket?

Bicuspid valve and tricuspid valve (function)

[2013]

**Ans.** The difference between bicuspid valve and tricuspid valve are given below

<b>Bicuspid valve</b>	<b>Tricuspid valve</b>
It guards the opening when blood rushes from left auricle into left ventricle.	It guards the opening when blood rushes from right atrium to right ventricle.

**45.** State the correct location of pulmonary semilunar valve. [2018, 13]

**Ans.** Pulmonary semilunar valve is located at the base of the pulmonary trunk.

**46.** Sino-atrial node is called the pacemaker of our heart. Why?

**Ans.** Sino-atrial node of heart is responsible for initiating and maintaining the rhythmic activity, therefore it is known as pacemaker of the heart.

**47.** Give the exact location of the mitral valve. [2012]

**Ans.** Mitral valve is found between the left auricle and left ventricle.

**48.** Name the phase of cardiac cycle in which the auricles contract. [2012]

**Ans.** Auricular systole is the phase of cardiac cycle in which the auricles contract.

**49.** Choose the odd one out from the following set, giving the reason for your choice. [2005]

Mitral valve, sino-atrial node, aorta, pulmonary vein.

**Ans.** Odd one is Sino-Atrial (SA) node. It is the structure present in the right side of the heart and the remaining three are found in the left side of the heart.

**50.** Give scientific reasons for the following statements. Blood flows in arteries with spurts and high pressure. [2016]

**Ans.** The blood is pumped from heart with high pressure to the various parts of the body by arteries so, it flows with spurts and high pressure.

**51.** Give scientific reasons for the following statements.

(i) Mature erythrocytes within human lack nucleus and mitochondria.

(ii) Blood flows in arteries with spurts and high pressure.

**Ans.** (i) RBCs in human blood are meant to carry oxygen so to minimise their own energy expenditure, they lose nucleus and mitochondria at maturity.

(ii) The blood is pumped with high pressure from heart to the various parts of the body by arteries so, it flows with spurts and high pressure.

**52.** Differentiate between lubb and dupp (name of the valves whose closure produce the sound). [2016]

**Ans.** **Lubb** Mitral and tricuspid valve.

**Dupp** Aortic and pulmonary valve.

**53.** Name the instrument used to measure heartbeat.

**Ans.** Stethoscope.

**54.** State the main function of coronary artery. [2011]

**Ans.** Coronary artery supplies oxygenated blood to the walls of heart.

**55.** Give appropriate biological or technical term for the following.

The relaxation phase of the heart. [2018]

**Ans.** Diastole

**56.** Mention the phases of blood pressure. When are they seen?

**Ans.** Phases of blood pressure are

(i) Systolic blood pressure is seen during the contraction of left ventricle.

(ii) Diastolic blood pressure is seen during the relaxation of left ventricle.

## **b** 2 Marks Questions

**57.** Circulatory system can also be called as a 'transport system'. Do you agree? Comment.

**Ans.** Circulatory system helps in the transport of  $\text{CO}_2$ ,  $\text{O}_2$ , hormones, metabolic wastes, etc. So it can also be called as a transport system.

**58.** Mention the two fluids that circulate in the body.

**Ans.** Two fluids that circulate in the body are

(i) Blood is a fluid connective tissue which is found circulating inside the body. It is bright red in colour.

(ii) Lymph is the tissue fluid, that flows in the lymph vessels. It is a colourless fluid. [1×2]

**59.** Differentiate between the following pairs on the basis of what is given in brackets.

(i) Lymphocytes and neutrophils (structure of the nucleus).

(ii) Plasma and serum (composition).

**Ans.** (i) In lymphocytes, nucleus is large with a dent-like depression.

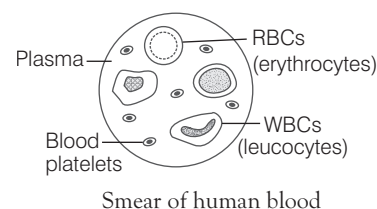
In neutrophils, 3-4 lobed nucleus is present.

(ii) In plasma, fibrinogen is present.

In serum, fibrinogen is absent. [1×2]

**60.** Draw a diagram of the different blood cells as seen in a smear of human blood. [2014]

**Ans.**



**61.** What is the importance of plasma proteins?

**Ans.** Fibrinogen, globulins and albumins are the major plasma proteins. Fibrinogens are needed for clotting or coagulation of blood.

Globulins primarily are involved in defence mechanism of the body and the albumins help in osmotic balance.

**62.** Explain the consequences of a situation in which blood does not coagulate.

**Ans.** The absence of blood clotting mechanism result in huge loss of blood. It usually happens in a disease called haemophilia, which can be fatal.

**63.** What is the significance of time gap in the passage of impulse from sino-atrial node to the ventricle?

**Ans.** The time gap in the passage of impulse from sino-atrial node to the ventricles allows ventricles to relax. Fall in the ventricular pressure, results in the closing of semilunar valves which prevents the backflow of blood into the ventricles.

**64.** Define venule.

**Ans.** A venule is a very small blood vessel in the micro-circulation that allows deoxygenated blood to return from the capillary beds to the larger blood vessels called veins.

**65.** Give the biological/technical term for the following. [2016]

- The vein which drains the blood from the intestine to liver.
- Blood vessels carrying blood to the left atrium.

**Ans.** (i) Hepatic portal vein

(ii) Vena cava [1 × 2]

### **C** 3 Marks Questions

**66.** Blood is called river of life. Comment.

**Ans.** Blood is called so, because blood plasma helps in transportation of materials like nutrients, gases, wastes, hormones, etc. within the body, which is very essential for the survival of life.

**67.** Why do we consider blood as a connective tissue?

**Ans.** Blood is a mobile connective tissue derived from mesoderm, which consists of fibre-free fluid matrix, plasma and other cells. It is called so, as it regularly circulates in the body and takes part in transport of materials.

**68.** Define plasma. Mention atleast two functions of blood plasma.

**Ans.** Plasma is the liquid portion of the blood, slightly yellow in colour (straw coloured). [1]

For functions refer to text on page no. 124. [1 × 2]

**69.** Name the following.

- The straw coloured fluid part of the blood.
- The red pigment in RBCs.
- Any two organelles absent in mature RBCs.

**Ans.** (i) Plasma (ii) Haemoglobin

(iii) Endoplasmic reticulum, nucleus. [1 × 3]

**70.** Mention the following.

- Average lifespan of RBCs.
- The two major categories of WBCs.
- Blood cells involved in leukaemia.

**Ans.** (i) 120 days (approximately).

(ii) Granulocytes and agranulocytes.

(iii) WBCs. [1 × 3]

**71.** One of the ABO blood groups is sometimes called the universal donor. Which group do you think it is and why?

**Ans.** Individuals with blood group O are called universal donors. These individuals do not have either A or B antigens on the surface of their RBCs, but their blood serum contains antibodies against both A and B antigens.

Therefore, blood group O individuals can receive blood only from a group O individual, but they can donate blood to individuals of any ABO blood group, (i.e. A, B, O or AB).

**72.** Blood does not clot in blood vessels. What do you think? Give reasons in support of your answer.

**Ans.** It is not possible for the blood to clot in blood vessels due to the following reasons:

- Anti-coagulants like heparin are present in the blood naturally.
- The endothelium of the blood vessels is intact.
- The coagulating factors remain inactive in the blood.

**73.** Why is closed circulatory system more efficient than the open system?

**Ans.** The closed circulatory system considerably enhances the speed, precision and efficiency of circulation. The blood flows far more rapidly and it takes less time to circulate through the closed system and return to the heart. This quickens the supply and removal of materials to and from the tissues by the blood.

- 74.** Mark the odd one in each of the following series
- (i) Purkinje fibres, AV bundle, AV valve, SA node.
  - (ii) Mitral valve, tricuspid valve, semilunar valve, venous valve.
  - (iii) Thoracic duct, aorta, pulmonary vein, vena cava.

**Ans.** (i) AV valve  
(ii) Venous valve  
(iii) Thoracic duct. [1 × 3]

- 75.** What is the significance of hepatic portal system in the circulatory system?

**Ans.** Significance of hepatic portal system in circulatory system are

- (i) The liver absorbs excess of fats and glucose so as to use them at the time of starvation, when blood passes through the hepatic portal system.
- (ii) Harmful nitrogenous waste like ammonia, is converted into urea, which is later removed by kidney.
- (iii) Liver produces proteins which are transported through blood circulation, e.g. fibrinogen for blood clotting.

- 76.** From where to where do the following blood vessels carry blood? [2013]

- (i) Hepatic vein
- (ii) Hepatic portal vein

**Ans.** (i) Hepatic vein carries blood from liver to posterior vena cava.  
(ii) Hepatic portal vein carries blood from intestine to liver. [1½ × 2]

### **d** 4 Marks Questions

- 77.** Write the differences between open circulatory system and closed circulatory system.

**Ans.** Refer to the text on page no. 123.

- 78.** State the functions of the following in blood.

- (i) Fibrinogen                      (ii) Globulin
- (iii) Neutrophils                (iv) Lymphocytes

**Ans.** (i) Fibrinogens are inactive components of blood plasma. Under the action of enzyme, thrombin, they form a clot or coagulum (a network of threads called fibrin), in which dead and damaged elements of blood are trapped.  
(ii) Globulins are primarily involved in immunity, i.e. defence mechanism of the body.

- (iii) Neutrophils are phagocytic cells which destroy foreign organisms entering the body.
- (iv) Lymphocytes are specialised cells which are responsible for the immune responses in the body. Two major types of lymphocytes that are involved in this process are B and T-lymphocytes. [1 × 4]

- 79.** Differentiate between

- (i) RBCs and WBCs
- (ii) Blood and Lymph

**Ans.** (i) Refer to text on page no. 124.  
(ii) Refer to text on page no. 133.

- 80.** Name any four substances transported by blood.

**Ans.** Four substances transported by blood are

- (i) Oxygen from the lungs to the tissues.
- (ii) Carbon dioxide from the tissues to the lungs.
- (iii) Body wastes from different body parts to the kidneys.
- (iv) Hormones from endocrine glands to the target organs. [1 × 4]

- 81.** Define blood vessel. Also explain its types in detail.

**Ans.** Refer to text on page no. 129.

- 82.** Describe the events in cardiac cycle.

**Ans.** Refer to the text on page no. 130-131.

- 83.** Give reasons for the following.

- (i) Blood flowing away from the stomach and intestines is put into circulation *via* the liver and not directly.
- (ii) The arteries are deep seated in the body.

**Ans.** (i) The veins starting from the stomach and the intestines do not directly convey the blood to the posterior vena cava. Instead, they first enter the liver as a combined hepatic portal vein.

This vein breaks up into capillaries in contrast to the general characteristics of a vein and a new vein is formed by their reunion which joins the posterior vena cava. Due to this, extra nutrients in the blood are absorbed and stored in liver, while only the required amount is sent to different parts of body.

- (ii) The arteries possess thick and muscular elastic walls. They do not have valves in their inner linings. The blood flows with jerks and under great pressure through them. So, these are deep seated in the body. [2 × 2]

## e 5 Marks Questions

**84.** Explain different types of blood groups and donor compatibility through a table.

**Ans.** Refer to text on page no. 126.

**85.** What physiological circumstances lead to erythroblastosis foetalis?

**Ans.** Erythroblastosis foetalis occurs due to Rh incompatibility between the foetus and mother during pregnancy.

Refer to text on page no. 126.

**86.** Mention the locations from where to where the following blood vessels carry blood.

- Pulmonary artery
- Posterior vena cava
- Pulmonary vein
- Posterior vena cava
- Hepatic portal vein

**Ans.** (i) Pulmonary artery carries blood from right ventricle to lungs.

(ii) Posterior vena cava carries blood from the lower parts of body into right auricle.

(iii) Pulmonary vein brings oxygenated blood to the left atrium from the body parts.

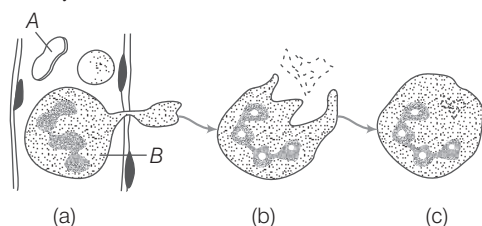
(iv) Posterior vena cava brings blood from the lower portion of the body, i.e. from abdomen and legs into the right atrium.

(v) Hepatic portal vein carries blood from stomach and intestine into liver. [1 × 5]

## Diagram Based Questions

**87.** Study the following diagram carefully and then answer the questions that follows.

- Name the cell labelled *A*.
- Identify the phenomenon occurring in (a).
- Mention two structural differences between *A* and *B*.
- Name the process occurring in (b) and (c) and state the importance of this process in the human body. [2011]



**Ans.** (i) Cell labelled as *A* in the diagram is a red blood cell.

(ii) The phenomenon occurring in part (a) is **diapedesis**.

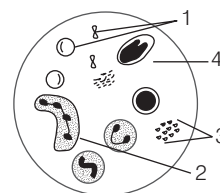
(iii) Structural difference between *A* (RBCs) and *B* (WBCs) are

RBCs	WBCs
Biconcave in shape.	Amoeboid in shape.
Nucleus absent.	Nucleus present.

(iv) Phagocytosis is the process occurring in (b) and (c).

During this phenomenon, the WBC engulfs the disease causing germs that enter the body and thus, defends our body from these organisms.

**88.** Given below is a diagram of a human blood smear. Study the diagram and answer the questions that follows [2014]



(i) Name the components numbered '1' to '4'.

(ii) Mention two structural differences between the parts '1' and '2'.

(iii) Name the soluble protein found in part '4' which forms insoluble threads during clotting of blood.

(iv) What is the average lifespan of the component numbered '1'?

(v) Component numbered '1' do not have certain organelles but are very efficient in their function. Explain. [2018]

**Ans.** (i) (1) RBC (2) WBC

(3) Platelets (4) Plasma

(ii) Structural differences between RBC and WBC are as follows

RBC	WBC
Biconcave in shape	Amoeboid in shape
Nucleus absent	Nucleus present

(iii) Plasma contains a soluble protein fibrinogen.

During blood clotting, soluble fibrinogen converts into fibrin (insoluble form) in the presence of enzyme thrombinase and  $\text{Ca}^{2+}$  ion.

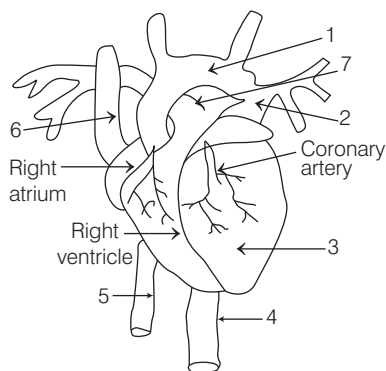
(iv) The average lifespan of RBC is 120 days.

(v) Mature RBCs are enucleated, i.e. they lack nucleus and endoplasmic reticulum which makes them

more flexible thus, increasing their surface area to volume ratio for carrying more oxygen.

They lack mitochondria which means that red cells cannot use oxygen by themselves instead all the oxygen absorbed from the lungs is transported to all other tissues.

- 89.** Given below is a diagram of the external features of the heart.



- Name the parts 1-7.
- What happens if the coronary artery gets an internal clot?
- What type of blood does 5 carry?
- Mention one structural difference between 5 and 4.

- Ans.** (i) 1 – Aorta; 2 – Left atrium; 3 – Left ventricle; 4 – Dorsal aorta; 5 – Inferior vena cava; 6 – Superior vena cava; 7 – Pulmonary artery.
- If the coronary artery gets a clot the corresponding part of the heart does not get blood supply. It may cause heart attack.
  - '5' carries deoxygenated blood.
  - '5' is vena cava which has thin muscular walls while '4' is aorta which has thick muscular walls.

- 90.** Given below is a diagrammatic representation of a certain part of the process of circulation of blood in man. Study the same and then answer the questions that follows

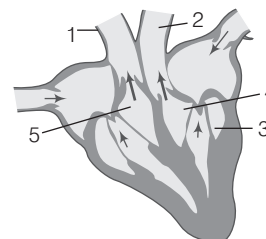
- Name the parts labelled *A*, *B*, *D* and *F*
- Give the number and name of vessel which contains the maximum amount of urea a few hours after a protein rich meal.
- Mention two structural difference between blood vessels '*C*' and '*H*'. [2015]

**Ans.** The parts labelled as *A*, *B*, *D* and *F* are

- A* – Pulmonary artery  
*B* – Pulmonary vein  
*D* – Renal artery  
*F* – Hepatic artery
- Based vessel *E* named as hepatic vein will contain the maximum amount of urea few hours after the protein rich meal.
- Two structural difference between blood vessels *C* and *H* are

Blood vessel <i>C</i> (Aorta)	Blood vessel <i>H</i> (Vena cava)
Lumen is small.	Lumen is large.
Valves absent.	Valves present.

- 91.** The diagram given below represents the human heart in one phase of its functions. Study the diagram carefully and answer the questions that follow: [2015]

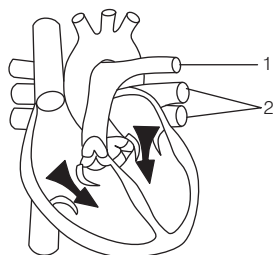


- Name the phase.
- Which part of the heart is contracting in this phase? Give a reason to support your answer.
- Name the parts labelled 1 to 4.
- Which type of blood flows through 2?
- State the function of the part numbered 5.
- Name the membrane that covers the heart.

- Ans.** (i) Ventricular systole  
(ii) Ventricular muscles  
(iii) 1 - Pulmonary artery  
2 - Aorta  
3 - Left atrioventricular valve  
4 - Left atrium

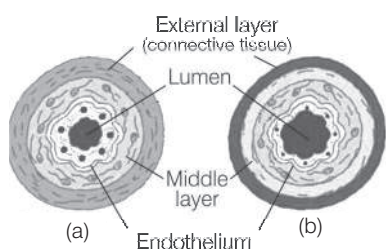
- (iv) Oxygenated blood flows through aorta.
- (v) Right atrium has thin muscular walls. It carries deoxygenated blood.
- (vi) The membrane that covers the heart is pericardium.

**92.** The given diagram represents a section of the human heart. Answer the questions that follows [2017]



- (i) Which parts of heart are in the diastolic phase? Give a reason to support your answer.
- (ii) Label the parts numbered 1 and 2 in the diagram. What type of blood flows through them?
- (iii) What causes the heart sounds 'lubb' and 'dupp'?
- (iv) Name the blood vessels that supply oxygenated blood to the heart muscles.
- (v) Draw neat labelled diagrams of a cross section of an artery and a vein.

- Ans.** (i) In the given figure, ventricles are in diastolic phase. The tricuspid and bicuspid valves are open. It occurs only when pressure in the ventricles falls. As a result blood flows from the atria into the ventricles.
- (ii) 1–**Pulmonary artery**. It carries deoxygenated blood to the lungs for purification.  
2–**Pulmonary veins**. They bring oxygenated blood to the left atrium.
- (iii) 'Lubb' sound is produced when tricuspid and mitral valves get closed, while 'dupp' sound is produced when pulmonary and aortic semilunar valves get closed.
- (iv) Blood vessel that supplies blood to the walls of the heart is 'coronary artery'.

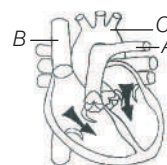


Cross section of (a) artery and (b) vein

**93.** The diagram given below represents the human heart in one phase of its functional activities. Study the same and answer the questions that follow.

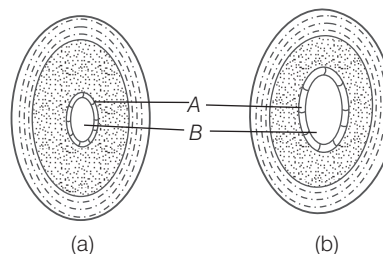
- (i) Name the phase.
- (ii) Label the parts *A*, *B* and *C*.
- (iii) Which part of the heart is contracting in this phase? Give a reason to support your answer.
- (iv) Draw well labelled diagrams of part *A* and *B* to show the structural differences between them.

[2013]



- Ans.** (i) The phase is atrial systole.
- (ii) The parts *A*, *B* and *C* in the given figure are labelled as  
*A*– Pulmonary artery *B*– Superior vena cava.  
*C*– Aorta
- (iii) Upper chambers, i.e. both the atria are contracting in this phase because blood is flowing downwards (towards the ventricles).
- (iv) Refer to fig in Ans. 92 (iv) (artery and vein).

**94.** The diagram given below shows the cross-section of two kinds of blood vessels. [2012]

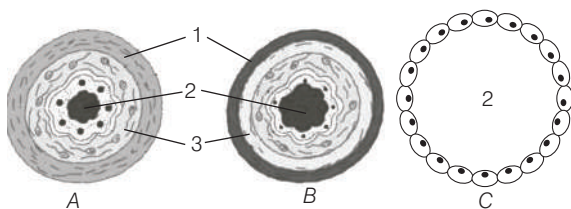


- (i) Identify the blood vessels (a) and (b). In each case, give a reason to support your answer.
- (ii) Name the parts labelled *A* and *B*.
- (iii) When are the sound 'lubb' and 'dupp' produced during a heartbeat?
- (iv) Name the blood vessel that
  - (a) begins and ends in capillaries.
  - (b) supplies blood to the walls of the heart. [2012]

- Ans.** (i) Blood vessel labelled as (a) is artery because it has narrow lumen and thick muscular wall and (b) is vein because it has wide lumen and thin muscular wall.

- (ii) The parts labelled *A* and *B* in the diagram are endothelium and lumen, respectively.
- (iii) Refer to Ans 92 (iii).
- (iv) (a) Blood vessel that begins and ends in capillaries is hepatic portal vein.
- (b) Blood vessel that supplies blood to the walls of the heart is 'coronary artery'.

**95.** The diagrams given below are cross-sections of blood vessels



- (i) Identify the blood vessels *A*, *B* and *C*.
- (ii) Name the parts labelled 1 to 3.
- (iii) Name the type of blood that flows through *A*.

- (iv) Mention one structural difference between *A* and *B*.
- (v) In which of the above vessels does exchange of gases actually take place?

**Ans.** (i) *A* – Artery  
*B* – Vein  
*C* – Capillary

- (ii) 1 – Tunica adventitia  
 2 – Lumen  
 3 – Tunica media

(iii) *A* (artery) carries fully oxygenated blood.

(iv) The structural difference between *A* and *B* is

A (Artery)	B (Vein)
They have narrow lumen and valves are absent.	They have wide lumen and valves are present.

- (v) Artery and veins are involved in the exchange of gases.

# CHAPTER EXERCISE

## Multiple Choice Questions

- Mark the pair of substances among the following which are essential for coagulation of blood.
  - Heparin and calcium ions
  - Calcium ions and platelet factors
  - Oxalates and citrates
  - Platelet factors and heparin
- Which of the following statements is incorrect?
  - A person of 'O' blood group has anti 'A' and anti 'B' antibodies in his blood plasma.
  - A person of 'B' blood group cannot donate blood to a person of 'A' blood group.
  - Blood group is designated on the basis of the presence of antibodies in the blood plasma.
  - A person of AB blood group is universal recipient.
- What will happen if blood from a Rh-ve person is exposed to the blood from a Rh+ve person?
  - Antigen formation takes place
  - ve and +ve Rh-antigen cancel out each other
  - Nothing will happen
  - Antibody will form
- The cardiac impulse is initiated and conducted further upto ventricle. The correct sequence of conduction of impulse is
 

(a)	SA node	AV node	Purkinje fibre	AV bundle
(b)	SA node	Purkinje fibre	AV node	AV bundle
(c)	SA node	AV node	AV bundle	Purkinje fibre
(d)	SA node	Purkinje fibre	AV bundle	AV node
- Which among the following is correct during each cardiac cycle?
  - The volume of blood pumped out by the right and left ventricles is same
  - The volume of blood pumped out by the right and left ventricles is different
  - The volume of blood received by each atrium is different
  - The volume of blood received by the aorta and pulmonary artery is different
- Which of the following is pressed exactly by a doctor on your wrist, while recording your pulse?
  - Vein
  - Capillary
  - Artery
  - Nerves

## Answers

1. (b) 2. (c) 3. (d) 4. (c) 5. (a) 6. (c)

## Fill in the Blanks

- Blood is slightly ..... in nature.
  - The plasma protein, globulin, helps in ..... mechanism.
  - Monocytes have ..... shaped nucleus.
  - The plasma membrane of RBCs contains certain glycoproteinaceous molecules known as .....
  - There are ..... types of blood group, as per the Rh system.
  - In people with blood group O, both antigen ..... and B are not present.
  - The mechanism of transferring blood into the body of the patient from a healthy person is called .....
  - ..... is a colourless fluid containing high concentration of WBCs.
  - The blood pressure is low in ..... circulatory system.
  - The aorta arises from ..... ventricle.
  - The largest artery in human body is called .....
  - The substances transported to and from the tissues diffuse through the walls of .....
  - During ventricular relaxation, ..... prevents blood from moving from aorta into left ventricle.
  - The full form of AV node is .....
  - The full form of SA node is .....
  - ..... is also known as pacesetter.
  - ..... node strengthens the signals generated by SA node.
  - Smallest vein ..... breaks into arterioles.
  - ..... get collapsed when empty.
  - Walls of capillaries consist of a single layer of squamous ..... cells.
  - The blood from the intestinal villi goes to the .....
  - During each cardiac cycle, each ventricle pumps out about ..... mL of blood known as stroke volume.

## True-False

8. Identify whether the following statements are true/false.
- Blood from the right ventricle goes to the lungs for oxygenation.
  - Oxygenated blood from the lungs comes into the left auricle.
  - Process of coagulation starts with the release of a substance from RBCs.
  - Blood fails to clot readily in the case of deficiency of calcium.
  - Heart is endodermal in origin.
  - The closing and opening of the heart occur through the valves during each heartbeat.
  - Bicuspid and tricuspid valve open, when oxygen from the pulmonary vein and vena cava flows into left and right atrium, respectively.
  - Tissue fluid is composed of plasma, WBCs and RBCs.
  - Platelets are absent in tissue fluid.
  - The movement of the impulse passes from the SA node to all the regions of the heart wall.
  - The clear liquid that oozes out after the formation of a clot is serum.

## Match the Columns

9. Match the following columns.

Column I	Column II
A. Eosinophils	1. 2-5 lobed
B. Basophils	2. 2-3 lobed
C. Neutrophils	3. Bilobed

10. Match the following columns.

Column I	Column II
A. Lymphatic system	1. Carries oxygenated blood
B. Pulmonary vein	2. Immune response
C. Thrombocytes	3. To drain back the tissue fluid to the circulatory system
D. Lymphocytes	4. Coagulation of blood

## 1 Mark Questions

- Name the blood corpuscles by which the human body is protected from invading bacteria.
- Choose the odd one out.  
RBCs, ATP, WBCs, Platelets.

- Mention one major function of WBCs.
- Explain the term 'blood transfusion'.
- Mention the location of spleen in the human body.
- Give the technical term for the fluid that transports fatty acids and glycerol.
- Name the fine blood vessels in the tissues through which exchange of materials occurs.
- State the function of vena cava.
- Mention the value of systolic BP and diastolic BP of a normal human adult.

## 2 Marks Questions

- Observe the relationship between the first two words and give the suitable word/words for the fourth place.  
(i) Lubb : Atrio-ventricular valves : : Dupp :  
(ii) Coronary artery : Heart : : Hepatic artery :
- Name the following  
(i) The part inside the heart that initiates heartbeat.  
(ii) The structure that holds the heart valves in position.
- Blood flow in humans is known as double circulation. Why?

## 3 Marks Questions

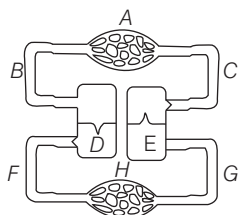
- Name three structures which are present in all eukaryotic cells, but absent in RBCs.
- The composition of lymph is similar to blood with some exceptions. State few of them.
- Define  
(i) Leukaemia  
(ii) Angina pectoris  
(iii) Hypertension
- Spleen is known for the RBC storage. Discuss this statement briefly.
- On the basis of the difference in the pressure of blood, explain open and closed circulatory system.
- People believe that the heart is located on the left side of the chest. Do you agree? Give Justification of your opinion.

### 4/5 Marks Questions

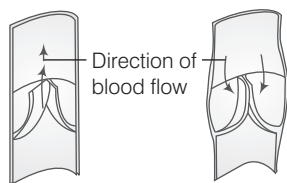
- 29.** On the basis of functions, differentiate between
- Neutrophils and eosinophils [2]
  - Lymphocytes and thrombocytes [2]
- 30.** (i) Mention the two distinguishing features of eosinophils. [2]
- (ii) Define granulocytes and agranulocytes. [2]
- 31.** Differentiate between
- Pulmonary vein and pulmonary artery [2]
  - Aorta and vein [2]
- 32.** Explain the flow of blood from the heart to different parts of the body. [5]
- 33.** Explain the advantage of the complete partition of ventricle among mammals (humans) leading to double circulation. [5]

### Diagram Based Questions

- 34.** Given below is a simple diagram of the circulation of blood in a mammal showing the main blood vessels, the heart, lungs and body tissues. The blood vessel labelled *F* contains deoxygenated blood and the valve leading to it has three semilunar pockets.

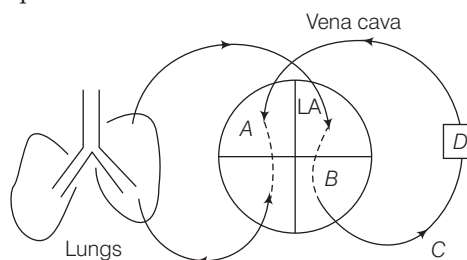


- Name the blood vessels or organs marked by numbers *A* to *H*.
  - What do you mean by 'double circulation' of blood in mammals?
  - What is diastole?
- 35.** The diagram below represents a certain category of blood vessels showing the role of a special structure in their walls.

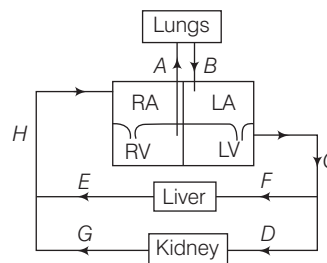


- Name the kind of blood vessels shown.
- Name the structure shown inside the blood vessels.
- Describe the role of these structures.
- Are these structures present in any other kind of blood vessel? If so, name it.
- Towards which side of the figure (top or bottom) is the heart located?

- 36.** Given below is a schematic representation of the circulatory system in man. Study the same and answer the questions that follows.



- Label the parts *A* to *D* indicated in the diagram.
  - Give one difference between the parts *A* and *B* based on
    - their structure
    - the nature of blood flowing through them.
  - What is the specific name of the type of blood circulation that takes place between the heart and the lungs?
  - Name the valve found at the beginning of the part labelled *C*. [2006]
- 37.** Given below is a diagrammatic representation of a certain part of the process of circulation of blood in man. Study the same and then answer the questions that follows.



- Name the parts labelled *A*, *B*, *D* and *F*.
- Identify the number and name of vessel which contains the maximum amount of urea a few hours after a protein rich meal.
- Mention any two structural differences between blood vessels *C* and *H*. [2004]

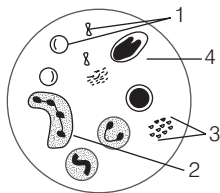
# ARCHIVES\*

## (Last 8 Years)

Collection of Questions Asked in Last 8 Years' (2018-2011) ICSE Class 10th Examinations

### 2018

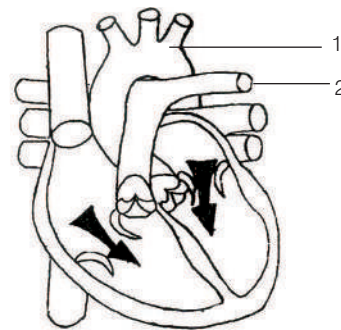
1. Name the blood vessel which supplies blood to the liver. [1]
2. Choose between the two options to answer the question specified in the brackets for the following.
  - (i) Blood in the renal artery or renal vein (Which one has more urea?) [1]
  - (ii) Blood in the pulmonary artery or pulmonary vein (Which one contains less oxyhaemoglobin?) [1]
3. Choose the odd one out from the following terms given and name the category to which others belong.  
Lumen, muscular tissue, connective tissue, pericardium [1]
4. Mention the exact location of the following.  
Pulmonary semilunar valve [1]
5. Give appropriate biological or technical term for the following.
  - (i) Squeezing out the white blood cells from the capillaries into the surrounding tissues. [1]
  - (ii) The relaxation phase of the heart. [1]
6. Given below is a diagram of a human blood smear. Study the diagram and answer the questions that follows



- (i) Name the components numbered '1' to '4'. [1]
- (ii) Mention two structural differences between the parts '1' and '2'. [1]
- (iii) Name the soluble protein found in part '4' which forms insoluble threads during clotting of blood. [1]
- (iv) What is the average lifespan of the component numbered '1'? [1]
- (v) Component numbered '1' do not have certain organelles but are very efficient in their function. Explain. [5]

### 2017

7. Given below are sets of five terms each. Rewrite the terms in correct order in a logical sequence.  
Fibrin, Platelets, Thromboplastin, Fibrinogen, Thrombin [1]
8. Given biological reasons for the following statements.  
The left ventricle of the heart has a thicker wall than the right ventricle. [1]
9. Give appropriate biological/technical terms for the following.  
Cellular components of blood containing haemoglobin [1]
10. The given diagram represents a section of the human heart. Answer the questions that follows [5]



- (i) Which parts of heart are in the diastolic phase? Give a reason to support your answer. [1]
- (ii) Label the parts numbered 1 and 2 in the diagram. What type of blood flows through them? [1]
- (iii) What causes the heart sounds 'Lubb' and 'Dupp.' [1]
- (iv) Name the blood vessels that supply oxygenated blood to the heart muscles. [1]
- (v) Draw neat labelled diagrams of a cross sections of an artery and a vein. [5]

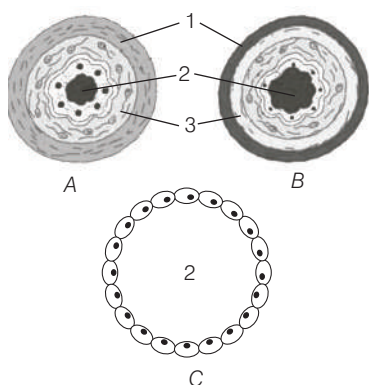
### 2016

11. State the main function of the lymphocytes of blood. [1]
12. Differentiate between lubb and dupp (name of the valves whose closure produce the sound). [1]

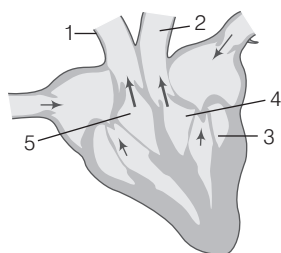
- 13.** Give the biological/technical term for the following.
- The vein which drains the blood from the intestine to liver.
  - Blood vessels carrying blood to the left atrium. [1 × 2]
- 14.** Give scientific reasons for the following statements.
- Mature erythrocytes within human lack nucleus and mitochondria.
  - Blood flows in arteries with spurts and high pressure. [1 × 2]

## 2015

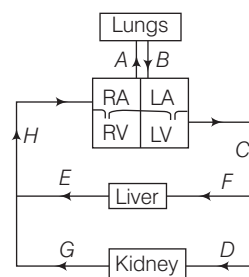
- 15.** Rewrite and complete the following sentences by inserting the correct word in the space indicated. Oxygen combines with haemoglobin present in RBCs and forms ..... [1]
- 16.** The diagrams given below are cross-sections of blood vessels.



- Identify the blood vessels A, B and C.
  - Name the parts labelled 1-3.
  - Name the type of blood that flows through A.
  - Mention one structural difference between A and B.
  - In which of the above vessels does exchange of gases actually take place? [1 × 5]
- 17.** Differentiate between the RBCs and WBCs (shape). [1]
- 18.** The diagram given below represents the human heart in one phase of its functions. Study the diagram carefully and answer the questions that follows.



- Name the phase.
  - Which part of the heart is contracting in this phase? Give a reason to support your answer.
  - Name the parts labelled 1-4.
  - Which type of blood flows through 2?
  - State the function of the part numbered 5. [5]
- 19.** Given below is a diagrammatic representation of a certain part of the process of circulation of blood in man. Study the same and then answer the questions that follows



- Name the parts labelled A, B, C and D.
- Give the number and name of the vessel which contains the maximum amount of urea a few hours after a protein rich meal.
- Draw a neat, labelled diagram of the cross sectional view of the blood vessel numbered C.
- Mention two structural differences between blood vessels C and H. [5]

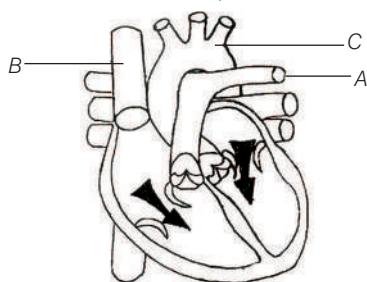
## 2014

- 20.** Give the technical term for the fluid portion of blood. [1]
- 21.** Briefly explain the term 'diapedesis'. [1]
- 22.** Name the protective covering of the heart. [1]
- 23.** State the exact location of the tricuspid valve. [1]
- 24.** Draw a diagram of the different blood cells as seen in a smear of human blood. [2]

## 2013

- 25.** Pulse wave is mainly caused by the
- systole of atria
  - diastole of atria
  - systole of the left ventricle
  - systole of the right ventricle [1]
- 26.** Differentiate between the following pair on the basis of what is given in the bracket? Bicuspid valve and tricuspid valve (function). [1]

- 27.** Give biological reasons for the wall of the ventricle is thicker than the auricles. [1]
- 28.** State the correct location of pulmonary semilunar valve. [1]
- 29.** Mention the locations from where to where do the following blood vessels carry blood?  
(i) Hepatic vein  
(ii) Hepatic portal vein [1×2]
- 30.** The diagram given alongside represents the human heart in one phase of its functional activities. Study the same and answer the questions that follows

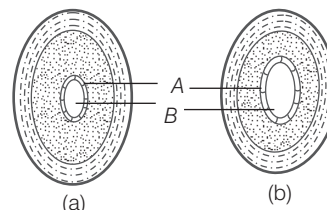


- (i) Name the phase. [1]
- (ii) Label the parts A, B and C. [1]
- (iii) Which part of the heart is contracting in this phase? Give a reason to support your answer. [1]
- (iv) Draw well-labelled diagrams of part A and B to show the structural differences between them. [2]

## 2012

- 31.** Give the biological/technical term for the following. WBCs squeeze through the walls of the capillaries into the tissue. [1]
- 32.** Name the mineral element essential for the clotting of blood. [1]
- 33.** Name the phase of cardiac cycle in which the auricles contract. [1]
- 34.** Briefly explain the pulse. [1]
- 35.** Give the exact location of the mitral valve. [1]

- 36.** The diagram given below shows the cross-section of two kinds of blood vessels.



- (i) Identify the blood vessels a and b. In each case give a reason to support your answer.
- (ii) Name the parts numbered A and B
- (iii) When are the sound 'lubb' and 'dupp' produced during a heartbeat?
- (iv) Name the blood vessel that  
(a) begins and ends in capillaries.  
(b) supplies blood to the walls of the heart. [5]

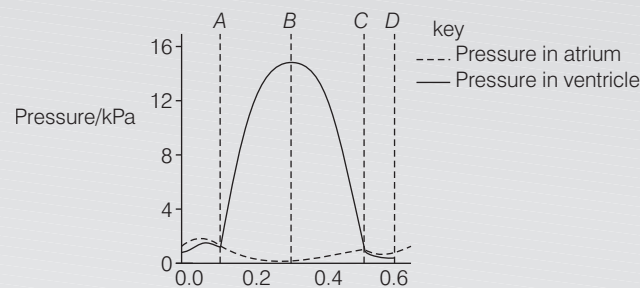
## 2011

- 37.** State the main function of thrombocytes. [1]
- 38.** Give reason for the a matured mammalian erythrocyte lacks nucleus and mitochondria. [1]
- 39.** Write down the difference between the following pairs as indicated within the bracket.  
Erythrocytes and leucocytes (function). [1]
- 40.** Name the mineral element essential for the clotting of blood. [1]
- 41.** State the main function of coronary artery. [1]
- 42.** Rewrite the complete sentence by inserting the correct word in the space indicated.  
The blood vessel that begins and ends in capillaries is the ..... [1]
- 43.** Differentiate between the following pair according to what is given in the bracket.  
Beginning of the ventricular systole and the end of ventricular diastole. (type of heart sound) [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 The graph shows pressure changes in the left side of the heart, during a single heartbeat. At which point does the bicuspid (mitral) valve open, allowing blood to flow from the atrium to the ventricle?



- (a) A (b) B (c) C (d) D
- 2 The level of glucose in blood plasma is highest in the
- (a) aorta (b) pulmonary vein  
(c) hepatic portal vein (d) renal vein
- 3 The table shows features of some blood vessels. Which of them is the pulmonary artery?

Features			
Muscle layer	Lumen	Direction of Blood Flow	Blood
(a) Thick	Narrow	Away from the heart	Deoxygenated
(b) Thick	Wide	Away from the heart	Oxygenated
(c) Thin	Narrow	Towards the heart	Oxygenated
(d) Thin	Wide	Towards the heart	Deoxygenated

- 4 When the skin is cut, the blood forms clot. In which order would the components of the blood involve in the process of clot formation?

First <span style="float: right;">→ Last</span>			
(a) Fibrin	Platelet	Red blood cell	Fibrinogen
(b) Fibrinogen	Red blood cell	Platelet	Fibrin
(c) Platelet	Fibrin	Fibrinogen	Red blood cell
(d) Platelet	Fibrinogen	Fibrin	Red blood cell

- 5 The blood groups of both the donor and recipient must be known before transfusing blood. Give reason.
- 6 Why renal portal system is absent in mammals?

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Excretory System

Various metabolic reactions occurring inside the body, whether anabolic (constructive, i.e. formation of complex molecules from simple ones) or catabolic (destructive, i.e. breakdown of complex molecules into simpler forms) release energy and form some substances that are not required by the body. These substances are called waste products and they need to be removed from the body at earliest possible time, as they can be toxic to the body.

In this chapter, we will discuss how these waste products are formed and thereafter, the entire process of removal of these products (excretion) will be studied.

## Excretion : Products and System

The process of removal of harmful metabolic waste products from the body is called excretion. It is an important process in all living beings. It also maintains the osmotic concentration of all the body fluids, i.e. **osmoregulation** within the body.

## Excretory Products in Animals

Different animals excrete different nitrogenous compounds. Based on the excretory products produced by an organism, they are classified into three categories

- (i) **Ammonotelic** Ammonia, the most toxic form of nitrogenous waste requires large amount of water for its elimination.  
The organisms excreting ammonia as waste product are called ammonotelic and the process is called **ammonotelism**, e.g. aquatic amphibians, fishes, etc.
- (ii) **Ureotelic** The organisms excreting urea as waste product are called ureotelic and the process is called **ureotelism**, e.g. mammals, amphibians (frog), etc.
- (iii) **Uricotelic** The organisms excreting uric acid in semi-solid form as waste product are called uricotelic and excretion process is called **uricotelism**, e.g. birds, reptiles, etc.

## Chapter Objective

- Excretion : Products and System
- Excretory Organs in Higher Animals
- Human Excretory System
- Kidneys
- Mechanism of Urine Formation
- Urine
- Micturition
- Disorders of Excretory System

## Excretory Organs In Higher Animals

General human beings, the process of excretion is brought about by the following organs

- (i) **Kidneys** It is the primary excretory organ for the excretion of liquid waste products in the form of urine.
- (ii) **Skin** It bears several sweat glands under it. These glands secrete sweat which carries small amount of nitrogenous wastes, salts and excess water along with it. Sweating is mainly concerned with the process of thermoregulation, i.e. maintaining temperature of the body.
- (iii) **Lungs** These are meant to excrete carbon dioxide (a waste product) formed during expiration (breathing out).
- (iv) **Liver** It removes urea, bile pigments and other toxins and is known as a detoxifying gland. Urea is synthesised from extra amino acids in the liver.

### Defaecation is not Excretion

- Passing out or removal of faeces, i.e. defaecation is not considered as an excretory process. It is the removal of undigested or indigestible food from the alimentary canal via the anus.
- Excretion is the removal of metabolic waste products formed due to various biochemical reactions and since faecal matter is not formed by metabolism, its removal is not considered as excretion.

### Important Metabolic Wastes Excreted from the Body

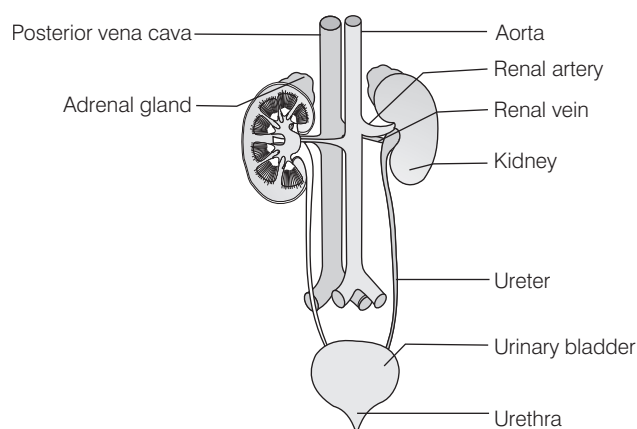
Chemical	Source	Organ of Excretion
Ammonia	Deamination (removal of amine group) of amino acids in liver	Kidneys
Bile pigments	Haemoglobin breakdown in liver	Liver (into small intestine)
Carbon dioxide	Breakdown of glucose in cells	Lungs.
Inorganic ions	Food and water	Kidneys and salivary glands
Urea	Derived from ammonia	Kidneys and skin
Uric acid	Nucleotide breakdown in liver	Kidneys
Urochrome	Haemoglobin breakdown in liver	Kidneys
Water	Food and water; breakdown of glucose	Kidneys, skin and lungs

### CHECK POINT 01

- 1 Why is it important to remove nitrogenous waste from the body?
- 2 What mode of excretion is found in fishes and frog?
- 3 Name an organism which excretes uric acid.
- 4 The process of thermoregulation is concerned with which part of body?
- 5 Water is excreted through which part of body?
- 6 How is defaecation different from excretion?

## Human Excretory System

Excretory system in humans consists of a pair of kidneys, a pair of ureters, urinary bladder and urethra.



Excretory system in human

## Kidneys

These are two bean-shaped structures, located on either side of the backbone in the abdominal cavity. Kidneys are located below the diaphragm on the left and right sides and protected by the last two ribs.

Right kidney is slightly lower than left kidney because liver takes much space of right side and pushes it down.

## External Structure of Kidney

Each kidney is about 10cm long, 6cm wide and 3.5cm thick. The outer surface of kidney is convex and the inner surface is concave.

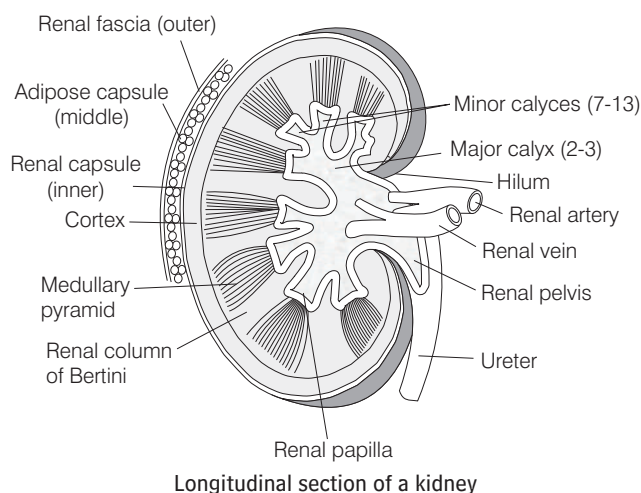
At the inner concave surface, a notch-type structure called **hilum** is present, through which the supply of blood occurs, i.e. renal artery and renal vein pass in and out of the kidneys alongwith ureter and nerve supply of the kidney.

The kidney is bounded externally by a thin sheet of white fibrous tissue called **renal capsule**.

## Internal Structure of Kidney

Internally, each kidney is made up of two main regions, i.e. **outer cortex** and **inner medulla**. The cortex is the outer darker region which is dotted in appearance. The nephrons are highly coiled in this region.

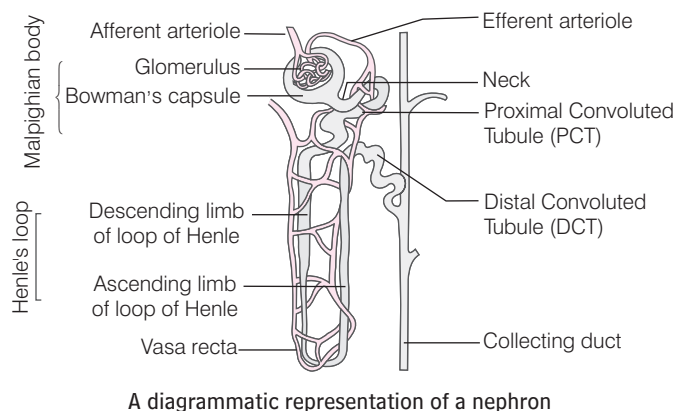
The medulla is composed of finely stripped substance being arranged in several conical projections called **renal** or **medullary pyramids**. Apex of each renal pyramid projects inwards towards the pelvis.



Each kidney is composed of enormous number of microscopic tubules called **nephrons** or **renal tubules** or **uriniferous tubules**, which are the functional units of the kidney.

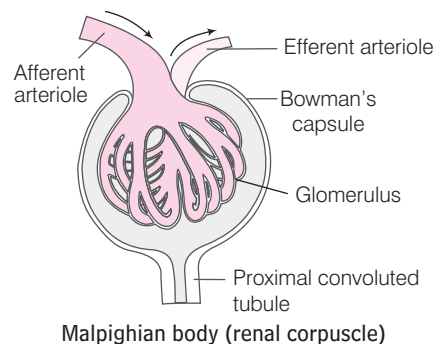
## Nephron

It is highly coiled, tube-like structure. It filters the blood in order to regulate chemical concentrations of water and soluble substances like sodium salts and thereby produce urine. Each nephron consists of two parts, the **Malpighian body** or **renal corpuscle** and **renal tubules**.



- (i) **Malpighian body** It lies in the cortex of the kidney. It is differentiated into two parts, i.e. Bowman's capsule and glomerulus.

**Bowman's capsule** is a single-celled, thick walled, cup-like structure and **glomerulus** is a tuft of capillaries formed by afferent arteriole (a fine branch of renal artery). Malpighian body filters out large solutes from the blood and delivers small solutes into the renal tubule for their modification.



- (ii) **Renal tubules** The Bowman's capsule leads into a coiled part of nephron called renal tubule. After passing through the renal tubules, the filtrate continues to the collecting duct system. These long and thin structures are further divided into three distinct regions as follows

- (a) **Proximal Convoluted Tubule (PCT)** It is the starting point of the convoluted region which makes few coils and is found behind the neck of Malpighian body. PCT along with Bowman's capsule lies in the cortex region of the kidney.
- (b) **Henle's loop** It is a U-shaped (hairpin- shaped) region of renal tubule, that runs in the medulla region of kidney. It has a descending loop that ends into the medulla and an ascending loop that extends back from medulla into the cortex.
- (c) **Distal Convoluted Tubule (DCT)** It is considered as the end part of renal tubule lying in the cortex region of the kidney. It further opens up into a **collecting duct** which receive the waste products and then pour it into the pelvis of kidney as urine.

## Blood Vessels (in and out) of Renal Tubules

- (i) A pair of renal arteries branch off from dorsal aorta and enter into the kidneys.
- (ii) Renal artery further give rise to arterioles, which enter the Bowman's capsule and supplies blood to the glomerulus. These are known as **afferent arterioles**.

- (iii) The afferent arteriole breaks into many capillaries forming a knot-like mass called glomerulus, which fits closely inside the Bowman's capsule.
- (iv) The capillaries forming the glomerulus reunite together and emerges out from the Bowman's capsule forming an **efferent arteriole**, carrying blood away from the glomerulus.
- (v) Efferent arteriole emerges out of the glomerulus and breaks up into a **secondary capillary network** (vasa recta), which further joins to form venules.
- (vi) These venules join to form a **renal vein**, that opens into the posterior vena cava.

**Note** The entire blood present in our body passes through the kidneys about 350-400 times per day with a rate of 1-2 times per minute.

## Functions of Kidney

- (i) It helps in regulating water and electrolyte balance.
- (ii) It helps in excreting metabolic waste products.
- (iii) It helps in regulating pH of the blood.
- (iv) It helps in the regulation of arterial pressure.

## Ureters

These are the paired tubular structures arising from the pelvis of each kidney. The upper half of the ureter is located in the abdomen and lower half is located in the pelvic area.

The tube has thick walls comprised of a fibrous, a muscular and mucus coat, which are able to contract. The urine produced in the kidneys constantly flows through these ureters and collects into the urinary bladder.

The valves present in the ureters prevent the backflow of urine during the contraction of bladder.

## Urinary Bladder

It is a thin-walled, pear-shaped sac which is meant to store the urine temporarily. Urine enters the bladder *via* ureters and exits *via* urethra. It is located in the lower abdominal area of body near the pelvic bones.

## Urethra

It is a membranous tube through which urine emptied from bladder is conducted to the exterior.

The **urethral sphincters** keep the urethra closed and opens it only at the time of urination. Its main function is to excrete waste product out of the body.

### CHECK POINT 02

- 1 Give the position of kidney in our body.
- 2 What are the two components of nephron that together form renal corpuscle?
- 3 Blood enters and leaves the glomerulus through different arterioles. Is it true? If yes give their names.
- 4 Name the knot-like mass of blood capillary inside the Bowman's capsule.
- 5 Give the name of the reservoir of urine in the body.

## Mechanism of Urine Formation

Urine is an excretory product formed in the nephrons of the kidney. The process of formation of urine is called **uropoiesis**.

It is a three steps process that involves

### 1. Glomerular Filtration or Ultrafiltration

It is the very first step in the process of formation of urine. It involves the filtration of blood in the glomerulus.

- During ultrafiltration, the blood flows under a great pressure through glomerulus. This is because the efferent (outgoing) arteriole is narrow in diameter than the afferent (incoming) arteriole.
- Due to this high pressure, the liquid portion of the blood is filtered out from glomerulus and passes into the Bowman's capsule to enter into the renal tubule.
- This fluid (which is entering in the renal tubule) is now known as **glomerular filtrate** or **primary urine**. It is hypotonic to the urine, that is actually excreted out. The amount of the filtrate formed by the kidneys per minute is called **Glomerular Filtration Rate (GFR)**.

### 2. Selective Reabsorption

- During the second step of urine formation, glomerular filtrate in the form of dilute solution enters the renal tubule and various materials present in the filtrate are reabsorbed. As much as 99% of the materials in the filtrate are reabsorbed.
- As the filtrate passes down the tubule, some amount of water is reabsorbed alongwith other useful substances such as salts, amino acids, glucose, etc. to the extent without affecting the normal concentration of the blood.

Depending upon the types of molecules being reabsorbed, movements into and out of epithelial cells in different segments of nephron occurs either by passive transport or active transport.

These are described as follows

- (i) **Water** and **urea** are reabsorbed by passive transport (i.e. water is reabsorbed by osmosis and urea by simple diffusion).
- (ii) **Glucose** and **amino acids** are reabsorbed by active transport.
- (iii) The **reabsorption of  $\text{Na}^+$**  occurs both by passive and active transport.

### 3. Tubular Secretion

It is the last step in the formation of urine.

- The substances such as  $\text{K}^+$ ,  $\text{Na}^+$ ,  $\text{H}^+$  and certain chemicals, which are not removed by filtration are removed by this process.

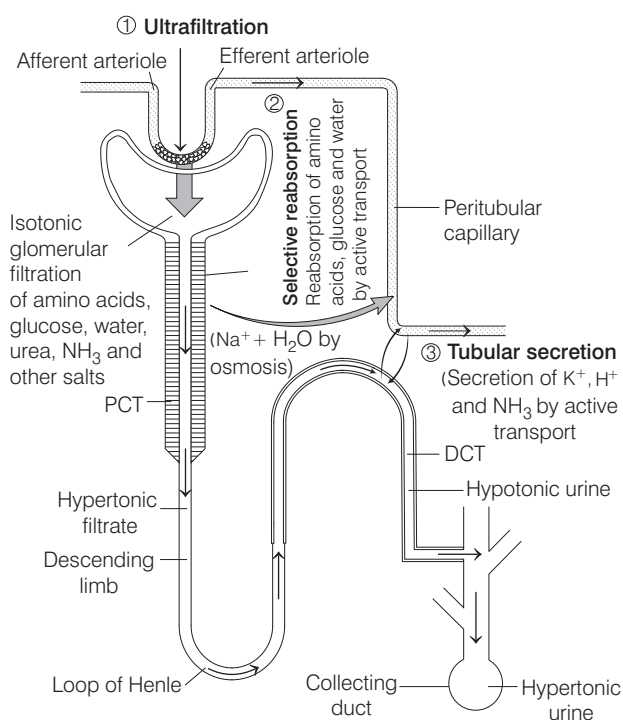


Diagram showing three main processes of urine formation

- They are instead passed into the distal convoluted tubule by the activity of cells of tubular walls, i.e. reabsorption and secretion.

- This step helps in the maintenance of ionic and acid base balance of body fluids.

#### Summary of Urine Formation

Steps	Occurrence	Molecules
<b>Glomerular filtration</b>	Blood pressure pushes small molecules from the glomerular capsule.	Water, glucose, amino acids, salt, urea, uric acid and creatinine.
<b>Tubular reabsorption</b>	Diffusion and active transport bring back molecules to blood at the proximal convoluted tubule.	Water, glucose, amino acids and salts.
<b>Tubular secretion</b>	Active transport moves molecules from blood to the distal convoluted tubule.	Uric acid, creatinine, hydrogen ions, ammonia and penicillin.
<b>Reabsorption of water</b>	Along the length of the nephron and notably at loop of Henle and collecting duct, water returns by osmosis by active reabsorption of salts.	Salt and water.
<b>Excretion</b>	Urine formation rids body of metabolic wastes.	Water, salts, urea, uric acid, ammonium and creatinine.

#### CHECK POINT 03

- List the three steps of urine formation.
- What role does blood pressure play during glomerular filtration?
- What is the main transformation present in glomerular filtrate compared to blood?
- In which step of urine formation does excess of water, urea, glucose and amino acids are reabsorbed?
- List the molecules that are filtered out during tubular secretions.

## Urine

The filtrate left behind after the completion of all steps of urine formation is known as **urine**. It is expelled out from the urethra (in the penis in males and directly to exterior in females) under the impulse of nervous system.

This process of expelling out of urine is known as **urination** or **micturition**.

Urine is a clear yellow fluid having pH around 6 (slightly acidic in nature).

The colour of urine is yellow due to the presence of **urochrome**, a pigment formed by the breakdown of haemoglobin.

The colour and pH of urine may vary with the diet of a person.

## Composition of Urine

Normally, urine constitutes about 95% water and 5% solid wastes (including organic and inorganic substances).

Constituents of urine (in gm/L of urine) are listed in the table given below

Composition of Urine	
Organic (g/L)	Inorganic (g/L)
Urea-2.3	NaCl-9.0
Uric acid-0.7	KCl-2.5
Creatinine-1.5	Ammonia-0.6
Others-2.6	Others-2.5

## Micturition

The process of release of urine is called **micturition** and the neural mechanism causing it, is called the **micturition reflex**. Let us study how the process of micturition takes place.

Urine is produced and drained continuously by the nephron into the renal pelvis. From here, it is carried down to the ureters and then into the urinary bladder.

The bladder serves to store the urine temporarily till a voluntary signal is given by the **Central Nervous System** (CNS). As soon as the urine is collected, the muscular walls of the bladder distend to accommodate it.

The stretch receptors on the walls of the bladder set up reflexes, i.e. send signals to the CNS by stimulating the sensory nerve ending in the bladder. It causes an urge to pass out urine.

## Disorders of Excretory System

Malfunctioning of kidneys can lead to several disorders of the excretory system as given below

Disorders	Causes
Glycosuria	When glucose passes with urine due to diabetes mellitus, i.e. lack of insulin hormone in the body.
Diuresis	Lack of Antidiuretic Hormone (ADH), increases production of urine.
Kidney stones	The accumulation of calcium oxalate crystals in the kidney.
Gout	Uric acid crystals gets deposited in the joints.
Haematuria	The infection in the urinary tract. During this condition, the formation of kidney stone or tumour occurs and also blood passes with urine.
Uremia	The presence of an excessive amount of urea in the blood.
Kidney failure	When a kidney becomes partially or completely unable to perform excretory functions.

In case of various infections, injury or restricted blood flow to kidneys, etc, the normal activities of kidneys decreases, leading to accumulation of poisonous wastes in the body, which can even lead to death. Such situations of the kidney failure can be coped up by **artificial kidney**, that is a device used to remove nitrogenous waste products from the blood through dialysis.

### Difference between Artificial Kidney and Natural Kidney

Artificial kidney is different from natural kidney as the process of reabsorption does not occur in artificial kidney. Normally, in a healthy adult, the initial filtrate is about 180 L daily. However, the volume actually excreted is only 1-1.8 L a day. This happens because the remaining filtrate is reabsorbed in the tubules of the kidney. This does not happen in the case of artificial kidney.

**Note** Kidney transplantation is the ultimate procedure in case of complete kidney failure.

### CHECK POINT 04

- 1 What is the pH of urine of a normal person?
- 2 What amount of urea and sodium chloride is found in urine?
- 3 Define micturition.
- 4 How does gout occur in our body?
- 5 Give the biological/technical term for the presence of excess amount of urea in the blood.
- 6 Name the scientific term for the presence of blood in urine.

# SUMMARY

- Excretion is the process of removal of waste material from the body.
- Osmoregulation is the process of maintaining osmotic and ionic concentration of body fluid.
- Type of excretory products depends on the habitat, feeding habits and metabolism of an organism. It can be ammonia (ammonotelism), urea (ureotelism) and uric acid (uricotelism).
- Human excretory system consists of two kidneys, two ureters, a urinary bladder and a urethra.
- Human kidneys are mesodermal in origin, with retroperitoneal arrangement (present outside coelomic cavity). Externally, they are reddish-brown, bean-shaped. Right kidney is smaller and placed lower compared to left one.
- Internally, human kidneys contain three protective layers, renal capsule, adipose capsule and renal fascia. Kidney is divided into two zones, i.e. an outer cortex and an inner medulla.
- Nephrons are the structural and functional unit of kidneys. They consist of renal corpuscle or Malpighian body and renal tubules.
- Renal corpuscles consist of Bowman's capsule, i.e. a cup-shaped structure containing network of thin capillaries called glomerulus.
- Renal tubules are associated with process of reabsorption and secretion. It is formed of four parts, i.e. proximal convoluted tubule, Henle's loop (descending, ascending and a main loop), DCT and collecting duct.
- Ureters are muscular tubes conveying urine from kidneys to the bladder. Urinary bladder, a pear-shaped structure where urine is stored. Urethra is present in mammals only, it is a canal extending from bladder to outside via external urethral orifice.
- Urine formation is called uropoiesis and occurs in three steps. These are ultrafiltration, selective reabsorption and tubular secretion.
- Ultrafiltration occurs when blood containing water and solutes enters the afferent arteriole in glomerulus. Glomerulus Filtration Rate (GFR) is the amount of filtrate formed by kidneys per minute (180 L/day).
- Selective reabsorption is the absorption of almost 99% of filtrate in renal tubules. 65% of filtrate is reabsorbed in PCT ( $\text{Na}^+$ ,  $\text{K}^+$ , glucose, amino acids, etc.). Reabsorption is minimum in Henle's loop, absorption of  $\text{Na}^+$  occurs in DCT due to aldosterone. In collecting duct, water reabsorption occurs.
- Tubular secretion is the phenomenon of secretion of metabolic wastes by tubular cells into the filtrate. It is an active process which occurs in PCT, DCT and collecting duct. It helps in maintenance of ionic and acid-base balance of body fluid.
- The blood supply to kidneys is maintained by the renal artery and renal veins.
- Micturition is the release of urine from bladder. It occurs due to the contraction and relaxation of urinary bladder and urethral sphincter. The signal for micturition originates from a stretched bladder.
- Urine is pale yellow (due to urochrome pigment), slightly acidic (pH-6), normally transparent and faintly aromatic.
- Disorders of excretory system occur due to failure of kidneys or malfunctioning of renal components, e.g. renal stones, renal failure, uremia, etc.

# EXAM PRACTICE

## Multiple Choice Questions

- Excretion process involves
  - removal of nitrogenous waste
  - removal of byproducts of anabolism and catabolism
  - removal of bile pigments
  - All of the above

**Ans.** (d)

- 'Aquatic animals excrete ammonia'. Which one of the following statements does not support this statement?
  - Ammonia is easily soluble in water
  - Ammonia is released from the body in gaseous state
  - Ammonia is highly toxic and needs to be eliminated when formed
  - Ammonia gets converted into less toxic form called urea and uric acid

**Ans.** (b)

- The chief nitrogenous waste in mammals is
  - ammonia
  - urea
  - uric acid
  - amino acids

**Ans.** (b)

- The formation of urine in our excretory system is known as
  - haemopoiesis
  - uropoiesis
  - leucopoiesis
  - None of these

**Ans.** (b)

- Ultrafiltrate generated by the glomerulus is having all the constituents of the blood plasma except
  - protein
  - RBC
  - WBC
  - All of these

**Ans.** (b)

- Maximum amount of water from the glomerular filtrate is reabsorbed in
  - PCT
  - DCT
  - ascending limb of Henle's loop
  - descending limb of Henle's loop

**Ans.** (a)

- Which substance is present at a lower concentration in the renal artery than in the renal vein?

- Amino acids
- Carbon dioxide
- Glucose
- Urea

**Ans.** (b)

- The nephron discharge their urine at the [2016]

- urinary bladder
- urethra
- renal pelvis
- renal pyramid

**Ans.** (c)

- The proximal convoluted tubule of a nephron is present in

- medulla
- cortex
- ureter
- None of these

**Ans.** (b)

- Which of the following statement(s) is/are true?

- Urine is hypertonic in distal convoluted tubule
- When the urine passes into collecting tubule, it becomes hypotonic
- Urine becomes more and more hypotonic as it passes through Henle's loop
- Both (a) and (c)

**Ans.** (d)

- The thin membranous sac serving as the reservoir of urine is

- urinary bladder
- ureter
- glomerulus
- kidney

**Ans.** (a)

## Fill in the Blanks

- The process of removal of waste products formed by metabolic activities is called .....
  - The renal artery carries blood which supplies high concentration of ..... and ..... for tissue respiration in the kidney cells.
  - Urochrome helps in breakdown of ..... in liver.
  - ..... and ..... are reabsorbed by passive transport.
  - Increased production of urine is called .....
  - ..... of excess amino acids in liver produces urea which is excreted by the .....

- (vii) The outer part of a kidney is ..... and the inner part is ..... .
- (viii) Water along with other useful substances like salts, amino acids, glucose, etc., are reabsorbed in ..... .
- (ix) The process of uropoiesis that helps in maintenance of ionic and acid-base balance is ..... .
- (x) The process of release of urine is ..... .

**Ans.** (i) excretion  
 (ii) oxygen, nutrients  
 (iii) haemoglobin  
 (iv) Water, urea  
 (v) diuresis  
 (vi) Deamination, kidney  
 (vii) cortex, medulla  
 (viii) renal tubule  
 (ix) tubular secretion  
 (x) micturition

### True-False

- 13.** State whether the following statements are true or false.
- (i) Ammonia is very toxic for brain cells because it changes the polarity of cell membrane of brain cells.
- (ii) Urine contains 2.6 g/L of urea.
- (iii) Artificial kidney is better than natural kidney.
- (iv) The colour of urine depends upon diet of person.
- (v) Urea is formed in lungs.
- (vi) DCT is the end part of a neuron.
- (vii) The glomerulus helps in reabsorption.
- (viii) The glomerular filtrate consists of glucose along with other components.

**Ans.** (i) True  
 (ii) True  
 (iii) **False.** Because process of reabsorption can't take place in artificial kidney.  
 (iv) True  
 (v) **False.** Urea is formed in liver.  
 (vi) **False.** DCT is the end part of a nephron.  
 (vii) **False.** Glomerulus helps in ultra-filtration.  
 (viii) True

### Match the Columns

- 14.** Match the following columns.

Column I	Column II
A. Liver	1. Blood supply to glomerulus.
B. Skin	2. Knot-like tuft of blood capillaries in Bowman's capsule.
C. Kidney	3. Breakdown of proteins.
D. Glomerulus	4. Sweat glands.
	5. Bean-shaped excretory organ.

**Ans.** A-3, B-4, C-5, D-2

- 15.** Match the following columns.

Column I	Column II
A. Proximal convoluted tubule	1. Formation of concentrated urine.
B. Distal convoluted tubule	2. Filtration of blood.
C. Henle's loop	3. Reabsorption of 70-80% of electrolytes.
D. Micturition	4. Ionic balance.
E. Renal corpuscle	5. Process of release of urine from the body.

**Ans.** A-3, B-4, C-1, D-5, E-2

- 16.** Match the following columns.

Column I	Column II
A. Uremia	1. The presence of blood cells in urine.
B. Hematuria	2. The presence of glucose in urine.
C. Glycosuria	3. The presence of urea in urine.

**Ans.** A-3, B-1, C-2

### **a** 1 Mark Questions

- 17.** Name the following.

- (i) The organisms excreting urea as their excretory product.
- (ii) The functional units of kidney.

**Ans.** (i) Ureotelic  
 (ii) Nephron.

[½ × 2]

- 18.** Give appropriate biological or technical term for the following

Process of maintaining water and salt balance in the blood. [2018]

**Ans.** Osmoregulation

- 19.** Name the organ which produces urea. [2017, 12]

**Ans.** Liver is the organ that produces urea.

- 20.** Choose the odd one out of the following terms given and name the category to which the other belong. [2017]

Bile, urea, uric acid, ammonia

**Ans.** Odd term Bile

Which helps in the digestion of lipid in small intestine.

Rest three are the type of excretory material in different organisms.

- 21.** Given below is the set with four terms, in which one term is odd and cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong. Urethra, uterus, urinary bladder, ureter. [2014]

**Ans.** Odd term is uterus. It is the part of reproductive system. Other three are the part of excretory system.

- 22.** Differentiate between the following pair on the basis of what is mentioned in bracket. [2017]

Renal cortex and renal medulla  
[Parts of the nephrons present].

**Ans.** Difference between renal cortex and renal medulla is

Renal cortex	Renal medulla
Malpighian body, Proximal Convoluted Tubule (PCT) and Distal Convoluted Tubule (DCT) and found in renal cortex.	Henle's loop is found in renal medulla.

- 23.** Mention the exact location of 'Loop of Henle'. [2015]

**Ans.** Henle's loop is a U-shaped (or hairpin-shaped) region of renal tubule that runs in the medulla region of kidney. It has a descending loop that ends into the medulla and an ascending limb that extends back from medulla into the cortex.

- 24.** Name the following

Knot-like mass of blood capillaries inside the Bowman's capsule. [2013]

**Ans.** Glomerulus is the knot-like mass of blood capillaries found inside the Bowman's capsule.

- 25.** Write special functional activity of the ureter. [2013]

**Ans.** Ureter carries urine from kidney to the urinary bladder.

- 26.** Differentiate between the following what is given in the bracket. Bowman's capsule and Malpighian capsule (parts included). [2013]

**Ans.** Difference between Bowman's capsule and Malpighian capsule is as follows

Bowman's capsule	Malpighian capsule
It is a cup-shaped structure that indicates the beginning of nephron.	It is comprised of glomerulus and Bowman's capsule.

- 27.** Given below is the set of five terms rewrite the terms in logical sequence as directed at the end of statement.

Renal vein, renal artery, afferent arteriole, efferent arteriole, glomerulus (pathway of blood through glomerulus). [2012]

**Ans.** Logical sequence for pathway of blood through glomerulus is as follows

Renal artery, afferent arteriole, glomerulus, efferent arteriole, renal vein.

- 28.** State the exact location of proximal convoluted tubule. [2016]

**Ans.** Cortex region of kidney.

- 29.** The renal cortex has a dotted appearance, why? [2013]

**Ans.** Renal cortex is dark in colour and presence of numerous nephrons in a highly coiled manner gives this region a dotted appearance.

- 30.** Name the two main stages of urine formation. [2005]

**Ans.** The two main stages of urine formation are

- Ultrafiltration
- Selective reabsorption

- 31.** Give the biological/technical terms for the hormone increasing reabsorption of water by kidney tubules. [2015]

**Ans.** Antidiuretic hormone (vasopressin)

- 32.** Correct the following statement by changing the underlined word.

Normal pale yellow colour of the urine is due to the presence of the pigment melanin. [2018]

**Ans.** Urochrome

**33.** Give reason.

Urine is slightly thicker in summer than in winter. [2011]

**Ans.** In summer, considerable part of water is lost due to perspiration. So, more water is reabsorbed in the kidney. Thus, making the urine more concentrated.

**34.** State whether true or false. If false, rewrite the correct form of the statement by changing the first or last word only.

Urethra carries urine from kidney to the urinary bladder.

**Ans.** The given statement is false. Correct statement is ureter carries urine from kidney to the urinary bladder.

**35.** Expand the following terms.

(i) PCT (ii) GFR

**Ans.** (i) Proximal Convoluted Tubule (PCT)  
(ii) Glomerular Filtration Rate (GFR) [1/2 × 2]

**36.** How does CNS receive the signals when there is an urge to pass urine?

**Ans.** Stretch receptors present in the walls of urinary bladder send signal to CNS by setting up reflexes.

## **b** 2 Marks Questions

**37.** In what way kidney is a homeostat organ?

**Ans.** Homeostasis means maintenance by an organism of a constant internal environment. Kidney helps to maintain a steady or constant state of internal atmosphere by excreting waste products and reabsorbing useful substances like water and salts of sodium and potassium. It also maintains the water contents of blood constant.

**38.** The excretion process is different from osmoregulation. How?

**Ans.** Excretion is the process of removal of toxic wastes from the body, whereas osmoregulation is the process of maintenance of sufficient amount of water and the ionic balance of body fluids in the body.

**39.** Where does the selective reabsorption of glomerular filtrate take place?

**Ans.** The selective reabsorption of glomerular filtrate takes place in Proximal Convoluted Tubules (PCT) and Distal Convoluted Tubules (DCT). In PCT, all essential elements, nutrients, 70-80% of electrolytes and water is absorbed. Whereas, Distal Convoluted Tubule (DCT) is involved in conditional reabsorption of  $\text{Na}^+$  and water.

**40.** Give the biological technical term for the following [2016]

- (i) Pigment providing colour to urine
- (ii) The removal of nitrogenous wastes from the body

**Ans.** (i) Urochrome  
(ii) Excretion. [1 × 2]

**41.** The composition of glomerular filtrate and urine is not same. Comment.

**Ans.** The composition of **glomerular filtrate** and **urine** is not the same.

The glomerular filtrate contains a large amount of water and other dissolved substances such as urea, uric acid, creatinine, amino acid, glucose, sodium, potassium, vitamins, etc.

Urine on the other hand is a transparent, light yellow fluid, which is formed after rigorous reabsorption and secretion from the filtrate. It constitutes about 95% water and 5% of other organic (urea, nitrogen, creatine, etc.) and inorganic substances ( $\text{Cl}^-$ ,  $\text{Ca}^{2+}$ ,  $\text{Fe}^{2+}$ , etc.).

**42.** Explain the process of micturition.

**Ans.** Refer to text on page no. 158.

**43.** What role is played in excretion by (i) lungs  
(ii) kidneys?

**Ans.** (i) The lungs excrete carbon dioxide and water vapour from the body in the expired air.  
(ii) The kidneys excrete excess mineral salts, nitrogenous waste products (urea, creatinine and uric acid) and excess water in the urine. [1 × 2]

**44.** What is the composition of sweat produced by sweat glands?

**Ans.** Sweat produced by sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, etc. Its primary function is to facilitate a cooling effect on the body surface and also help in removal of waste.

**45.** What is the procedure advised for the correction of extreme renal failure? Give a brief account of it.

**Ans.** Kidney transplantation is the ultimate method for the correction of acute/extreme kidney failure. A functional kidney is used as a transplant from a donor, preferably a close relative to minimise its chances of rejection by the immune system of the host. Modern clinical procedures have increased the success rate of such a complicated technique.

### C 3 Marks Questions

**46.** What is ureotelism? Describe the process of formation of urea.

**Ans.** The process of excreting urea is called ureotelism. Animals which do not live in high abundance of water, convert ammonia produced in the body into urea in the liver. Thereafter, this urea is released into the blood, which is filtered and thus, urea is excreted out by the kidneys.

**47.** Mention atleast three functions of kidney.

**Ans.** Functions of kidney are

- (i) It helps in regulation of water and electrolyte balance.
- (ii) It helps in the excretion of metabolic waste products.
- (iii) It helps in the reabsorption of useful products in the body and regulates pH of the blood. [1 × 3]

**48.** Name the following

- (i) The organic constituents of normal urine.
- (ii) The organ in humans concerned with maintenance of water balance in body.
- (iii) The process by which kidneys regulate the water content of the body.

**Ans.** (i) Urea, creatinine  
(ii) Kidney  
(iii) Osmoregulation [1 × 3]

**49.** Where do ultrafiltration, reabsorption and secretion occur in a nephron?

**Ans.** (i) Ultrafiltration occurs in Bowman's capsule.  
(ii) Reabsorption occurs in PCT, loop of Henle, DCT and collecting duct.  
(iii) Secretion occurs in PCT, loop of Henle and DCT. [1 × 3]

**50.** Define the term 'uropoiesis'. Where does it take place? Name the processes involved in the formation of urine.

**Ans.** The process of urine formation is called uropoiesis. Urine formation occurs in the kidneys. It involves three processes  
(i) Glomerular filtration  
(ii) Selective reabsorption  
(iii) Tubular secretion. [1 × 3]

**51.** Name any three disorders of excretory system.

**Ans.** The three disorders related to excretory system are  
(i) Pyuria (ii) Gout (iii) Uremia [1 × 3]

**52.** Explain any three disorders of the excretory system.

**Ans.** The disorders of excretory system include  
(i) **Uremia** It is the presence of an excessive amount of urea in the blood. Urea is highly harmful as it poisons the cells at high concentration and may lead to kidney failure.  
(ii) **Kidney failure** (renal failure) Partial or total inability of kidneys to carry on excretory and salt-water regulatory functions is called renal or kidney failure.  
(iii) **Kidney stones** or **Renal calculi** It is the formation of stone or insoluble mass of crystallised salts (calcium, magnesium, phosphates and oxalates, etc.) formed within the kidney. [1 × 3]

### d 4 Marks Questions

**53.** Give reason for the following

- (i) Certain useful products like glucose, salt, etc. are filtered but not excreted by ultrafiltration.
- (ii) Reabsorption is called as selective reabsorption.
- (iii) It is necessary to maintain a normal osmotic concentration of the blood.
- (iv) Dialysis

**Ans.** (i) Glucose, salt, etc. get reabsorbed in the proximal part of renal tubules, hence are not filtered.  
(ii) Only certain selected materials such as glucose, some salts, etc. are reabsorbed in the renal tubule. Thus, it is called selective reabsorption  
(iii) To keep the body cells in a steady state, it is essential to maintain the osmotic concentration of blood.  
(iv) Dialysis is done when both kidneys of a patient are impaired to carry out their normal functions. [1 × 4]

**54.** Name the following

- (i) An organic waste produced in man.
- (ii) The structure formed by Bowman's capsule and glomerulus together.
- (iii) The branch of renal artery entering the Bowman's capsule.
- (iv) The pH of the normal urine.

**Ans.** (i) Carbon dioxide (ii) Malpighian body  
(iii) Afferent arteriole (iv) 6 [1 × 4]

**55.** Differentiate between

- (i) Ureter and urethra
- (ii) Afferent and efferent arterioles.

**Ans.** (i) Differences between ureter and urethra are

Ureter	Urethra
It transports urine from the kidney to urinary bladder.	It transports urine from urinary bladder to the exterior or outside of our body.
Sphincter muscle is absent.	The opening and closing is regulated by sphincter muscle.

(ii) Differences between afferent and efferent arterioles are

Afferent Arteriole	Efferent Arteriole
It carries blood containing waste materials.	It carries blood having less waste material or reduced amount of waste material.
It transports blood to the glomerulus.	It transports blood away from the glomerulus.

[2 × 2]

**56.** (i) Why glucose is not found in the urine of a healthy person?

(ii) There is frequent urination in winter than in summer. Why?

**Ans.** (i) Glucose is reabsorbed into the blood stream in the proximal part of nephron. So, in a normal healthy persons, urine is devoid of glucose. [2]

(ii) In winter, sweating is less, so more water is given out in the form of urine. Reverse process happens in summer. [2]

**57.** 'Defaecation is not excretion'. Explain.

**Ans.** Refer to text on page no 154.

**58.** (i) What is the medical term used for the stone in kidney?

(ii) Why should we drink a lot of water on the regular basis?

(iii) Name the ions which are involved in the formation of renal stones.

(iv) Urochrome, the pigment present in urine develops where and from what?

**Ans.** (i) Renal calculi.

(ii) For the normal regulation of kidney functions.

(iii) Calcium, magnesium, phosphates and their oxalates, etc.

(iv) Urochrome is formed by the breakdown of bile pigments in liver. [1 × 4]

## e 5 Marks Questions

**59.** State the functions of following structures

- (i) Sweat glands
- (ii) Renal pelvis
- (iii) Glomerulus
- (iv) Loop of Henle
- (v) Bladder sphincter

**Ans.** (i) Sweat glands eliminate extra water and salts through sweating, i.e. perspiration.

(ii) Renal pelvis is the proximal part of ureter that breaks into 2-3 branches towards kidney to form major calyx. It acts as a funnel that collect urine flowing into ureter.

(iii) Glomerulus is the part of nephron where filtration of blood occurs.

(iv) Loop of Henle absorbs the water and solutes from the glomerular filtrate.

(v) Bladder sphincter regulates the opening and closing of bladder for urination. [1 × 5]

**60.** How does tubular secretion help in maintaining ionic and acid-base balance in body-fluids?

**Ans.** In addition to the role of Proximal Convoluted Tubules (PCT) in selective reabsorption of materials from the glomerular filtrate, they also alter the composition of filtrate by the process of **secretion**.

In its distal part, epithelial cells extract certain excretory substances from the blood of peritubular capillaries and secrete these into the filtrate.

Creatinine, hippuric acid, pigments, drugs including penicillin are actively secreted into the filtrate in the proximal convoluted tubule from the interstitial fluid. Hydrogen ions and ammonia are also secreted into the proximal convoluted tubules.

Urea enters the filtrate *via* diffusion in the thin segment of ascending limb of Henle's loop. Maximum hydrogen secretion occurs in the proximal convoluted tubules. Removal of hydrogen ion and  $\text{NH}_3$  from the blood in the PCT and Distal Convoluted Tubule (DCT) helps in maintaining pH of the blood, between 6 to 8.

Tubular secretion although possesses a minor role in functioning of the human kidney, but plays an essential role in animals like marine fishes and desert amphibians because these animals do not possess well developed glomeruli. Hence, their urine is mainly formed by the tubular secretion of urea, creatinine and mineral ions.

**61.** (i) 'Urine is formed from alkaline blood but is acidic in nature.' Comment on this statement.

(ii) Kidneys are the master chemist of the body. Comment.

**Ans.** (i) The blood in our body is alkaline in nature but the urine that forms from the blood is acidic. It is so because the acidic products are being continuously added to the blood.

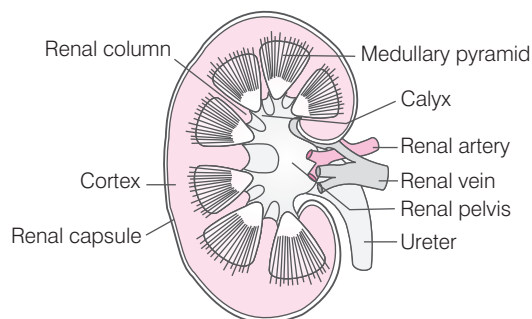
But the filtration process of kidney selectively absorbs such products from the blood into urine, which makes the nature of urine acidic when compared with alkalinity of the blood. [2½]

(ii) The kidneys purify the blood by excreting toxic and waste products from the blood. The maintenance of ionic, salt and water balance is also a function of kidney.

Hence, the kidneys are master chemist as they eliminate only the wastes and extra substances from the body to outside. Thus, it maintain the correct ionic, water and salt balance. [2½]

**62.** Draw a labelled diagram of the longitudinal section of the kidney.

**Ans.** The longitudinal section of kidney is given in diagram below



Longitudinal section of a kidney

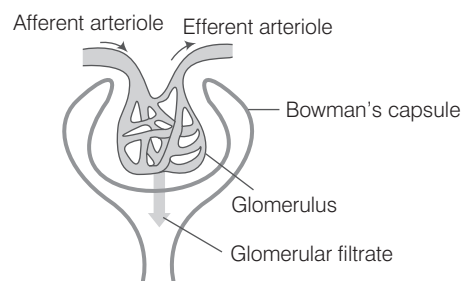
The outer layer of the kidney is a tough capsule. Inside the kidney, there are two zones-cortex and medulla. Medulla is divided into few conical masses called medullary pyramids.

The cortex extends in between the medullary pyramids as renal columns called columns of Bertini.

**63.** (i) Draw a neat diagram of a single Malpighian capsule (body) and label the following parts. Glomerulus, Bowman's capsule, afferent arteriole and efferent arteriole.

(ii) Name and define the process that occurs in the glomerulus. [2015]

**Ans.** (i)



(ii) Ultrafiltration is the process that occurs in the glomerulus. It is defined as the filtration of blood that takes place under high pressure. [2½ × 2]

**64.** Draw the basic structure of renal tubule.

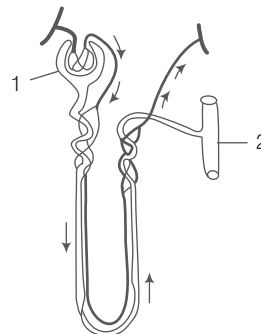
**Ans.** Refer to fig on page 155.

## Diagram Based Questions

**65.** The diagram given below is that of a structure present in a human kidney.

Study the same and answer the questions that follows

- (i) Name the structure represented in the diagram.
- (ii) What is the liquid entering part '1' called? Name two substances present in this liquid that are reabsorbed in the tubule.



- (iii) What is the fluid that comes to part '2' called? Name the main nitrogenous waste in it.
- (iv) Mention the three main steps involved in the formation of the fluid mentioned in (iii) above.
- (v) Name the substance which may be present in the fluid in part '2' if a person suffers from diabetes mellitus. [2018]

**Ans.** (i) Nephron

(ii) Glomerular filtrate

Glucose, amino acids, salts, etc., get reabsorbed from the filtrate as it passes down the tubule.

(iii) Urine

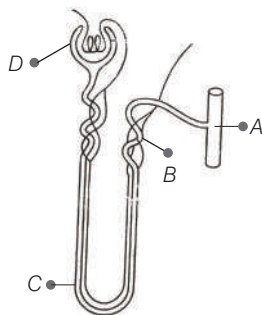
Urea is the main nitrogenous waste (2.6 g/L) present in urine.

(iv) Three main steps of urine formation are  
(a) Ultrafiltration (Glomerular filtration)

- (b) Selective reabsorption
- (c) Tubular secretion
- (v) The urine of a person suffering from diabetes mellitus contains glucose in it.

This condition is called as glycosuria.

**66.** The diagram given below represents a nephron and its blood supply. Study the diagram and answer the following questions.



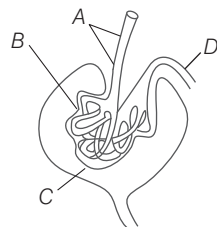
- (i) Label parts *A*, *B*, *C* and *D*.
- (ii) State the reason for the high hydrostatic pressure in the glomerulus.
- (iii) Name the blood vessel which contains the least amount of urea in this diagram.
- (iv) Name the part of the nephron which lies in the renal medulla.

[2014]

- Ans.** (i) Different parts in the diagram are labelled as  
*A* – Collecting duct, *B* – Distal convoluted tubule  
*C* – Loop of Henle, *D* – Bowman's capsule.
- (ii) As the afferent arteriole splits into many fine branches so the volume of capillaries reduce, thereby raising the hydrostatic pressure in the glomerulus.
  - (iii) Blood vessel that contains the least amount of urea in this diagram is efferent arteriole, that connects to renal vein.
  - (iv) Loop of Henle is the part of renal tubule that lies in medulla region of kidney.

**67.** Study the diagram below and then answer the questions that follows

- (i) Name the region in the kidney where the structure is present.
- (ii) Name the parts labelled *A*, *B*, *C* and *D*.



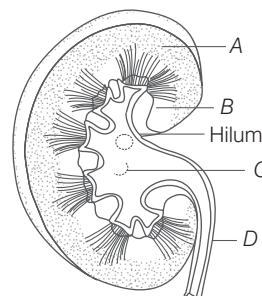
- (iii) What is the technical term given to the process occurring in *B* and *C*? Briefly

**Ans.** (i) Cortex.

- (ii) *A* – Afferent arteriole, *B* – Glomerulus,  
*C* – Bowman's capsule, *D* – Efferent arteriole.

- (iii) **Ultrafiltration** It is the process of filtration of the liquid part of blood in the glomerulus due to the hydrostatic pressure created. It is because of the diameter differences of afferent arteriole and efferent arteriole. The filtrate which is pushed into the Bowman's capsule is called glomerular filtrate.

**68.** (i) The diagram given below shows a section of a human kidney. Study the diagram carefully and answer the questions that follows [2015]



- (a) Label the parts numbered *A* to *D*.
- (b) Why does part '*B*' have a striped appearance?
- (c) What is the fluid that passes down part '*D*'?  
Name the main nitrogenous waste present in it.
- (d) Mention the structural and functional units of kidneys.
- (e) Name the two major steps in the formation of the fluid mentioned in Q. 65 (iii).

- (ii) Draw neat and labelled diagram of the Malpighian capsule.

- Ans.** (i) (a) *A* – Cortex, *B* – Medulla, *C* – Pelvis, *D* – Ureter
- (b) Part *B* has striped appearance because the nephrons run about straight in this region and conical pyramids are present.
  - (c) The fluid that passed down from part *D* is urine. The main nitrogenous waste present in it is urea.
  - (d) The structural and functional unit of kidney is nephron.
  - (e) The two major steps are
    - Ultrafiltration
    - Selective reabsorption

- (ii) Refer to fig on page 155.

# CHAPTER EXERCISE

## Multiple Choice Questions

- The following substances are the excretory products in animals. Choose the least toxic form among them.  
(a) Urea (b) Uric acid  
(c) Ammonia (d) Carbon dioxide
- A detoxifying gland present in our body which performs excretory functions is  
(a) thyroid (b) liver  
(c) hypothalamus (d) lungs
- A large quantity of one of the following is removed from our body by lungs.  
(a) Only  $\text{CO}_2$  (b) Only  $\text{O}_2$   
(c) Both (a) and (b) (d) ammonia
- Micturition reflex is a neural mechanism to  
(a) release sweat  
(b) formation of urine  
(c) release urine  
(d) release inorganic substance to the urine
- Identify the incorrect statement.  
(a) The outer layer of the kidney is called renal pelvis  
(b) Cortex is divided into outer cortex and inner medulla  
(c) Medulla is divided into medullary pyramids  
(d) The cortex extends in between the medullary pyramids, which is called as columns of Bertini

## Answers

1. (b) 2. (b) 3. (a) 4. (c) 5. (a)

## Fill in the Blanks

- Fill in the blanks  
(i) The sum total of all the chemical reactions that occur in a cell is known as.....  
(ii) The presence of glucose in urine is observed during.....  
(iii) The first step in urine formation is the ..... of the blood, which is carried by the ... and is called as ...  
(iv) The excretory system removes the waste products generated from several ..... reactions occurring in our body.

## True-False

- State whether the following statements are true or false.  
(i) The nitrogenous wastes are formed by breakdown of fat molecules.  
(ii) The renal artery transports blood to the kidneys.  
(iii) Urine contains urea in excess.  
(iv) A diuretic substance increases the amount of urine.  
(v) Lungs aids in excretory process by elimination of urea while liver breaks down salts.  
(vi) Renal transplant is required when a kidney is not functioning properly.

## Match the Columns

- Match excretory functions in column I with the parts of excretory system in column II and choose the correct option from the codes given below.

Column I (Function)	Column II (Part of Excretory System)
A. Ultrafiltration	1. Henle's loop
B. Concentration of urine	2. Ureter
C. Transport of urine	3. Urinary bladder
D. Storage of urine	4. Malpighian corpuscle
	5. Proximal convoluted tubule

## 1 Mark Questions

- Classify the following organisms as ammonotelic, uricotelic and ureotelic.  
Pigeon, fishes, lizard, cockroach, man and frog.
- Write special functional activity of the ureter.
- What is the ratio of the concentrated filtrate to that of the initial filtrate?
- Complete the following  
(i) Urinary excretion = Tubular reabsorption + Tubular secretion - .....  
(ii) Dialysis fluid = Plasma - .....

## 2 Marks Questions

- Give reasons.  
(i) The body needs to remove excess water from it.  
(ii) All living beings must excrete.
- Given below is a jumbled sequence of various parts of a specific structure.

Proximal convoluted tubule, glomerulus, Henle's loop, Bowman's capsule, distal convoluted tubule.

Now answer the following questions

- (i) Identify the structure to which the given parts belong.
- (ii) Rearrange these structures in their logical sequence from start to end.

- 15.** Explain how the blood system carries waste product from the liver to the kidneys.

### 3/4 Marks Questions

- 16.** Choose the odd word out from the sets given below
- (i) Kidney, liver, skin, lungs, pancreas
  - (ii) Afferent arteriole, efferent arteriole, vasa recta, glomerulus
  - (iii) Urea, carbon dioxide, ammonia, uric acid
- 17.** Differentiate between
- (i) Excretion and defaecation
  - (ii) PCT and DCT in a nephron
  - (iii) Cortex and medulla
- 18.** The given statements are incorrect. Rewrite the correct form of the statements by changing the underlined words.
- (i) Glomerulus and tubular reabsorption.
  - (ii) Micturition and diuresis.
  - (iii) Haematuria and inflammation.
- 19.** Describe how molecules are reabsorbed during selective reabsorption.
- 20.** Differentiate between the modes of excretion including excretory products, examples and processes.
- 21.** Why nephrons are also called uriniferous tubules?

### 5 Marks Questions

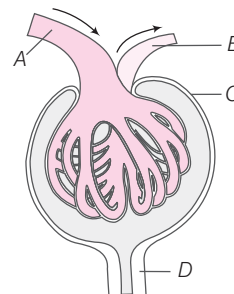
- 22.** Name the waste products of metabolism and for each waste product, state which organ removes it from the blood.
- 23.** (i) Why is the removal of faeces from the alimentary canal not considered as excretion?  
(ii) Name the waste products excreted by lungs and skin.
- 24.** Name the following
- (i) The gas excreted by lungs as waste product.
  - (ii) The light coloured division of kidney, which is sub-divided into conical renal pyramids.
  - (iii) The inner concave margin of a kidney.

- (iv) The blood vessels transporting pure blood to kidneys.

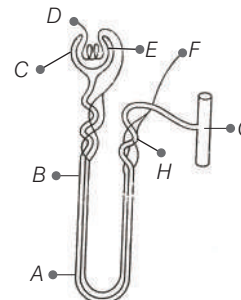
- 25.** (i) Briefly discuss the following processes given below  
(a) Ultrafiltration (b) Selective reabsorption  
(c) Tubular secretion
- (ii) Which event include the above processes as its part.
  - (iii) Identify the product formed by combination of the above processes.
- 26.** Draw a diagram showing process of urine formation.
- 27.** (i) Draw a well-labelled diagram of human excretory system.  
(ii) What kind of wastes are generally excreted out from various organs?

### Diagram Based Questions

- 28.** Observe the diagram given below and answer the following questions



- (i) In which part ultrafiltration takes place? Identify this part.
  - (ii) Highest concentration of urea will be observed in which part? Name it.
  - (iii) Reabsorption of water occurs in which part? Name the part.
  - (iv) The figure given above is fundamental unit of which organ?
- 29.** Observe the diagram given below and answer the following questions.



- (i) The region of kidney, where the given structure is present.
- (ii) Identify the parts labelled as A, B, C and D.

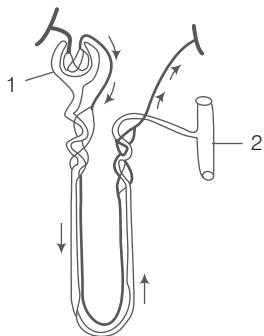
# ARCHIVES\*

## (Last 8 Years)

Collection of Questions Asked in Last 8 Years' (2018-2011) ICSE Class 10th Examinations

### 2018

- Correct the following statement by changing the underlined word.  
Normal pale yellow colour of the urine is due to the presence of the pigment melanin. [1]
- Give appropriate biological or technical term for the following  
Process of maintaining water and salt balance in the blood. [1]
- The diagram given below is that of a structure present in a human kidney.  
Study the same and answer the questions that follows



- Name the structure represented in the diagram.
- What is the liquid entering part '1' called?  
Name two substances present in this liquid that are reabsorbed in the tubule.
- What is the fluid that comes to part '2' called?  
Name the main nitrogenous waste in it.
- Mention the three main steps involved in the formation of the fluid mentioned in (iii) above.
- Name the substance which may be present in the fluid in part '2' if a person suffers from diabetes mellitus. [5]

### 2017

- Name the organ which produces urea. [1]

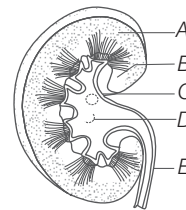
- Choose the odd one out of the following terms given and name the category to which the others belong.  
Bile, urea, uric acid, ammonia [1]
- Differentiate between the following pair on the basis of What is mentioned in bracket.  
Renal cortex and renal medulla [Parts of the nephrons present]. [1]

### 2016

- The nephron discharge their urine at the  
(a) urinary bladder (b) urethra  
(c) renal pelvis (d) renal pyramid [1]
- State the exact location of proximal convoluted tubule. [1]
- Give the biological/technical term for the following  
(i) Pigment providing colour to urine.  
(ii) The removal of nitrogenous wastes from the body. [1 × 2]

### 2015

- Give the biological term for the hormone increasing reabsorption of water by kidney tubules. [1]
- The diagram given below shows a section of a human kidney. Study the diagram carefully and answer the questions that follow



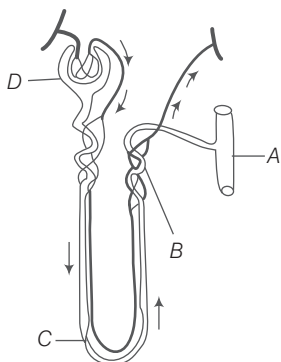
- Label the parts numbered A to D.
- Why does part B have a striped appearance?
- What is the fluid that passes down to part D? Name the main nitrogenous waste present in it.

- (iv) Mention the structural and functional units of kidneys.
- (v) Name the two major steps in the formation of the fluid mentioned in (iii). [5]

- 12.** (i) Draw a neat and labelled diagram of Malpighian capsule and label the following parts  
Glomerulus, Bowman's capsule, afferent arteriole and efferent arteriole. [2]
- (ii) Name and explain the process that occurs in the glomerulus. [3]
- 13.** Explain the term 'selective reabsorption'. [3]
- 14.** Mention the exact location of 'Loop of Henle'. [1]

## 2014

- 15.** Given below is the set with four terms, in which one term is odd and cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong. [1]  
Urethra, uterus, urinary bladder, ureter.
- 16.** The diagram given below represents a nephron and its blood supply. Study the diagram and answer the following questions [5]



- (i) Label parts A, B, C and D.
- (ii) State the reason for the high hydrostatic pressure in the glomerulus.
- (iii) Name the blood vessel, which contains the least amount of urea in this diagram.
- (iv) Name the part of the nephron, which lies in the renal medulla. [5]

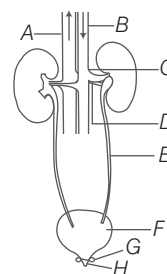
## 2013

- 17.** Name the following  
Knot-like mass of blood capillaries inside the Bowman's capsule. [1]

- 18.** Write special functional activity of the ureter. [1]
- 19.** Differentiate between the following about what is given in the bracket.  
Bowman's capsule and Malpighian capsule. (Parts included). [1]
- 20.** The renal cortex has a dotted appearance. Why? [2]

## 2012

- 21.** Name the organ that produces urea. [1]
- 22.** Given below is the set of five terms rewrite the terms in logical sequence as directed at the end of each statement.  
Renal vein, renal artery, afferent arteriole, efferent arteriole, glomerulus (pathway of blood through glomerulus). [1]
- 23.** The diagram given below shows the excretory system of a human being. Study the same and then answer the questions that follow [5]



- (i) Name the parts labelled A, B, C and D.
- (ii) Give the main function of the parts labelled E, F, G and H.
- (iii) Name the endocrine gland, which could be added in the diagram and state its location/position.

## 2011

- 24.** Name the structural and functional unit of the kidney. [1]
- 25.** State whether true or false. Rewrite the false statement by changing first or last word only.  
Urethra carries urine from kidney to urinary bladder. [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

**1** The four structures listed are part of the human excretory system

I. Bladder

II. Kidney

III. Ureter

V. Urethra

In which order does a molecule of urea pass through these structures?

First → Second

	First	→	Last
(a)	I	II	III
(b)	I	IV	III
(c)	II	I	III
(d)	II	III	I

**2** Glomerular filtrate and blood plasma differ in the fact that

(a) plasma contains proteins

(b) glomerular filtrate contains proteins

(c) plasma contains high level of chlorides

(d) Both (b) and (c)

**3** Akash takes the diet containing large amount of proteins. He is likely secrete large amount of

(a) uric acid

(b) CO<sub>2</sub>

(c) sugar

(d) urea

**4** What processes in nephron are involved in regulating acidity and alkalinity of plasma?

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Nervous System and Sense Organs

An essential feature of living things is their ability to detect changes in their environment. They also exhibit responses to external stimuli. This becomes possible only due to the presence of well-organised network of neural system. It provides point to point connections for quick coordination for receiving and responding to stimuli. The nervous system in human beings is the most advanced in terms of evolution. The detailed structural and functional components of nervous system are discussed in this chapter.

## Nervous System

The nervous system is the fastest system of communication within the body. It enables us to think, remember, react and to figure out the things around us. The nervous system performs the functions like control and coordination of all parts of the body, stores experiences or memory and maintains the body's internal environment.

The neural system consists of highly specialised cells called **neurons**. The sensory neurons detect and receive information from different sense organs (receptors) in the form of stimuli and transmit the stimuli to the Central Neural System (CNS) through sensory nerve fibres.

## Neurons

These are the structural and functional unit of the nervous system. Neurons are the longest cells in the body. Human neural system has about 100 billion neurons. Fully formed neurons never divide and once a neuron is dead, they can not be replaced.

## Structure of Neuron

Structurally, a neuron is composed of three major parts

### 1. Cell Body (Cyton/Perikaryon/Soma)

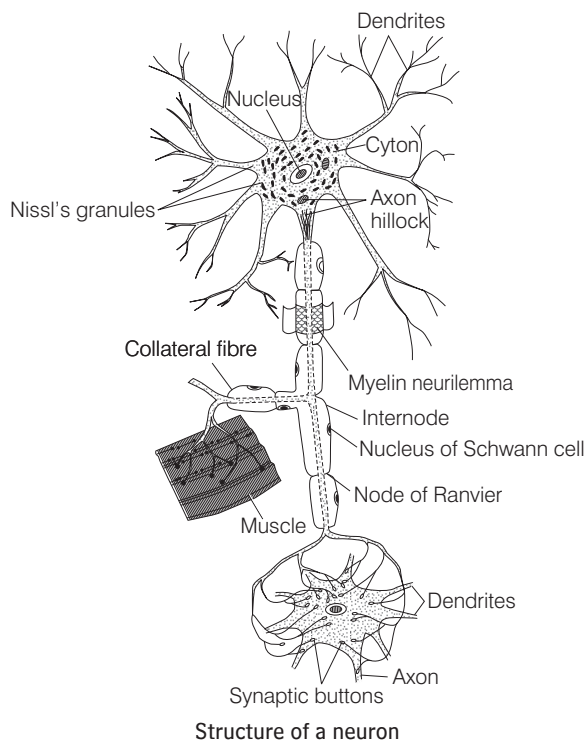
Like a typical cell, it consists of cytoplasm, nucleus and cell membrane. The cytoplasm has typical cell organelles like mitochondria, Golgi apparatus, etc with certain granular bodies, neurofibrils, neurotubules and **Nissl's granules**. Neurofibrils helps in the transmission of impulses.

## Chapter Objective

- Nervous System
- Neurons
- Nerves
- Divisions of Nervous System
- Central Nervous System
- Brain
- Spinal Cord
- Peripheral Nervous System
- Reflex Action and Reflex Arc
- Sense Organs
- Eye
- The Ear

## 2. Dendrites (Dendrons)

These are shorter, tapering and much branched processes that project out of the cell body. They also contain Nissl's granules and may be one to several in number. They conduct nerve impulses towards the cell body.



## 3. Axon

It is a single, very long fibre-like process of uniform thickness. The axon contains neurofibrils and neurotubules but does not have Nissl's granules, cell organelles and granular bodies. In most neurons, axon is surrounded by a myelin sheath. **Myelin sheath** provides insulation to the axon.

Myelin sheath is covered by the outermost thin sheath called **neurolemma**. The gaps between the two adjacent myelin sheath are called **nodes of Ranvier**. The axon ends (distal end) in a group of branches, the terminal arborisation (axon terminals). The terminal arborisations of the axon meet the dendrites of another neuron to form a **synapse**.

Each branch terminates as a bulb-like structure called **synaptic knobs**, which possess mitochondria and secretory vesicles (containing chemicals called neurotransmitters). The axons transmit nerve impulses away from the cell body through a synapse.

**Note** Dendrites and axon are collectively called **neurites**. These are formally called the processes of neurons.

## Types of Neuron

Neurons are of following three main types

- (i) **Sensory neuron** It transmits information to the main nervous system, i.e. brain and spinal cord.
- (ii) **Motor neuron** It transmits information from the main nervous system to effectors such as muscles and glands.
- (iii) **Relay (association or connecting) neuron** It serves as a link between the sensory and motor neuron. These are mainly found in brain and spinal cord.

## Nerves

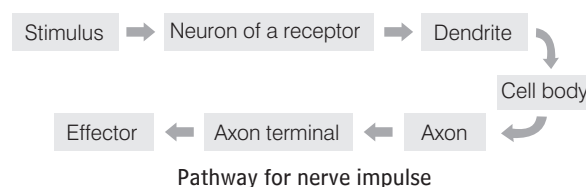
Nerves are thread-like white structures which emerge out from the brain and spinal cord and branch out to usually all parts of the body. The aggregate of nerve cells is called **ganglion**. It is formed of a bundle of nerve fibres (axons of separate neurons) being enclosed in a tube-like sheath. Nerves are of following three main types

- (i) **Sensory nerve** It consists of only sensory fibres.
- (ii) **Motor nerve** It consists of only motor fibres.
- (iii) **Mixed nerve** It consists of both sensory and motor fibres.

## Transmission of Nerve Impulse

The transmission of a nerve impulse in the body has a general scheme of flow. All the information from the environment is detected by the **receptors** (sense organs) in the body. The neurons of the receptors transfer this information to the **effectors** for the appropriate response.

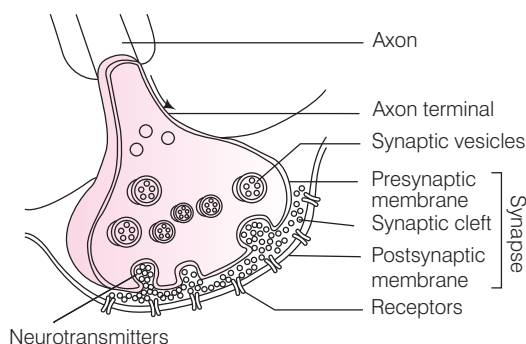
The information acquired at the end of the dendrite neuron causes a chemical reaction that produces an electrical impulse. It travels from the dendrite to the cell body (cyton) and then along the axon to its end. At the end of axon, the electrical impulse causes the release of some chemicals. These chemicals cross the gap (synapse) and start a similar electrical impulse in the dendrite of next neuron. A similar synapse finally allows delivery of such impulses from one cell to other cells, such as muscle cells of gland. Thus, the complete pathway followed by the nerve impulse in the body is given below



## Synapse

It is the point of contact between the nerve endings of one neuron (axon) and the dendrites of another neuron separated by a fine gap. This gap is called **synaptic cleft**.

When the impulse reaches the terminal end of an axon, neurotransmitters (the chemicals such as acetylcholine) are released into synaptic cleft.



Axon terminal and synapse

These neurotransmitters set a nerve impulse in the dendrites and travel across the receptors on the membrane of the next nerve ending.

### CHECK POINT 01

- 1 Give two functions of nervous system.
- 2 Where neurolemma is found?
- 3 Which part of the neuron does not contain Nissl's granules?
- 4 What are the synaptic knobs?
- 5 An aggregate of nerve cells is called .....
- 6 What are neurotransmitters?

## Divisions of Nervous System

Nervous system is divided into two main divisions, i.e. Central Nervous System (CNS) and Peripheral Nervous System (PNS).

### Central Nervous System (CNS)

It is the integrating and command centre of the nervous system. CNS is mainly comprised of two parts, i.e. brain and spinal cord.

#### 1. Brain

The brain is the central information processing organ of our body and acts as the 'command and control system' of all body activities. The brain is the anteriormost part of the central neural system, which is located in the cranium (cranial cavity) of the skull. It weighs about 1.4 kgs. It is made up of approximately 86 billion neurons.

## Protective Covering of the Brain

Inside the skull, the brain is protected by meninges. The meninges are continuous with the spinal cord and consists of three layers as follows

- (i) **Duramater** tough fibrous outermost covering.
- (ii) **Arachnoid mater** middle, very thin and delicate layer.
- (iii) **Piamater** innermost very thin, tough and highly vascular.

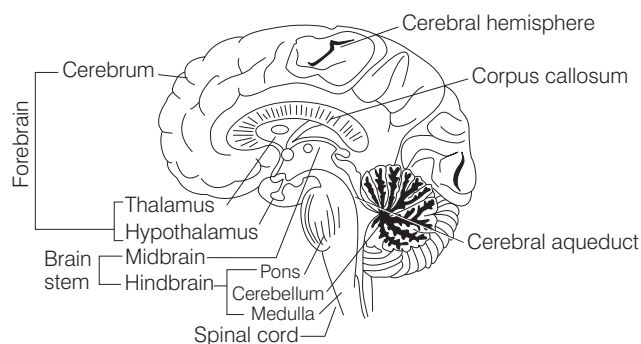


Diagram showing sagittal section of the human brain

The space between arachnoid and piamater is filled with **cerebrospinal fluid**. It is a clear and colourless fluid. The same fluid is also found in the spaces of brain and spinal cord.

It acts as a cushion for the brain cortex and provides mechanical protection and nourishment to the brain.

### Parts of Brain

Human brain is divisible into three main parts

#### (i) Forebrain

It is the largest part of the brain and is divided into olfactory lobe, cerebrum and diencephalon. All of these are discussed below

- (a) **Olfactory lobe** These are paired lobes and functionally related with sense of smell.
- (b) **Cerebrum** It is the largest, most complex and most developed part of the human brain. Hence, it is considered as **seat of intelligence**.
  - It is divided into two main parts (halves) known as **cerebral hemispheres**. Each cerebral hemisphere is hollow from interior and has two regions, i.e. **outer cortex** and **inner medulla**.
  - The outer (cortex) portion is grayish in colour containing all the cell bodies of the neuron. It is also known as **grey matter**.

- The large grooves formed by the layers of grey matter are called **gyri** and the small folds in it are called **sulci**.
- The inner (medulla) portion is composed of **white matter**, which mainly consists of axons of the neurons.
- The two cerebral hemispheres are interconnected by a sheet of fibres known as **corpus callosum**. It is meant to transfer information from one cerebral hemisphere to the another.
- Cerebrum enables us to think, invent, plan, memorise, reason, logic, etc. It mainly controls all the voluntary actions. It also contain subconscious mind where past experiences are stored.

(c) **Diencephalon** It consists of two major parts **thalamus** (a major coordinating centre for sensory and motor signalling) and **hypothalamus** (mainly controls body temperature, urge for eating, drinking, anger, pleasure and actions of pituitary gland).

## (ii) Midbrain

It is located in between the thalamus/hypothalamus (of forebrain) and pons (of hindbrain). It is the small tubular part (about 2cm long) of brain, which helps to relay information for vision and hearing. The medulla oblongata, the pons and the midbrain forms **brain stem**. It connects forebrain to spindle cord.

## (iii) Hindbrain

It further consists of following three main parts

- (a) **Cerebellum** It is situated at the base, under the cerebrum of forebrain. It is also known as Little brain.
- It is composed of outer cortex and inner medulla consisting of grey and white matter, respectively.
  - It has no convolutions but has numerous furrows.
  - It coordinates the muscular activity and maintains the balance of the body.

(b) **Pons** It is located below the cerebellum and is responsible for carrying impulses from cerebellum to cerebrum. It also helps in the regulation of breathing movements.

(c) **Medulla oblongata** It is the lowermost portion of the hindbrain situated at the base of the skull. It continues behind as the spinal cord.

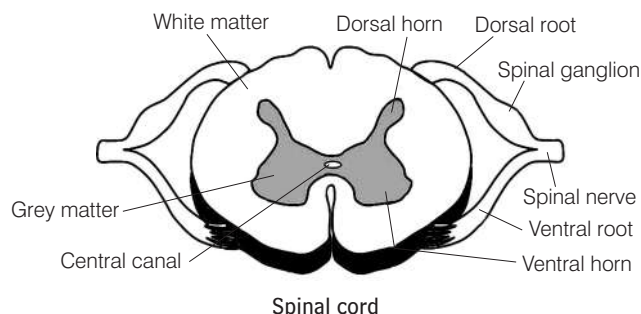
It's main function is to control the activities of internal organs like respiration, gastric secretions, beating of heart, peristaltic movements, etc.

### Note

- Any damage to the medulla oblongata may lead to death of a person. The projecting process of the vertebra axis in the neck pierces the medulla under heavy shock, as a result of which involuntary actions such as breathing and heart beats are stopped.
- Electroencephalogram (EEG) is the instrument which records waves of brain.

## 2. Spinal Cord

It forms the posterior part of the CNS, running mid-dorsally in the neural canal of the vertebral column. In an adult, the spinal cord is about 42-45 cm long. Its diameter varies at different stages of growth. The spinal cord is formed of two types of nervous tissue, i.e. grey matter and white matter. The grey matter contain cell bodies and it is surrounded by white matter. Latter consist of groups of myelinated axons.



The spinal nerve tracts are divisible into two, **ascending** (conducting sensory impulses towards brain) and **descending** (conducting motor impulses from brain) tracts.

Spinal cord conducts impulses to and from the brain and controls most of the reflex activities. It also provides a means of communication between spinal nerves and the brain.

### CHECK POINT 02

- 1 In our skull which part is responsible for the protection of brain?
- 2 Name the fluid present in a space between arachnoid and piameter.
- 3 Mention any two functions of hypothalamus.
- 4 Name an instrument which records waves of brain.
- 5 How does the spinal cord differ from the brain, in terms of arrangement of grey matter and white matter?

## Peripheral Nervous System (PNS)

This system of brain mainly consists of all the nerves, which transmit impulses to and from the central nervous system.

It is sub-divided into two main divisions as follows

## 1. Somatic Nervous System (SNS)

It contains nerves that relay information in the form of impulses from CNS to the skeletal muscles. On the basis of their origin, nerves of SNS are further categorised as **cranial nerves** (arise from brain) and **spinal nerves** (arise from spinal cord). Cranial nerves are either sensory, motor or mixed nerves but every spinal nerve is mixed nerve having both sensory and motor fibres.

There are 12 pairs of **cranial nerves** and 31 pairs of **spinal nerves** in humans. Spinal nerves are classified into five groups, i.e. cervical (8 pairs in the neck), thoracic (12 pairs in thorax), lumbar (5 pairs in abdomen), sacral (5 pairs in hip region) and coccygeal (1 pair in tail region).

Each spinal nerve has two separate connections with the spinal cord—a dorsal root, which is a sensory root and a ventral root, which is a motor root.

The dorsal root has an enlargement called the dorsal root ganglion outside the vertebral column that contains the neurons. Since, the dorsal root of spinal nerve is made up of only sensory neurons, it forms a route for the entry of the sensory impulses into the spinal cord in a reflex action.

## 2. Autonomous Nervous System (ANS)

It consists of **sympathetic** and **parasympathetic** nervous system and control the involuntary actions of the internal organs.

Nerves of sympathetic system arise from the spinal cord between the neck and the waist region. The parasympathetic system is located at two places, one anteriorly in the head and neck and the other posteriorly in the sacral region. The sympathetic nervous system prepares the body for violent action against abnormal conditions. Parasympathetic system is more concerned with re-establishing normal conditions after the violent act is over.

Functions of Sympathetic Nervous System	Functions of Parasympathetic Nervous System
Vasoconstriction in general and vasodilation (brain, heart, lungs and skeletal muscles)	Vasodilation of coronary vessel
Dilates pupil	Constricts pupil
Increases lacrimal glands secretion	Inhibits lacrimal glands secretion
Inhibits salivary glands + digestive glands	Stimulates secretion
Accelerates heartbeat	Retards heartbeat
Dilates trachea, bronchi and lungs	Constricts these organs.

Functions of Sympathetic Nervous System	Functions of Parasympathetic Nervous System
Inhibits gut peristalsis	Stimulates it
Contracts anal sphincter	Relaxes anal sphincter
Relaxes urinary bladder	Contracts and relaxes this
Increases adrenal secretion	Inhibits it
Blood sugar increases (glucagon)	Blood sugar inhibits (insulin)
Semen ejaculation increases	Increases external genitalia excitement and sex drive
Increases sweat secretion	Inhibits this
Contracts arrector pili	Relaxes these

## Different Actions in the Body

Our body perform various actions, which are categorised into following two main categories

### Voluntary Actions

These actions are under the control of our will, i.e. changing the channel while watching TV, picking an apple to eat, running, walking, etc.

### Involuntary Actions

These actions are not under the control of our will and are performed instantaneously. These actions are therefore, called **reflexes**, e.g. flushing of tears, when some particles fall into an eye, withdrawal of hand after touching hot thing, shivering in cold, etc.

#### Differences between Involuntary and Voluntary Actions

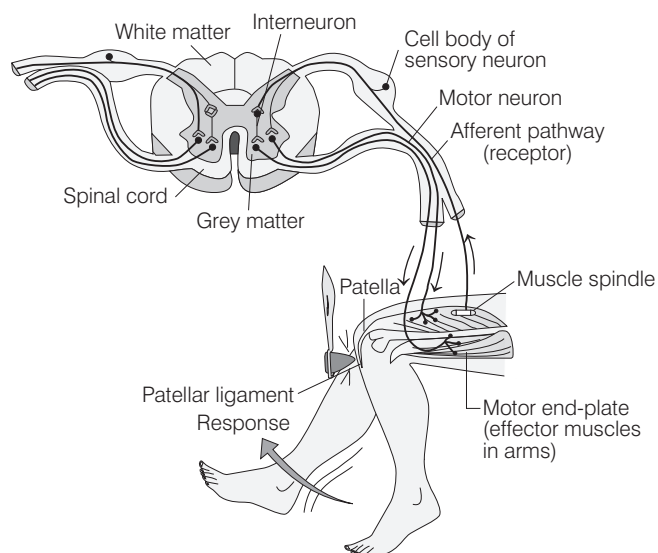
Involuntary Actions (Reflexes)	Voluntary Actions
Mainly self-protective due to environment.	Fulfilment of a desired goal.
Initiated by some stimulus (touch, pain, pressure, heat, light, etc).	Initiated by a willing thought.
Involve muscles and glands.	Involves only muscle.
Commands originate mostly in the spinal cord and autonomic nervous system and a few in the brain as well.	Commands originate in the brain.

## Reflex Action and Reflex Arc

The entire process of response to a peripheral nervous stimulation, that occurs involuntarily, i.e. without conscious effort or thought and requires the involvement of a part of the central nervous system is called a **reflex action**. The nervous pathway taken by nerve impulses in a reflex action is called **reflex arc**.

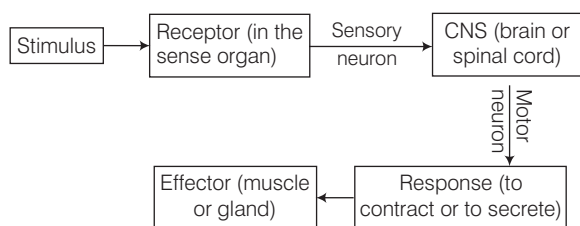
## Mechanism of Reflex Action

- (i) The reflex pathway comprises at least one afferent (receptor) neuron and one efferent (effector) neuron arranged in a series.
- (ii) The afferent neuron receives signal from a sensory organ and transmits the impulse *via* a dorsal nerve root into the CNS (at the level of spinal cord).



Diagrammatic representation of a reflex action

- (iii) The efferent neuron then carries signals from CNS to the effector. The stimulus and response in this way form a reflex arc, e.g. knee jerk reflex as shown above in the figure. This general pathway is depicted below



## Types of Reflexes

Reflexes are categorised as follows

- (i) **Natural (unconditioned) reflexes** These are the inborn reflexes and are inherited from parents, e.g. blinking of eyes, breast feeding, swallowing, coughing, salivation, sneezing, withdrawal of hand on touching hot things, etc.
- (ii) **Conditioned (acquired) reflexes** These reflexes are acquired after birth or adopted during the course of the lifetime, e.g. playing a musical instrument, applying brakes to vehicles, giving hand to a signal,

using keys of the keyboard while working, tying shoe laces, wild animals trained in circus to perform acts, standing up when teacher enters the class, etc.

### Differences between Unconditioned and Conditioned Reflexes

Unconditioned Reflex (Inherited)	Conditioned Reflex (Acquired)
Inborn, requiring no previous experience.	Developed by experience or learning.
Directly related to the stimulus.	Brought about by a condition totally different from the direct initial stimulus.
Similar in all humans (similar among all individuals of any one species).	Differs in different individuals, subjected to learning and experience.

### CHECK POINT 03

- 1 There are ..... pairs of cranial nerves and ..... pairs of spinal nerves in humans.
- 2 Name the different connections of spinal nerve.
- 3 Dilation of pupil is the function of ..... nervous system.
- 4 What do you understand by reflex arc?
- 5 Mention the type of reflexes involved in a reflex arc.
- 6 Give an example of acquired reflex.

## Sense Organs

The sense organs enable us to detect all types of changes that occur in the environment. These organs send appropriate signals to the CNS, where all the inputs are processed and analysed.

The most complex sensory receptor consists of numerous **sense cells**, **sensory neurons** and **associated accessory** structures, e.g. eye (sensory organ for vision), the ear (sensory organ for hearing) and skin (touch, temperature).

## Eye

In human beings the pair of eyes are the organ of sight and vision. The eyes are located in the protective, deep bony cavities of the skull known as **eye sockets** or **orbits** on the front side of the head.

Main structural components of eye are

- (i) **Eyebrows** These are the arched eminences of skin above the eyes, which bear hairs. They protect eyes from rainwater or perspiration from entering into the eyes.

(ii) **Eyelids** These are the upper and lower movable part of the eyes which prevent the entry of dust particles into the eyes.

(iii) **Tear glands** (lacrimal glands) They are located at the upper sideward portion of the orbit and secrete tears.

The tears help in keeping front surface of the eye lubricated and clean by washing away the dust particles. It contains an enzyme called lysozyme, having antiseptic property and help in killing germs (like bacteria). Tears also communicate with emotions, e.g. you cry when you are sad, feel alone or extremely happy.

## Structure of Eye : Eyeball

Human eyeball is nearly spherical in structure. It consists of three concentric layers sclera, choroid and retina.

### Outer (Sclerotic) Layer

It is made up of tough fibrous tissue and is white in colour. It contains dense connective tissue, which maintains the shape of the eyeball.

The front white portion of the eye is the sclerotic layer, which further bulges out in the front and becomes transparent.

This transparent portion covers the coloured part of the eye and is known as **cornea**. Cornea lacks blood vessels thus, it can be easily removed and replaced in case of eye donations.

The entire surface of sclera is covered by a thin membrane called conjunctiva. When this membrane gets infected by a virus, it turns red and this is called **conjunctivitis**.

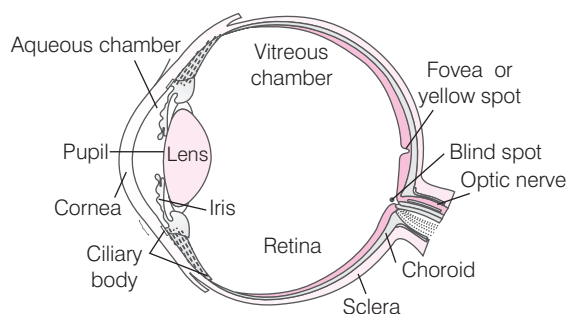


Diagram showing different parts of an eye

### Middle (Choroid) Layer

This layer is richly supplied with blood vessels in order to provide nourishment to the eyes. It is located beneath the sclera. It is thin over the posterior part of the eye, but becomes thick over the anterior part of eye to form **ciliary body**. It also contains a dark coloured pigment called **melanin**. It helps in preventing light rays from reflecting and scattering inside the eye.

The **eyeball** contains a transparent, biconvex crystalline structure called **lens**. Smooth muscles of ciliary body holds the lens in position by suspensory ligament and also helps in altering the shape of the lens.

**Iris** is the extension of the choroid layer, which forms a pigmented circle of muscular layer attached to the ciliary body in front of the lens. Pigment of iris is responsible for the colour of the eye, i.e. either blue, black or brown.

**Pupil** is an aperture surrounded by the iris. The movement of muscle fibres of iris controls the size of pupil and regulates the amount of light entering the eye.

Due to this adjustment, we blink our eyes when see bright light or not able to see when enters a dim light room because pupil takes time to adjust its size according to the amount of light.

### Inner Layer (Retina)

**Retina** is the innermost layer of the eye, which is most sensitive to light. It consists of two types of photoreceptor cells known as **rods** and **cones**. Both of these cells contains different photopigments. **Rods cells** are sensitive to dimlight but does not respond to colour.

They contain a pigment **rhodopsin** and are distributed almost throughout the retina. **Cones cells** are sensitive to bright light and respond to colour. They contain a pigment **iodopsin** and are usually confined to the yellow spot only.

### Other Structures

Besides sclera, choroid and retina, there are other structures present in the eye. These are

- (i) **Yellow spot** The distribution of rods and cones is not uniform inside the retina. Yellow spot is the area containing the maximum number of photoreceptor cells (mainly cones), therefore it is known as the **region of brightest vision**. It is also called **macula lutea** or **fovea centralis**.
- (ii) **Blind spot** This spot is found at the lateral side of the yellow spot. It does not contain any photoreceptor cells thus, this is known as the **region of no vision**, i.e. no image is formed in this region.

### Contents (Chambers) of the Eye

The eye contains two chambers, i.e.

- (i) **Aqueous humor** The space between the cornea and lens is called the aqueous or front chamber. It contains a thin watery fluid called aqueous humor. It helps in keeping the lens moist and prevents it from physical shock. It helps to refract light from the eye.

- (ii) **Vitreous humor** The space between the lens and retina is called the vitreous chamber. It is filled with a transparent gel-like substance called the vitreous humor.

It helps to protect the retina. It also helps in maintaining the shape of the eyeball.

## Mechanism of Vision

The vision in human eyes is binocular or stereoscopic vision, i.e. both the eyes can be focused on a common object simultaneously. An image is formed on the retina by successive refractions at the cornea, the aqueous humour, lens and vitreous humour.

The light-sensitive cells in the retina get activated upon illumination and generate electrical signals. These signals are sent to the brain *via* the optic nerves. The brain interprets these signals and finally processes the information so that we can perceive objects.

For a person of perfect vision, the range of clear vision is around 25 cm. The image formed on retina is inverted and real.

**Note** **Stereoscopic vision** is formed by the overlapping of images (from both eyes) in the brain to give a three-dimensional effect. Besides humans, it is acquired by monkeys and apes.

## Accommodation of Eye

The ability of eye to change its focus so as to see an object clearly is known as accommodation of eye. It is achieved by changing the curvature of lens by ciliary muscles. To see the distant objects, lens become flat and thin. To see the nearby objects, lens become rounded.

## Common Defects of the Eye

The defects due to which the person cannot see the object distinctly and comfortably, are called **defects of vision**. The main defects of vision are

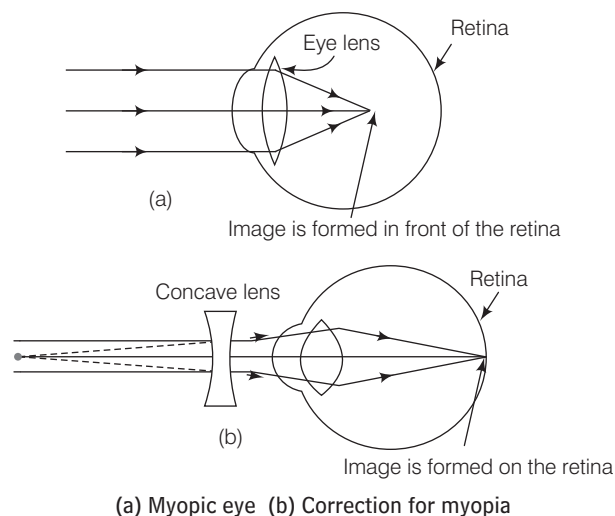
### Myopia (Short Sightedness)

It is the defect in which a person cannot see distant objects clearly but can see nearby objects clearly. In this case, image forms in front of retina (and not on the retina).

**Causes** This defect arises due to the decrease in focal length of the lens due to either excessive curvature of eye lens or elongation of the eyeball. As a result, the image is formed before retina.

**Correction** This defect can be corrected by using concave lens of appropriate power (negative power lens).

A concave lens of suitable power will bring the image back on the retina, thus, the defect is corrected.



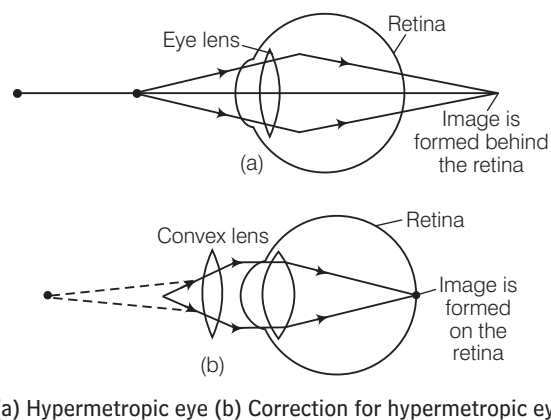
### Hypermetropia (Long Sightedness)

It is the defect in which a person cannot see nearby objects clearly but can see distant objects clearly. In this, image forms beyond the retina. It is also called hypermetropia.

**Causes** This defect arises due to following reasons

- Focal length of eye lens becomes large.
- Eyeball becomes too short so that the image is formed behind retina.

**Correction** Hypermetropia can be corrected by using convex lens of appropriate power (positive power lens). Hence, a convex lens of suitable power will bring the image back on retina, thus the defect is corrected.



## Presbyopia (Old Age Long Sightedness)

This condition is found more commonly in old age people. In this defect, one cannot read comfortably and clearly. For most people, the near point gradually precedes away. Sometimes, a person may suffer from both myopia and hypermetropia.

**Causes** This defect arises due to following reasons

- (i) Weakness of ciliary muscles.
- (ii) Hardening of eye lens.

**Correction** This defect can be corrected by using bifocal lenses (consisting of both convex and concave lenses). The upper portion consist of a concave lens (for myopia) and lower portion of convex lens (for hypermetropia).

## Astigmatism

It is the defect, in which eye is unable to focus objects both in horizontal and vertical lines clearly.

**Causes** This defect arises due to imperfect shape (not perfect spherical) of cornea or lens or both.

**Correction** This defect can be corrected by using cylindrical lens.

## Cataract

It is the condition in which crystalline lens of eye becomes milky and cloudy due to the growth of membrane over it. It generally occurs among people at an old age. This causes partial or complete loss of vision. It is possible to restore vision in this condition through the **cataract surgery**.

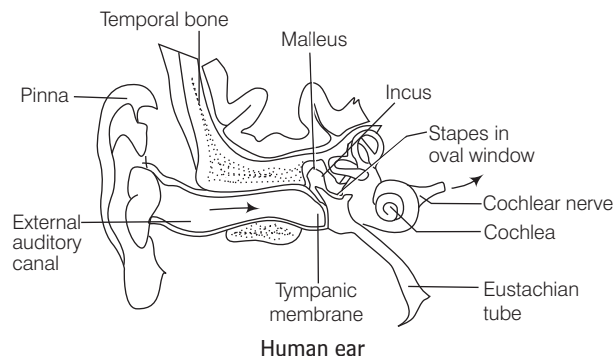
### CHECK POINT 04

- 1 What is the function of eyebrows?
- 2 Why our eyes are of different colours?
- 3 Which muscle controls the movement of eye lens?
- 4 Write the names of the light sensitive pigments present in rods and cones.
- 5 What is the range of clear vision in a person?
- 6 Name the organisms possessing stereoscopic vision.
- 7 Name the lens used to correct myopia.
- 8 Where does the image formed in a person with hypermetropia?
- 9 Give a cause of presbyopia.

## The Ear

Human ear is concerned with two functions, sensory functions such as hearing and maintenance of body balance.

This organ receives sound waves during hearing. The ear analyse these sound waves for examining the pitch, intensity, quality and direction of these waves.



## Structure of Ear

Each ear is divided into three main divisions as follows

### Outer (External) Ear

This portion of ear mainly consists of **pinna** and **auditory canal** leading to the eardrum.

### Middle Ear

This portion of the ear contains three ossicles or bones called **malleus** (hammer), **incus** (anvil) and **stapes** (stirrup), which are attached to each other in chain-like fashion. One end of hammer is attached to the eardrum (tympanic membrane) and the other free end is attached to the oval window of inner ear.

It opens into the **Eustachian tube**, which connects with the pharynx and maintains the pressure on each sides of the eardrum. An infection in throat may also lead to ear infections due to this connection.

### Inner (Internal) Ear

This portion of ear consists of a labyrinth, i.e. fluid-filled chambers within the temporal bone of the skull. The fluid within the chambers of membranous labyrinth is called **endolymph**. The membranous labyrinth is divided into two main parts

- (i) **Cochlea** It is a coiled portion of the labyrinth and has around two and half turns. Its inner winding cavity is divided into three parallel canals separated by membranes. Out of these, the middle canal contains areas, which have auditory sense cells called **organ of Corti**.

An extracellular fluid called '**perilymph**' is found within the cochlea containing hair cells. The impulses from the cochlea of the ear are transmitted to the brain through **auditory nerve**.

- (ii) **Semicircular canals** These are the set of three semicircular, interconnected tubes located inside each ear.

Each canal widens to form ampulla. The ampulla contains sense cells (cristae), which provide dynamic equilibrium to body. Each canal is filled with the fluid called **endolymph** and contains motion sensor cells within the fluid.

### Mechanism of the Hearing

**Pinna** (of outer ear) collects the sound waves from the surroundings. These waves pass through the ear canal (auditory canal) and fall on the eardrum (tympanum) or **tympanic membrane**.

The eardrum starts vibrating back and forth rapidly.

These vibrations are amplified several times by the three bones in the middle ear and then passed to the liquid (endolymph) in the cochlea.

Due to this, the liquid in the cochlea begins to vibrate and the pressure variations are turned into electrical signals by the cochlea. These electrical signals are carried by auditory nerve to the brain and the brain interprets them as sound and we get the sensation of hearing.

### Role of Ear in Maintaining Balance of Body

When we move our head in different directions, the fluid inside the semicircular canal is also shaken, which is pushed against the sensory hair cells. This sends the nerve impulse through the nerve fibres to the brain through the auditory nerve. The sensory cells in semicircular canal are concerned with the **dynamic equilibrium**, i.e. when body is in motion. The similar sensory cells are located in two parts of semicircular canal, i.e. **utricle** and **sacculus**. These are concerned with the **static equilibrium** of the body, i.e. balance with respect to gravity.

#### CHECK POINT 05

- 1 State the function of pinna.
- 2 Give the location of perilymph in inner ear.
- 3 Name the three ossicles found in middle ear.
- 4 Name the fluid found in the chambers within temporal bone of the skull.
- 5 Which part of inner ear converts the pressure variations into electrical signals?
- 6 Parts of ear concerned with static equilibrium are .....

# SUMMARY

- Nervous system provides an organised network of point to point connections for quick neural coordination and fastest means of communication.
- The nervous system in all animals is composed of structural and functional units called neurons which can detect, receive and transmit different types of stimuli.
- Human neural system is divided into-Central Nervous System (CNS) and Peripheral Nervous System (PNS).
- Central Nervous System (CNS) includes brain and spinal cord.
- Peripheral Nervous System (PNS) consists of cranial nerves (12 pairs) and spinal nerves (31 pairs).
- Autonomic Nervous System (ANS) consists of sympathetic and parasympathetic nerve cords.
- Human brain is protected by cranium or skull and meninges. The meninges have three layers-duramater, arachnoid and piamater.
- Cerebrum is the largest part of human brain. It is the seat of memory, thought, reason, logic, etc.
- Cerebellum is the part of brain which controls coordination of muscular movements.
- Medulla oblongata controls the involuntary activities like heartbeat, breathing, etc.
- Thalamus is a part of diencephalon of the forebrain. It is a relay centre to cerebrum for pain and pressure.
- Hypothalamus is located below the thalamus. It controls the body temperature and controls the pituitary gland.
- The spinal cord is concerned with reflex action. In spinal cord, the grey matter lies inside and white matter is outside.
- Reflex action includes nerve bodies associated with CNS and its involuntary response to PNS. The pathway during reflex action is called reflex arc. These are of two kinds (i) natural or unconditional reflexes (ii) conditioned reflexes.
- Natural reflexes are inborn, e.g. knee jerk.
- Conditioned reflexes are complicated and depend on experiences, e.g. applying brakes on seeing an obstacle.
- Sensory organs are the receptors which detect changes in the environment with the help of sensory receptors.
- Human eyes are the organ of sight which work on the principle of photographic camera. Eyebrows, eyelids and lacrimal glands are accessory organs associated with eye for its proper functioning.
- Disorders related to eye are myopia, hypermetropia, cataract, presbyopia and astigmatism.
- Human ears are a pair of statoacoustic organs meant for both balancing and hearing. It is divided into external, middle and inner ear.

# EXAM PRACTICE

## Multiple Choice Questions

1. Which of the following is the functional unit of the nervous system?

(a) Neuron (b) Perikaryon  
(c) Axon (d) Cyton

**Ans.** (a)

2. A structure of neuron comprises of

(a) cell body, synaptic knob, ganglia  
(b) synaptic vesicles, ganglia, dendrites  
(c) cell body, dendrites, ganglia  
(d) cell body, dendrites, axon

**Ans.** (d)

3. Axons can be

(a) non-myelinated (b) myelinated  
(c) Either (a) or (b) (d) None of these

**Ans.** (c)

4. A synapse is found between

(a) dendrite and dendrite  
(b) axon terminal and axon terminal  
(c) dendrite and axon terminal  
(d) All of the above

**Ans.** (c)

5. Chemicals which are released at the synaptic junction are called

(a) hormones (b) neurotransmitters  
(c) cerebrospinal fluid (d) lymph

**Ans.** (b)

6. A mixed nerve

(a) contains both sensory and motor fibres  
(b) carries sensations from two or more different sense organs  
(c) has a common root but branches into two nerves to different organs  
(d) has two or more roots from different parts of brain

**Ans.** (a)

7. Which of the following can be considered as the function of nervous system?

(a) Irritability  
(b) Receive stimuli  
(c) Conduction of enzymes  
(d) To prepare the body against reactions

**Ans.** (b)

8. Which of the following is true about neurilemma?

(a) The cell membrane around the nerve cell  
(b) A layer of fatty substance around axon  
(c) A layer of specialised neuroglia around myelin sheath of nerve fibres  
(d) The connective tissue around a nerve tract

**Ans.** (c)

9. Which of the following parts of the brain continues into spinal cord?

(a) Cerebrum (b) Cerebellum  
(c) Pons (d) Medulla oblongata

**Ans.** (d)

10. Which of the following is mainly associated with the maintenance of the posture? [2015]

(a) Cerebrum (b) Cerebellum  
(c) Thalamus (d) Pons

**Ans.** (b)

11. Which of the following pairs of brain part is not correctly matched with its function?

(a) Cerebellum : Balance of body  
(b) Cerebrum : Memory  
(c) Pons : Consciousness  
(d) Medulla oblongata : Controls activities of internal organs

**Ans.** (c)

12. The number of spinal nerves in a human being are [2018]

(a) 31 pairs (b) 10 pairs  
(c) 21 pairs (d) 30 pairs

**Ans.** (a)

13. The ventral root ganglion of the spinal cord contains cell bodies of the [2013]

(a) motor neuron (b) sensory neuron  
(c) intermediate neuron (d) association neuron

**Ans.** (a)

14. The reflex action is controlled through

(a) central nervous system  
(b) peripheral nervous system  
(c) autonomic nervous system  
(d) None of the above

**Ans.** (a)

**15.** Which of the following is not a natural reflex action? [2014]

- (a) Knee-jerk
- (b) Blinking of eyes due to strong light
- (c) Salivation at the sight of food
- (d) Sneezing when any irritant enters the nose

**Ans.** (c)

**16.** A reflex arc in man is best described as movement of stimuli from [2012]

- (a) receptor cell, sensory neuron, relaying neuron, effector muscles
- (b) receptor cell, efferent nerve, relaying neuron, muscles of the body
- (c) receptor cell, spinal cord, motor neuron, relaying neuron
- (d) receptor cell, synapse, motor neuron, relaying neuron

**Ans.** (a)

**17.** From which of these, tears come?

- (a) Eyeball
- (b) Aqueous chamber
- (c) Vitreous chamber
- (d) Lachrymal glands

**Ans.** (d)

**18.** The part of eye which is grafted in a needy patient from a donated eye is

- (a) conjunctiva
- (b) cornea
- (c) choroid
- (d) ciliary muscles

**Ans.** (b)

**19.** Aqueous humor is present between the [2018]

- (a) lens and retina
- (b) iris and lens
- (c) cornea and iris
- (d) cornea and lens

**Ans.** (d)

**20.** The part of the human eye, where rod cells and cone cells are located is the [2012]

- (a) retina
- (b) cornea
- (c) choroid
- (d) sclera

**Ans.** (a)

**21.** Which of the following parts of human ear contribute in hearing?

- (a) Cochlea, ear ossicles and tympanum
- (b) Semicircular canals, utricle and saccule
- (c) Eustachian tube, tympanum and utricle
- (d) Perilymph, ear ossicles and semicircular canals

**Ans.** (a)

## Fill in the Blanks

**22.** Fill in the blanks with correct words.

- (i) Nervous system controls and ..... the working of all parts of the body.
- (ii) The terminal portions of the axons have swollen bulb-like structure called.....
- (iii) Certain chemicals called..... are stored in synaptic knob.
- (iv) The axon transmits ..... away from the cell body to a synapse.
- (v) A bundle of axons enclosed in a tubular sheath is called .....
- (vi) Dendrites and axon are collectively called .....
- (vii) Grey matter is mainly composed of .....
- (viii) The part of the brain concerned with the body balance is .....
- (ix) There are ..... layers of meninges in the brain.
- (x) ..... is the tough, fibrous outermost covering of brain.
- (xi) The fluid filled between the meninges is called .....
- (xii) There are 31 pairs of spinal nerves, emerging out of the .....
- (xiii) ..... movements are under our conscious control.
- (xiv) ..... movements are not under our conscious control.
- (xv) ..... is the thin, transparent membrane covering the eye.
- (xvi) The three layers of the eye are ....., ..... and .....
- (xvii) The place of best vision in the retina of eye is .....
- (xviii) Place of no vision in the retina of the eye is .....
- (xix) ..... is the capacity of the eye to focus at different distances.
- (xx) ..... vision is the condition in which both the eyes participate in viewing an object.
- (xxi) Astigmatism is corrected by using ..... or ..... lenses.
- (xxii) Cochlea is filled with .....
- (xxiii) Tympanic chamber is filled with .....
- (xxiv) The middle ear is separated from the external ear by the .....
- (xxv) Area in middle ear having auditory sense cells is .....
- (xxvi) ..... is also known as external ear.
- (xxvii) The three small bones in the middle ear are called .....

- Ans.** (i) coordinates (ii) synaptic knob  
 (iii) neurotransmitters (iv) impulses  
 (v) nerve (vi) neurites  
 (vii) cytons (viii) cerebellum  
 (ix) three (x) Duramater  
 (xi) cerebrospinal fluid (xii) spinal cord  
 (xiii) Voluntary (xiv) Involuntary  
 (xv) Conjunctiva (xvi) sclera, choroid, retina  
 (xvii) yellow spot (xviii) blind spot  
 (xix) Power of accommodation  
 (xx) Binocular  
 (xxi) spherical, cylindrical  
 (xxii) endolymph  
 (xxiii) perilymph  
 (xiv) tympanic membrane  
 (xxv) organ of Corti  
 (xxvi) Pinna  
 (xxvii) ear ossicles

### True-False

**23.** Identify the statements as true/false.

- (i) Absence of neurofibrils is the characteristic of all neurons.
- (ii) Dendrites conduct nerve impulses towards the cell body.
- (iii) Dendrites are called efferent processes.
- (iv) Sensory neuron transmits information from the main nervous system to effectors.
- (v) A nerve is a bundle of nerve fibres.
- (vi) Olfactory lobe is functionally related to smell.
- (vii) Pia mater is the outermost layer of meninges.
- (viii) Nerves of autonomic nervous system arise from the spinal cord and from the brain.
- (ix) Autonomic nervous system controls the voluntary actions of the internal organs.
- (x) The commands for voluntary actions originate in brain.
- (xi) Involuntary actions are stimulated by some stimulus.
- (xii) With practice, one cannot control the reflex actions.
- (xiii) Reflex actions enable the organism for an immediate response to a harmful stimulus.
- (xiv) The outermost layer of the eye is choroid.

- (xv) Pupil is responsible for the eye colour.
- (xvi) Retina is the innermost layer of the eye.
- (xvii) Rod cells are sensitive to light.
- (xviii) Cone cells are sensitive to dim light.
- (xix) Aqueous humor helps in keeping the lens moist and prevents it from physical shock.
- (xx) Vitreous humor helps to protect retina.
- (xxi) Sometimes medicines dropped into the eye come into the nose and even throat.
- (xxii) The size of the pupil is regulated by ciliary muscles.
- (xxiii) Fovea centralis is also called the yellow spot of the eye.
- (xxiv) The auditory nerve is responsible for perceiving sound.
- (xxv) Short sightedness and hypermetropia are one and the same thing.
- (xxvi) Deafness is caused due to the rupturing of pinna.
- (xxvii) Blind spot is called so because no image is formed on it.
- (xxviii) Semicircular canals are related to the static balance.

**Ans.** (i) False. Presence of neurofibrils and Nissl's granules is the characteristic of all neurons.

- (ii) True
- (iii) False. Dendrites are called afferent processes.
- (iv) False. Sensory neuron transmits information to the main nervous system.
- (v) True
- (vi) True
- (vii) False. Pia mater is the innermost layer of the meninges.
- (viii) True
- (ix) False. Autonomic nervous system controls the involuntary actions of the internal organs.
- (x) True
- (xi) True
- (xii) True
- (xiii) True
- (xiv) False. The outermost layer of the eye is sclera.
- (xv) False. Pigment of iris is responsible for the eye colour.
- (xvi) True
- (xvii) True
- (xviii) False. Cone cells are sensitive to bright light.
- (xix) True
- (xx) True

- (xxi) True  
 (xxii) False. The size of the pupil is regulated by the muscle fibres of iris.  
 (xxiii) True  
 (xxiv) True  
 (xxv) False. Long sightedness and hypermetropia are one and the same thing.  
 (xxvi) False. Deafness is caused due to the rupturing of tympanum.  
 (xxvii) True  
 (xxviii) True

### Match the Columns

24. Match the following columns.

Column I	Column II
A. Nerve impulse	1. Chemicals involved in the transmission of impulses at synapses.
B. Synaptic cleft	2. Gap between the presynaptic and post synaptic neurons.
C. Neurotransmitters	3. An electrical wave-like response of a neuron to a stimulation.

Ans. A – 3, B – 2, C – 1

25. Match the following columns.

Column I	Column II
A. Neurotransmitter	1. Myelinated sheath
B. Insulating sheath	2. Acetylcholine
C. Nodes of Ranvier	3. Neurolemma
D. Neurofibrils	4. Cyton

Ans. A – 2, B – 3, C – 1, D – 4

26. Match the following columns.

Column I	Column II
A. Diencephalon	1. Forebrain
B. Cerebrum	2. Spinal cord
C. Cerebellum	3. Hypothalamus
D. Central canal	4. Hindbrain

Ans. A – 3, B – 1, C – 4, D – 2

27. Match the following columns.

Column I	Column II
A. Cranial nerves	1. Voluntary action
B. Autonomous nervous system	2. Involuntary action
C. Watching TV	3. Somatic nervous system
D. Dilation of pupil (of eye)	4. Involuntary actions

Ans. A – 3, B – 2, C – 1, D – 4

28. Match the following columns.

Column I	Column II
A. External layer of eyeball	1. Choroid
B. Inner layer of eyeball	2. Orbits
C. Middle layer of eyeball	3. Sclera
D. Socket of the skull	4. Retina

Ans. A – 3, B – 4, C – 1, D – 2

### a 1 Mark Questions

29. Name the cell body of a nerve cell. [2013]

Ans. Cyton is known as the cell body of a nerve cell.

30. Briefly explain the term synapse. [2012]

Ans. Synapse is the point of contact between the axon ending s of one neuron with the dendrites of the other neuron.

The impulse is transmitted from one neuron to the other through the synapse.

31. Choose the odd one out from the following terms given and name the category to which others belong.

Dendrites, medullary sheath, axon, spinal cord [2018]

Ans. Odd term Spinal cord

Category Parts of a nerve cell

32. Given below is the chemical found in human brain, write its special functional activity. Neurotransmitters. [2013]

Ans. Neurotransmitters help in the conduction of nerve impulse.

33. Name the part of the brain associated with memory. [2014]

Ans. Cerebrum is the part of brain associated with the memory.

34. State the main function of cerebrospinal fluid. [2014]

Ans. Cerebrospinal fluid provides mechanical protection and nourishment to brain.

35. State the exact location of corpus callosum. [2013]

Ans. It is found between the two lobes of cerebrum called cerebral hemispheres.

- 36.** Differentiate between the following pair on the basis of what is mentioned in bracket.  
Cerebrum and spinal cord (arrangement of nerve cell). [2013]

**Ans.** Difference between cerebrum and spinal cord is as follows

Cerebrum	Spinal cord
Grey matter is found on the outer side, which contains cell bodies of the neurons whereas, white matter remains towards the inner side, which mainly contains the axons (nerve fibre) of the neuron.	White matter lies towards the outer side and contains the cell body of motor, while grey matter remains towards inner side and contains axons.

- 37.** Give the technical term for the protective covering of brain and spinal cord. [2012]

**Ans.** Meninges is the technical term for the protective covering of brain and spinal cord.

- 38.** Correct the following statement by changing the underlined word. [2018]

The outermost layer of meninges is piamater.

**Ans.** Duramater

- 39.** Give scientific/biological reason for the following statements.

A person after consuming alcohol walks clumsily. [2014]

*Or* An alcoholic person walks unsteadily when drunk. [2014, 10]

**Ans.** An alcoholic person when drunk walks clumsily because of the effect of alcohol on cerebellum. This is because cerebellum is mainly responsible for the muscular coordination.

- 40.** State the exact location of corpus callosum. [2013]

**Ans.** Corpus callosum is found between two lobes of cerebrum called cerebral hemispheres.

- 41.** Differentiate between the following on the basis of what is mentioned in the bracket.  
Thalamus and hypothalamus (function).

**Ans.** Difference between thalamus and hypothalamus is as follows

Thalamus	Hypothalamus
It controls emotional and memory functions.	It regulates sexual behaviour, expression of emotional reactions and motivation.

- 42.** Differentiate between the following pairs on the basis of what is mentioned within brackets. [2014]  
Spinal nerves and cranial nerves (number of nerves)

**Ans.** Spinal nerves are 31 in pairs while, cranial nerves are 12 in pairs.

- 43.** Briefly explain the term 'reflex action'. [2012, 10, 07]

**Ans.** A reflex action is a spontaneous, automatic and involuntary response to a stimulus.

- 44.** Give scientific reasons for the following statement.  
Injury to medulla oblongata leads to death. [2016, 07]

**Ans.** Medulla oblongata has pneumotaxis centre which controls breathing rate. Injury to this part of brain becomes fatal.

- 45.** Name the part of the brain that carries impulses from one hemisphere of the cerebellum to the other. [2016]

**Ans.** Pons Varolii

- 46.** State the exact location of ciliary body. [2016]

**Ans.** Anterior part of the eye.

- 47.** Differentiate between the rod cells and cone cells. (on the basis of pigment) [2016]

**Ans.** Rod cells – Rhodopsin, Cone cells – Iodopsin

- 48.** Give the name of the covering that maintains the shape of the eyeball.

**Ans.** Sclera (outermost layer).

- 49.** Give the biological/technical terms for the following. [2015]

(i) A thin membrane covering the entire front part of the eye.

(ii) The lens of eye losing flexibility resulting in a kind of long-sightedness in middle aged people.

**Ans.** (i) Cornea (ii) Presbyopia

- 50.** Which is the pigmented layer present beneath the sclera?

**Ans.** Choroid.

- 51.** State the exact location of yellow spot. [2014]

**Ans.** Yellow spot is located exactly behind the lens on the retina of the eye.

- 52.** Give scientific reasons for the following statement. We cannot distinguish colours in moonlight. [2014]

**Ans.** Moonlight is dimlight during which cone cells of our eye do not function well therefore, the colour is not well perceived. Rod cells are mainly active in moonlight.

**53.** Give the biological/technical term for the following  
Eye lens losing flexibility resulting in a kind of long sightedness in elderly people. [2012, 18]

**Ans.** **Presbyopia** is the technical term used for the kind of long sightedness in elderly people in which eye lens loses flexibility.

**54.** Given below is the structure found in human body. Write its functional activity.  
Iris of the eye. [2013]

**Ans.** Iris of the eye regulates the amount of light entering the eye.

**55.** State the main function of vitreous humor. [2011]

**Ans.** Vitreous humor is the jelly-like substance which gives round shape to the eyeball.

**56.** Differentiate between near vision and distant vision (shape of the eye lens). [2014]

**Ans.** For near vision, lens must be more concave/too curved.  
For distant vision, lens must be less convex/too flat.

**57.** Differentiate between the following on the basis of what is given in bracket.  
Myopia and hypermetropia (condition of eyeball).

**Ans.** Difference between myopia and hypermetropia is as follows

Myopia	Hypermetropia
Elongation of eye ball, as a result the image is formed before retina.	Eye ball become too short so that the image is formed behind retina.

**58.** Name the kind of lens required to correct myopia. [2017]

**Ans.** Myopia can be corrected by using concave lens of appropriate power.

**59.** Given below are groups of terms. In each group the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis.

Eye : Optic nerve :: Ear : ..... [2017]

**Ans.** Auditory nerves

**60.** State the main function of eustachian tube. [2016, 14]

**Ans.** Eustachian tube connects middle ear with pharynx and helps to maintain equal air pressure on either sides of the eardrum or tympanum.

**61.** Given below is an example of a certain structure and its special functional activity. On a similar pattern fill in the blanks with suitable functions.  
Example: Chloroplast and Photosynthesis  
Eustachian tube and ..... [2015]

**Ans.** Protect, aerate and drain the middle ear and mastoid.

**62.** Name the ear ossicle, which is attached to the tympanum. [2014]

**Ans.** Malleus/hammer is the ear ossicle, which is attached to the tympanum.

**63.** Give the exact location of organ of Corti. [2011]

**Ans.** Organ of Corti is located in the endolymph present in the middle canal of cochlea.

**64.** State the exact location of incus. [2013]

**Ans.** Incus is found in middle ear between malleus and stapes.

**65.** Give the biological term for the structure that carries visual stimuli from retina to the brain. [2012]

**Ans.** Optic nerve carries visual stimuli from retina to the brain.

**66.** Oval window, tympanum, cochlea, auditory canal, ear ossicle (correct path through which a vibration of sound is transferred in the human ear). [2012, 06]

**Ans.** Correct parts through which a vibration of sound is transferred in the human ear is  
Auditory canal → tympanum → ear ossicles → oval window → cochlea.

**67.** State the function of the suspensory ligament of the eye. [2014]

**Ans.** Suspensory ligament of the eyes helps in holding the lens in position.

**68.** Give biological reasons for the following.  
Throat infections can lead to ear infections. [2013, 08]

**Ans.** Eustachian tube connects with the pharynx. Thus, infection in throat may also lead to ear infections.

**69.** Given below is the set of four terms in which one term is odd. Identify the odd one in each set and name the category to which the remaining three belong.

Cyton, photon, axon and dendron. [2014]

**Ans.** Odd one is photon, rest all are the parts of a neuron.

**70.** Name the layer of the eyeball that forms the transparent cornea. [2018]

**Ans.** The transparent cornea is the continuation of sclera layer of eyeball.

**71.** Given below is the set with four terms. Identify the odd one in the set and name the category to which the remaining three belong.

Cerebrum, cerebellum, thalamus, hypothalamus. [2012]

**Ans.**

Set	Odd One	Category
Cerebrum, cerebellum, thalamus, hypothalamus	Cerebellum	All others are the parts of forebrain

**72.** Choose the odd one out of the following terms given and name the category to which the others belong.  
Aqueous humor, Vitreous humor, Iris, Central canal. [2017]

**Ans.** Odd Term — Central canal

Category — Present in spinal cord

Rest three structures are present in eye.

**73.** In the set of terms given below, there is an odd one cannot be grouped in the same category to which the other three belong. Identify the odd term and name the category to which the remaining three belong.

Malleus, Iris, Stapes, Incus [2016]

**Ans.** Odd – Iris

Category – Part of eye

Rest three are bones present in human ear.

**74.** Given below is the set of four terms in which one is odd and cannot be grouped in the same category to which other three belong. Identify the odd one in given set and name the category to which remaining three belong.

Haemoglobin, glucagon, iodopsin, rhodopsin. [2014]

**Ans.** Odd one is glucagon.

Rest all others are pigments found in the body.

**75.** Given below is the set with four terms. Identify the odd one and name the category to which the remaining three belong. [2013]

Semicircular canals, cochlea, tympanum, utricle

**Ans.**

Odd	Category
Tympanum	All others are the different parts of internal ear.

**76.** Give technical term for the nerve which transmits impulses from ear to the brain. [2014]

**Ans.** Auditory nerve is the one which transmits impulses from the internal ear to the brain.

**77.** Give biological explanation for the following  
We should not put sharp objects into our ears. [2018]

**Ans.** We should not put sharp objects into our ears as they can damage our eardrum (tympanic membrane) and can lead to deafness.

## **b** 2 Marks Questions

**78.** Given below is the group of terms. Arrange and rewrite the terms in the correct order, so as to be in a logical sequence.

Spinal cord, motor neuron, receptor, effector sensory neuron. [2013]

**Ans.** The correct logical sequence is receptor, sensory neuron, spinal cord, motor neuron, effector.

**79.** Give biological reasons for the following

The hand automatically shows the direction to turn a cycle without thinking. [2013]

**Ans.** Refer to text on page 178.

**80.** Given below are two structures, write their special functional activity.

(i) Myelin sheath (ii) Relay neuron

**Ans.** (i) **Myelin sheath** It provides an insulation around the axon for increasing the speed of impulses.

(ii) **Relay or connecting neuron** It serves as a link between the sensory and motor neuron. These are mainly found in brain and spinal cord. [1 × 2]

**81.** In what way sulci are different from gyri?

**Ans.** The cortex of the cerebrum is covered by a number of small, deep and shallow folds called sulci whereas, the convolutions of the brain, i.e. larger grooves (folds) that cover the cortex of the cerebrum is called gyri.

**82.** Which nerve tract connects the right and left hemispheres of the cerebrum? Into what four lobes is each hemisphere divided?

**Ans.** Right and left hemispheres of the cerebrum are connected by corpus callosum. Each hemisphere is divided into frontal lobe, temporal lobe, parietal lobe and occipital lobe.

**83.** During a street fight between two individuals, mention the effects on the following organs by the autonomous nervous system, in the table given below (one has been done for you as an example.) [2011]

Organ	Sympathetic Nervous System	Parasympathetic Nervous System
Lungs	Dilates bronchi and bronchioles	Constricts bronchi and bronchioles
Heart		
Pupil of the eye		
Salivary gland		

**Ans.** Refer to text on page 177.

**84.** State the main function of the medulla oblongata. [2011]

**Ans.** Medulla oblongata controls the involuntary activities of the brain.

**85.** Compare the following.  
Central Neural System (CNS) and Peripheral Neural System (PNS)

**Ans.** The CNS includes the brain and the spinal cord and is the site of information processing and control. The PNS comprises of all the nerves of the body associated with the CNS (brain and spinal cord).

**86.** Explain, what does nervous system consist of?

**Ans.** The nervous system consists of

- Central Nervous System (CNS)** It comprises brain and spinal cord.
- Peripheral Nervous System (PNS)** It comprises cranial and spinal nerves.
- Autonomic Nervous System (ANS)** It comprises parasympathetic and sympathetic nerves.

**87.** The statements given below are incorrect. Rewrite the correct statement by changing the underlined words of the statements. [2017]

- Deafness is caused due to the rupturing of the pinna.
- Gyri and sulci are the folds of cerebellum.

**Ans.** (i) Deafness is caused due to the rupturing of the eardrum (tympanic membrane).

- Gyri and sulci are the folds of cerebrum. Cerebellum only contains gyri and not sulci.

[1 × 2]

**88.** Given below are sets of five terms each. Rewrite the terms of correct order in a logical sequence.

- Cochlea, Malleus, Pinna, Stapes, Incus [2017]
- Receptor, Spinal cord, Effector, Motor neuron, Sensory neuron.

**Ans.** (i) Pinna → Malleus → Incus → Stapes → Cochlea (Route of sound waves in hearing process)

- Receptor → Sensory neuron → Spinal cord → Motor neuron → Effector (Reflex pathway).

[1 × 2]

**89.** Given below is the set of terms, in each case arrange and rewrite set of term so as to be in logical sequences.

- Dorsal root ganglion, receptor, effector, ventral root ganglion, associated neuron.
- Cochlear nerve, external auditory canal, ear drum, stapes, incus, malleus, cochlea

**Ans.** (i) The correct logical sequence is receptor, dorsal root ganglion, associated neuron, ventral root ganglion, effector.

- External auditory canal, eardrum, malleus, incus, stapes, cochlea and cochlear nerve.

[1 × 2]

**90.** Choose between the two options to answer the question specified in the brackets for the following.

- Perilymph or endolymph (Which one surrounds the organ of Corti?) [2018]
- Sclerotic layer or choroid layer (Which one forms the iris?) [2018]

**Ans.** (i) Choroid

- Endolymph

[1 × 2]

**91.** Write the function of the following.

- Suspensory ligaments .....
- Semicircular canals .....

[2010]

**Ans.** (i) Suspensory ligaments hold lens in position.

- Semicircular canals balance the body.

[1 × 2]

**92.** Give at least two reasons for the following.

A person from bright sunlight outside enters a poorly light room and feels blinded for a short while.

- Ans.** (i) Regeneration of the visual purple (or rhodopsin) the pigment of the rods, which was earlier broken down due to bright light.  
 (ii) Dilation of the pupil permitting more light to enter the eyes. [1 × 2]

**93.** Write short notes on the following.

- (i) Cochlea  
 (ii) Organ of Corti [2015]

- Ans.** (i) The membranous labyrinth of inner ear is filled with a fluid called endolymph. The coiled portion of the labyrinth is called cochlea.  
 (ii) **Organ of Corti** is a structure located on the basilar membrane of inner ear, which contains hair cells that act as auditory receptors. [1 × 2]

**94.** Mention the exact location of the following.

- (i) Lacrimal gland  
 (ii) Malleus [2018]

- Ans.** (i) Lacrimal glands or tear glands are located at the upper sideward portion of the orbits (eye sockets).  
 (ii) Malleus is an ear ossicle (bone) present in the middle ear. Its one end is attached to eardrum. [1 × 2]

### **C** 3 Marks Questions

**95.** Mention the functions of the human brain.

- Ans.** The human brain performs the following functions  
 (i) It coordinates activities of the body.  
 (ii) It stores information, so that behaviour of human being can be modified according to past experience.  
 (iii) It receives information carrying impulses from all the sensory organs of the body.  
 (iv) It correlates the various stimulus from different sense organs and produces appropriate response.  
 (v) It responds to the impulses.

**96.** Define the following terms.

- (i) Cranium (ii) CSF

- Ans.** (i) It is a box-like bony structure that protects the brain by covering it.  
 (ii) The space between the arachnoid and pia mater is filled with CSF (Cerebrospinal Fluid).  
 This fluid protects the brain from mechanical injuries by absorbing the shocks. [1½ × 2]

**97.** Give three importance of reflex action.

- Ans.** Reflex action is important because  
 (i) It enables the organism for an immediate response to a harmful stimulus.  
 (ii) It reduces the overloading in brain.  
 (iii) It increases the chances of survival of an organism. [1 × 3]

**98.** How are rods different from cones?

- Ans.** **Rod cells** are the cells which are sensitive to dimlight but do not respond to colour. They contain a pigment **rhodopsin** and are distributed almost throughout the retina. On the other hand, **cone cells** are sensitive to bright light and respond to colour. They contain a pigment **iodopsin** and are usually confined to the yellow spot only.

**99.** Mention the exact location of the following

[2017, 16]

- (i) Myelin sheath  
 (ii) Semicircular canals  
 (iii) Eustachian tube

- Ans.** (i) **Myelin sheath** It surrounds axon of the neuron.  
 (ii) **Semicircular canals** These are located in the inner ear.  
 (iii) **Eustachian tube** It is found in the middle ear. [1 × 3]

**100.** Briefly explain the following terms.

[2016]

- (i) Reflex action  
 (ii) Power of accommodation  
 (iii) Synapse

- Ans.** (i) **Reflex action** It is an involuntary action of any organ or part of the body in response to a particular stimulus without involvement of central nervous system.  
 (ii) **Power of accommodation** The adjustment of the eye to enable it to focus at various distances is called power of accommodation.  
 (iii) **Synapse** It is the junction of two adjacent neurons, between axon ending of one neuron and dendrite of other. [1 × 3]

**101.** Answer briefly.

- (i) How do you perceive the colour of an object?  
 (ii) Which part of our body helps us in maintaining the body balance?  
 (iii) How does the eye regulate the amount of light that falls on the retina?

**Ans.** (i) The daylight (photopic) vision and colour vision are the functions of cones. In the human eye, there are three types of cones, which possess their own characteristic photopigments. They respond to red, green and blue lights. The sensations of different colours are produced by various combinations of these cones and their photopigments.

When these cones are stimulated equally, a sensation of white light is produced.

(ii) The crista and macula are the specific receptors of the vestibular apparatus of inner ear, which are responsible for maintaining the body balance.

(iii) The diameter of the pupil is regulated by the muscle fibre of iris. Photoreceptors, rods and cones regulate the amount of light that falls on the retina. [1×3]

## **d** 4 Marks Questions

**102.** Differentiate between

- (i) Sensory and motor neurons.
- (ii) Write a short note on synapse.

**Ans.** (i) The differences between sensory and motor neurons are

Sensory neurons	Motor neurons
They transmit information from the organs to the main nervous system, i.e. brain and spinal cord.	They transmit information from the main nervous system to the various organs.

(ii) It is the point of contact between the nerve endings of one neuron (axon) and the dendrites of another neuron separated by a fine gap. This gap is called **synaptic cleft**.

When the impulse reaches the terminal end of an axon, neurotransmitters (the chemicals such as acetylcholine) are released. [2 × 2]

**103.** Identify the reflexes given below in humans. Write against each, the kind of reflex it is. (natural or conditional).

- (i) Watering of mouth on seeing a favourite dish.
- (ii) Knee-jerk
- (iii) Closing of eyelids, if a strong beam of light is flashed across.
- (iv) Tying of shoe laces while talking.

**Ans.** (i) Watering of mouth on seeing a favourite dish—Natural.

(ii) Knee-jerk— Natural

(iii) Closing of eyelids, if a strong beam of light is flashed across—Conditional.

(iv) Tying of shoe laces while talking—Conditional.

[1 × 4]

**104.** Differentiate between reflex action and voluntary action.

**Ans.** The differences between reflex action and voluntary action are

Reflex action	Voluntary action
Involuntary in nature.	Voluntary in nature.
It is quick and happens in response to a sudden stimulus.	It is usually slow and happens in a pre-planned manner.
It is mainly under the control of spinal cord.	It is under the control of cerebrum.
It is the part of a defence mechanism.	It is the part of routine activity.

**105.** Explain the mechanism of generation of light-induced impulse in the retina.

**Ans.** Light induces dissociation of the retinal from opsin resulting in changes in the structure of the opsin. This causes change in membrane permeability. As a result, potential differences are generated in the photoreceptor cells.

This produces a signal that generates action potentials in the ganglion cells through the bipolar cells. These action potentials (impulses) are transmitted by the optic nerves to the visual cortex area of the brain, where the nerve impulses are analysed and the image formed on the retina is recognised.

**106.** Explain the mechanism of focusing the image of a distant object in our eye when we raise our head after reading a book.

**Ans.** While reading a book (near by vision), the lens of our eye is more convex or rounded but when we focus our eye on a distant object, the ciliary muscles are relaxed.

The lens becomes concave or flattened. This accommodation power of eye enables us to have a clear vision of objects at varying distances.

**107.** Differentiate between

- (i) Rods and cones (sensitivity).
- (ii) Semicircular canal and cochlea (senses perceived).

**Ans.** (i) Rods are sensitive to light, while the cones are sensitive to colour. [2]

(ii) Semicircular canal helps in dynamic balance while the body is in motion, while cochlea is sensitive to sound for hearing. [2]

## e 5 Marks Questions

**108.** Differentiate between the following

- Auditory nerve and Optic nerve
- Sympathetic and Parasympathetic nervous system
- Simple and Conditional reflexes
- Spinal nerves and Cranial nerves
- Aqueous humor and Vitreous humor

**Ans.** (i) Auditory nerve and Optic nerve

Auditory nerve	Optic nerve
It carries impulses from the ear to the brain	It carries impulses from the eye to the brain

(ii) Sympathetic and Parasympathetic nervous system

Sympathetic nervous system	Parasympathetic nervous system
It prepares the body for an abnormal situation.	It prepares the body for the normal functioning after abnormal situation.

(iii) Simple and Conditioned reflexes

Simple reflex	Conditioned reflex
These are inborn reflexes	These are acquired reflexes

(iv) Spinal nerves and Cranial nerves

Spinal nerves	Cranial nerves
They arise from spinal cord	They arise from brain
There are 31 pairs of spinal nerves	There are 12 pairs of cranial nerves

(v) Aqueous and Vitreous humor

Aqueous humor	Vitreous humor
It is a watery fluid	It is jelly-like fluid
It is present between the lens and cornea of the eye.	It is present between the lens and the retina of the eye.

[1× 5]

**109.** With reference to the functioning of the eye, answer the questions that follows

- What is meant by power of accommodation of the eye?
- What is the shape of the lens during (a) near vision (b) distant vision?
- Name the two structures in the eye responsible for bringing about the change in the shape of the lens.

- Name the cells of the retina and their respective pigments which get activated (a) in the dark (b) in light. [2011]

**Ans.** (i) Refer to Ans. 100 (ii). [1]

- The shape of lens is as follows
  - During near vision, lens is more concave or rounded.
  - During distant vision lens is less convex or flat. [2]
- Ciliary muscles and suspensory ligaments are the two structures in the eye responsible for bringing about the change in the shape of lens. [1]
- (a) In the dark, rod cells get activated and their pigment is rhodopsin.
  - In the light, cone cells get activated and their pigment is iodopsin. [1]

**110.** With reference to the human ear, answer the questions that follows.

- Give the technical term for the structure found in the inner ear.
- Name the three small bones present in the middle ear. What is the biological term for them collectively?
- Name the part of the ear associated with (a) static balance (b) hearing (c) dynamic balance.
- Name the nerve which transmits messages from the ear to the brain. [2011]

**Ans.** (i) Membranous labyrinth. [1]

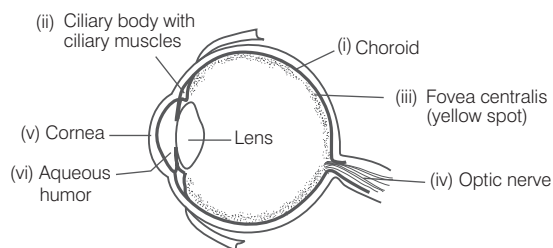
- Hammer, anvil and stirrup are the three small bones present in the middle ear. [1]  
Ear ossicles is the biological term used for these bones collectively.

- Different parts associated with following are
  - For static balance Utriculus and sacculus.
  - For hearing Cochlea.
  - For dynamic balance Semicircular canals. [2]
- Auditory nerve is responsible to transmit messages from ear to brain. [1]

**111.** Draw a diagram of the human eye as seen in a vertical section and label the part which suits the following functions/description.

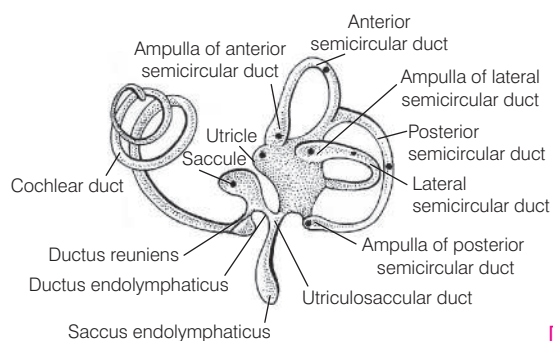
- The layer which prevents reflection of light.
- The structure that alters the focal length of the lens.
- The region of distinct vision.
- The part which transmits the impulse to the brain.
- Outermost transparent layer of the eye.
- Fluid in the anterior part of the eye. [2008]

Ans.



- 112.** (i) Draw a well-labelled diagram of the membranous labyrinth found in the inner ear.  
 (ii) Based on the diagram drawn above in (i) give a suitable term for each of the following descriptions. [2016]
- The sensory cells that help in hearing.
  - The part that is responsible for static balance of the body.
  - The membrane covered opening that connects the middle ear to the inner ear.
  - The fluid present in the middle chamber of cochlea.
  - The structure that maintains dynamic equilibrium of the body.

Ans. (i)



- Organ of Corti
- Vestibular apparatus
- Oval window
- Endolymph
- Semicircular canals

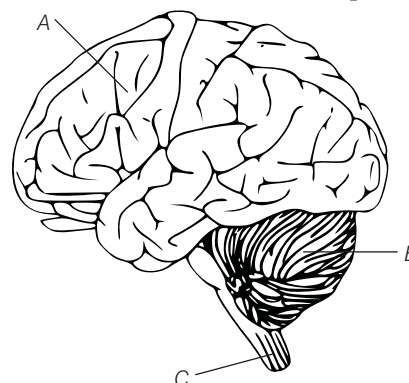
[2]

[3]

## Diagram Based Questions

- 113.** The given diagram is an external view of the human brain. Study the same and answer the questions that follows [2017]
- Name the parts labelled *A*, *B* and *C* in the diagram.
  - State the main functions of the parts labelled *A* and *B*.

- What are the structural and functional units of the brain? How are the parts of these units arranged in *A* and *C*?
- Mention the collective term for the membranes covering the brain.
- What is the function of cerebrospinal fluid?



Ans. (i) *A* – Cerebrum, *B* – Cerebellum and *C* – Spinal cord.

- A* (Cerebrum) – Site of controlling memory, reasoning, thinking, perception, emotions and speech.

*B* (Cerebellum) – Maintains posture, equilibrium and muscular coordination.

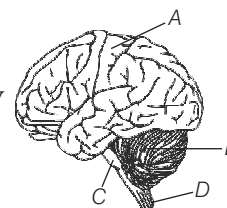
- The structural and functional unit of brain is called neuron.

In cerebrum, the outer portion is grayish in colour containing all the cell bodies of the neuron. It is called grey matter, while the inner portion is composed of white matter which mainly consists of axons of the neurons. Spinal cord also contains grey and white matter, but in opposite arrangement as that of brain (grey matter – inner side and white matter outer side).

- The collective term used for the membranes covering the brain is meninges.

- Cerebrospinal fluid provides mechanical protection and nourishment to brain.

- 114.** The following diagram represents the human brain as seen in an external view. Study the same and then answer the questions that follows



- Name the part labelled *A*, *B*, *C* and *D*.
- Mention the difference in the arrangement of the nerve cells in the parts marked '*A*' and '*D*'.

(iii) What is the main function of the parts marked 'C' and 'D'?

(iv) Name the sheet of nerve fibres that connect the two halves of the part labelled A.

**Ans.** Parts labelled from A to D are

(i) A– Cerebrum B– Cerebellum

C–Medulla oblongata D– Spinal cord.

(ii) In part A–Grey matter found outside and white matter is inside.

In part D –white matter is outside and grey matter is inside.

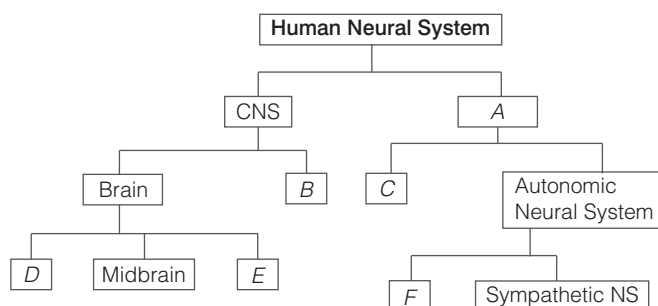
(iii) Different functions are as follows

C–Medulla oblongata, it controls all involuntary movements of internal organs, e.g. breathing movements of lungs and beating of heart.

D–Spinal cord, it relays messages from brain to different parts of body.

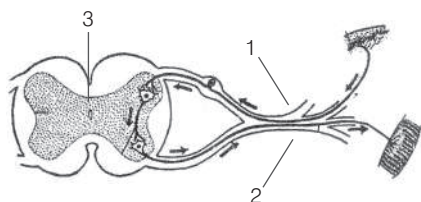
(iv) Corpus callosum is the bundle of nerve fibres that connect the two halves of the parts labelled A (cerebral hemispheres).

**115.** The major parts of the human neural system are depicted below. Fill in the empty boxes with appropriate words.



**Ans.** A–PNS, B–Spinal cord, C–Somatic neural system, D–Forebrain, E–Hindbrain F–Parasympathetic NS

**116.** The diagram given below shows the internal structure of a spinal cord depicting a phenomenon. Study the diagram and answer the questions



(i) Name the phenomenon that is depicted in the diagram. Define the phenomenon.

(ii) Give the technical term for the points of contact between the two nerve cells.

(iii) Name the parts numbered 1, 2 and 3.

(iv) How does the arrangement of neurons in the spinal cord differ from that of the brain?

(v) Mention two ways by which the spinal cord is protected in our body. [2018]

**Ans.** (i) The given figure shows the phenomenon of reflex action. It is an involuntary or instantaneous reaction in response to a stimulus, e.g. coughing, blinking of eyes, sneezing, etc.

(ii) Synapse

(iii) (1) Sensory neuron, (2) Motor neuron

(3) Grey matter

(iv) Arrangement of grey and white matter in spinal cord is opposite to that found in brain. Grey matter is in the inner side and the white matter is on the outer side.

(v) The spinal cord is well-protected by three membranous coverings known as meninges and cerebrospinal fluid.

**117.** (i) Name the unit of nervous system.

(ii) Draw a neat labelled diagram of it.

(iii) Indicate the cell body in the diagram.

(iv) Mention the location in the human body, where largest number of neurons are found.

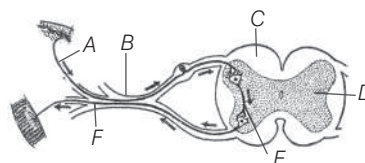
**Ans.** (i) The unit of nervous system is neuron.

(ii) Refer to fig on page 174

(iii) Cyton is the cell body (indicated in the above diagram).

(iv) Largest number of neurons are found in the brain.

**118.** The diagram given below is a representation of a phenomenon pertaining to the nervous system. Study the diagram and answer the following questions.



(i) Name the phenomenon that is being depicted.

(ii) Give the technical term for the point of contact between the two nerve cells.

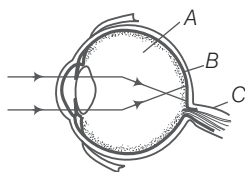
(iii) Name the parts A, B, C and D.

(iv) Write the functions of parts E and F.

(v) How does the arrangement of neurons in the spinal cord differ from that of the brain? [2014]

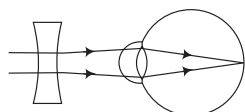
- Ans.** (i) The phenomenon depicted is reflex action.  
 (ii) Synapse  
 (iii) Different parts are labelled as  
     *A* – Sensory/Afferent neuron  
     *B* – Dorsal ganglion/dorsal root  
     *C* – White matter  
     *D* – Grey matter  
 (iv) Function of *E* (synapse) is to relay/transmit the stimulus from sensory neuron to the motor neuron.  
     Function of *E* (Motor neuron/Efferent neuron) is to relay transmit the command to the effector muscle or glands.  
 (v) Arrangement of the neurons in the spinal cord differs from the brain in the following ways.  
     **In brain**, grey matter is found on the outside and white matter on the inner side.  
     **In spinal cord**, white matter is found on the outside and grey matter on inner side.

- 119.** Given below is a diagram depicting a defect of the human eye. Study the same and then answer the questions that follows

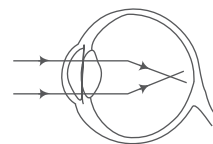


- (i) Identify the defect.  
 (ii) Name the parts labelled *A*, *B* and *C*.  
 (iii) Give two possible reasons for this eye defect.  
 (iv) Draw a labelled diagram to show how the above mentioned defect is rectified. [2009]

- Ans.** (i) The defect is myopia (short sightedness).  
 (ii) Different parts labelled from *A* to *C* are  
     *A* – Vitreous humour  
     *B* – Yellow spot  
     *C* – Optic nerve  
 (iii) Two possible reasons for this defect are:  
     (a) The eyeball becomes long from front to back.  
     (b) The lens becomes too curved/convex.  
 (iv) This defect can be rectified by concave lens as given below in the diagram.

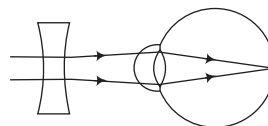


- 120.** Given below is a diagrammatic depicting a defect of the human eye, study same and then answer the questions that follows.

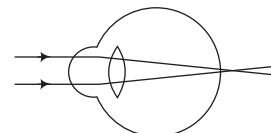


- (i) Name the defect shown in the diagram.  
 (ii) What are the two possible reasons that cause this defect?  
 (iii) Name the type of lens used to correct this defect.  
 (iv) With the help of a diagram show how the defect shown above is rectified using a suitable lens. [2016]

- Ans.** (i) Myopia (short sightedness)  
 (ii) (a) Image forms before retina.  
     (b) Caused by excessive curvature of lens.  
 (iii) Concave lens  
 (iv)



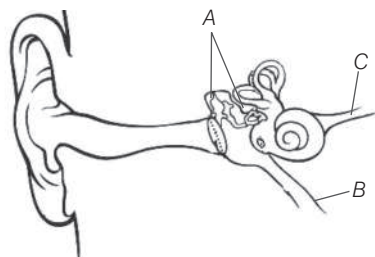
- 121.** Given below is a diagrammatic representation of a defect of the human eye.



- (i) Identify the defect.  
 (ii) Mention two reasons for the above defect.  
 (iii) State how the defect can be rectified.  
 (iv) Name the part of the eye responsible for maintaining the shape of the eyeball. [2007]

- Ans.** (i) The defect is hypermetropia because the image is formed behind the retina.  
 (ii) This defect arises due to the following reasons  
     (a) Focal length of eye lens becomes large  
     (b) Eyeball becomes too short so that the image is formed behind the retina.  
 (iii) This defect can be corrected by using convex lens of appropriate power. A convex lens of suitable power will bring the image back on retina and the defect is corrected.  
 (iv) Sclera layer is the part of eye responsible for maintaining the shape of eyeball.

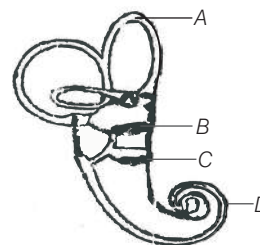
- 122.** Given below is the diagram of the human ear. Study the same and answer the questions that follows



- (i) Give the biological term for the part labelled 'A' and state its function.
- (ii) Name the part labelled 'B' and state its function.
- (iii) Name the part labelled 'C' and state its function.
- (iv) Give the function of ear wax. [2007]

- Ans.**
- (i) Part 'A' is ear ossicles, which helps in transmitting the sound waves from external to the internal ear.
  - (ii) Part 'B' is called as eustachian tube, which acts as ventilator to equalise pressure of air on both the sides of tympanic membrane that forms the outer boundary of middle ear.
  - (iii) Part 'C' is auditory nerve (vestibular and cochlear nerve), which carries hearing impulses to the brain.
  - (iv) Ear wax helps to lubricate the tympanum for proper functioning.

- 123.** The diagram given below represents the structure found in the inner ear. Study the same and then answer the questions that follows



- (i) Name the parts labelled A, B, C and D.
- (ii) Name the part of the ear responsible for transmitting impulses to the brain.
- (iii) Name the part labelled above which is responsible for
  - (a) static equilibrium
  - (b) dynamic equilibrium
  - (c) hearing
- (iv) Name the audio receptor cells, which pick up vibrations.
- (v) Name the fluid present in the inner ear.

- Ans.** Parts labelled from A to D are

- (a) A – Semicircular canals.
- B – Utriculus
- C – Sacculus
- D – Cochlea.

- (ii) **Auditory nerve** is the part of ear responsible for transmitting impulses to the brain.
- (iii) Refer to Ans. 110(iii).
- (iv) **Organ of Corti** are the audioreceptor cells, which pick up vibrations.
- (v) **Endolymph** is the fluid present in the inner ear.

# CHAPTER EXERCISE

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## Multiple Choice Questions

- Which pair of systems jointly coordinates and integrates all the activities of the organs, so that they function in a synchronised fashion?  
(a) Neural and respiratory system  
(b) Neural and digestive system  
(c) Neural and endocrine system  
(d) Neural and circulatory system
- Synaptic knob possesses  
(a) granular vesicles (b) Nissl's vesicles  
(c) synaptic vesicles (d) None of these
- Synaptic vesicles contain chemicals called  
(a) synaptic fluid (b) neurotransmitters  
(c) vesicular fluid (d) All of these
- Cerebellum is responsible for  
(a) interpreting sensations  
(b) conducting reflexes in the body  
(c) maintaining posture and equilibrium  
(d) controlling, thinking, memory and reasoning
- In autonomic nervous system, nerves arise from  
(a) neck region of the spinal cord  
(b) coccygeal region of the spinal cord  
(c) Between (a) and (b)  
(d) brain
- The amount of light entering the eye is regulated by  
(a) cornea (b) iris  
(c) lens (d) ciliary body
- The minimum distance for clear vision is  
(a) 10 cm (b) 20 cm (c) 25 cm (d) 35 cm
- Lens implantation is required in  
(a) myopia (b) hyperopia  
(c) cataract (d) astigmatism
- Identify the part of the human eye where rod cells and cone cells are located.  
(a) Cornea (b) Retina  
(c) Choroid (d) Sclera

- The aperture in the eye through which light enters is the  
(a) pupil (b) conjunctiva  
(c) ciliary muscles (d) choroid
- The functional unit of hearing is  
(a) utricle (b) organ of Corti  
(c) crista (d) incus

## Answers

1. (c) 2. (c) 3. (b) 4. (c) 5. (c) 6. (b)  
7. (c) 8. (c) 9. (b) 10. (a) 11. (b)

## Fill in the Blanks

- (i) Fibres of the tract of pons forms ..... matter.  
(ii) The forebrain develops into ..... and .....  
(iii) The nervous system of human being is derived from the embryonic .....  
(iv) Nervous system helps in the maintenance of the body's ..... environment.  
(v) The gaps between two adjacent myelin sheaths are called .....  
(vi) Nervous system in humans is divided into ..... nervous system and ..... nervous system.  
(vii) ..... is known as the integrating and command centre of the nervous system.  
(viii) Brain and spinal cord are the parts of ..... nervous system.  
(ix) ..... is known as the central information processing system of animal body.  
(x) ..... are paired lobes and functionally related to smell.  
(xi) ..... is the largest part of the brain.  
(xii) ..... is considered as the seat of intelligence.  
(xiii) ..... is known as the little brain.  
(xiv) Somatic nervous system consists of ..... and .....  
(xv) ..... of CNS mainly controls the reflex.  
(xvi) ..... of our ear is shaped like a snail.  
(xvii) The adult human eyeball is nearly a ..... structure.

## True-False

**13.** Identify the statements as true/false.

- (i) Nodes of Ranvier is absent in non-myelinated neuron.
- (ii) Cell body is the most sensitive part of neuron.
- (iii) The electrical impulse is limited to only those cells that are connected by nervous tissue.
- (iv) The speed of nerve impulse is 100m/sec.
- (v) Duramater is the outermost layer of the meninges.
- (vi) The arachnoid layer fits closely inside the piamater.
- (vii) Piamater is the middle layer of meninges.
- (viii) Cerebrum is the largest part of the brain.
- (ix) Perikaryon is the main component of the white matter of the brain.
- (x) Cerebellum continues into spinal cord.
- (xi) A double chain of ganglia, one on each side of the nerve cord belongs to the spinal cord.
- (xii) Parasympathetic nervous system is mainly concerned with re-establishing normal conditions in the body.
- (xiii) Reflex action is under direct control of the brain.
- (xiv) Swallowing of food is an example of conditioned reflex.
- (xv) Pupil is the aperture surrounded by the ciliary body.
- (xvi) Lens is the visible coloured portion of the eye.
- (xvii) Sclera of human eye is composed of connective tissue.
- (xviii) Photoreceptor cells of human eye are rods and cones.
- (xix) At blind spot, there is no involvement of retinal blood vessels at all.

## Match the Columns

**14.** Match the following columns.

Column I	Column II
A. Transmission of impulses towards the cell body	1. Dendrites
B. Conduction of impulses	2. Axon
C. Transmission of impulses away from the cell body	3. Cell body
D. Insulation around axon	4. Myelin sheath

**15.** Match the following columns.

Column I	Column II
A. Cerebrum	1. Controls vision and hearing
B. Cerebellum	2. Regulates breathing movements
C. Pons	3. Seat of intelligence
D. Midbrain	4. Maintains body posture

**16.** Match the following columns.

Column I	Column II
A. The blind spot	1. Colour of the eye
B. Ciliary muscle	2. Shape of the lens
C. The yellow spot	3. Free of rod cells
D. Iris	4. Vitreous humor
	5. Centre of the retina
	6. No sensory cells

## 1 Mark Questions

- 17.** Name the cytoplasmic process of the cell body of a neuron.
- 18.** Give the technical term for the following.  
The long extension from the cell body of a motor neuron.
- 19.** Write one word for the following.  
Wave of electrical disturbance that sweeps over the nerve cell.
- 20.** Complete the following statement by choosing the correct alternative out of those given below.  
Arachnoid mater, piamater, duramater.  
..... is the tough fibrous outermost covering of the brain.
- 21.** Give the technical term for the following.  
The lower part of the brain, which contains reflex centre like cardiac centre, respiratory and vasomotor centre.
- 22.** Name the part of the brain that controls the heart rate.

- 23.** Rearrange the following incorrect sequence pertaining to what is given within brackets at the end.

Diencephalon → Cerebellum → Medulla oblongata → Pons → Cerebrum → Midbrain  
(Sequence of parts of human brain)

- 24.** State the function of hypothalamus.  
**25.** State the exact location of yellow spot.  
**26.** State the function of the suspensory ligament of the eye.  
**27.** Explain the term 'stereoscopic vision'.  
**28.** Explain the term 'cataract'.  
**29.** Given below is the set of five terms, rewrite the terms in logical sequence as directed at the end of the statement. Pupil, yellow spot, cornea, lens, aqueous humor (correct path of entry of light into the eye from an object).  
**30.** Choose the odd one out.  
 Rods, cones, rhodopsin, cataract.  
**31.** Name the most sensitive region of the retina.

## 2 Marks Questions

- 32.** State where in human body central canal is located and also state its main function.  
**33.** Give reason for the following  
 The hand automatically shows the direction to turn a cycle without thinking.  
**34.** We see clearly at the central region of the retina. Give reason for this.  
**35.** Older people require glasses to read and write. Why?  
**36.** Mention the characteristics of the image that falls on the retina of the eye.

## 3 Marks Questions

- 37.** When you watch a movie from a very short distance from the screen in a cinema hall, you do not enjoy. Why?

- 38.** What do you understand by association neuron is a type of interneuron? Explain.  
**39.** Explain the type of nervous system that increases the defence system of body against adverse conditions.  
**40.** Categorise the following under the headings, stimulus and response.  
 (i) Seeing a green light turning into red at a road crossing, before applying the brakes.  
 (ii) Pain in the eye if something falls into it.  
 (iii) Withdrawal of hand on touching a hot plate.  
**41.** Discuss the parts of the ear that give us the ability to discriminate different pitches of sound.

## 4/5 Marks Questions

- 42.** Answer the following.  
 (i) What is the function of duramater?  
 (ii) Where is the hunger centre located in the human brain?  
 (iii) Name three involuntary actions controlled by medulla in the hindbrain.  
 (iv) Discuss the functions of tears. [4]  
**43.** List the advantages of having a nervous system. Also give differences between CNS and PNS. [5]  
**44.** What would happen if  
 (i) the olfactory lobe of cerebrum is damaged?  
 (ii) the cerebellum is damaged?  
 (iii) the diencephalon is damaged?  
 (iv) the spinal cord is damaged? [4]  
**45.** Differentiate between  
 (i) Receptor and Effector  
 (ii) Myelin sheath and Neurolemma  
 (iii) Nerve and Neuron  
 (iv) Cell body and Dendrite  
 (v) Stimulus and Response [5]  
**46.** What are the different types of neurons? Explain. [4]  
**47.** Explain the mechanism through which a sound produces a nerve impulse in the inner ear. [4]

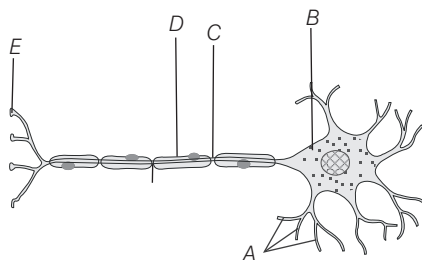
**48.** Answer the following questions.

- (i) Name the defect that results when the eye loses its power of accommodation due to age.
- (ii) State the changes that occur in the following structures when the eye accommodates for near vision.
  - (a) Ciliary muscle      (b) Suspensory ligament
  - (c) Lense
- (iii) Explain how the shape and position of the eye is maintained.

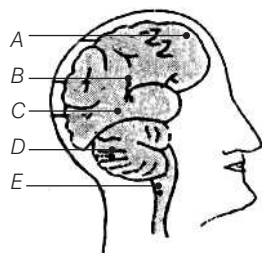
[5]

### Diagram Based Questions

**49.** Given below is the diagram of a neuron. Identify *A* to *E* and name them correctly.



**50.** Study the diagram shown below and answer the following questions.



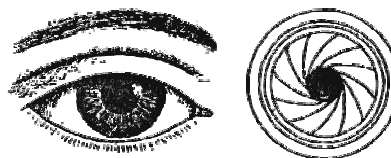
(i) What handicaps would result from

- (a) damage to part *C*
- (b) damage to part *D*

(ii) Name the brain membranes.

(iii) Why is the brain surface highly convoluted with ridges and grooves?

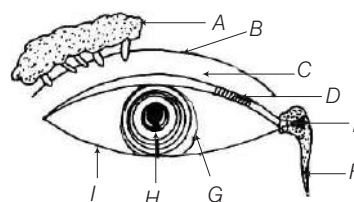
**51.** The figure below compares a part of our eye with a part of a photographic camera.



(i) Name the corresponding parts of the eye and the camera shown here that are comparable in function.

(ii) Explain the mode of working and the functions of the parts of the eye mentioned above.

**52.** The given figure shows the structure of a mammalian eye.



(i) Label the parts *A - I*

(ii) State the function of part *A*, *B* and *G*.

(iii) What special advantage do human beings derive in having both eyes facing forward?

# ARCHIVES\*

## (Last 7 Years)

Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

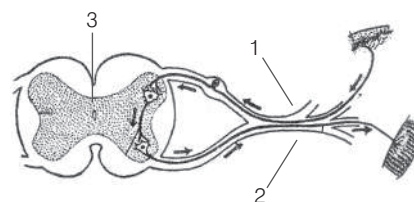
1. Name the layer of the eyeball that forms the transparent cornea. [1]
2. Choose the correct answer from each of the following options given below. [1]
  - (i) The number of spinal nerves in a human being are [1]
    - (a) 31 pairs
    - (b) 10 pairs
    - (c) 21 pairs
    - (d) 30 pairs
  - (ii) Aqueous humor is present between the [1]
    - (a) lens and retina
    - (b) iris and lens
    - (c) cornea and iris
    - (d) cornea and lens
3. Correct the following statement by changing the underlined word. [1]
 

The outermost layer of meninges is pia mater.
4. Choose between the two options to answer the question specified in the brackets for the following. [1]
  - (i) Perilymph or endolymph (Which one surrounds the organ of Corti?) [1]
  - (ii) Sclerotic layer or choroid layer (Which one forms the iris?) [1]
5. Choose the odd one out from the following terms given and name the category to which other belong. [1]
 

Dendrites, medullary sheath, axon, spinal cord
6. Mention the exact location of the following. [1]
  - (i) Lacrimal gland [1]
  - (ii) Malleus [1]
7. Give biological explanation for the following. [1]
 

We should not put sharp objects into our ears.
8. The diagram given below shows the internal structure of a spinal cord depicting a

phenomenon. Study the diagram and answer the questions



- (i) Name the phenomenon that is depicted in the diagram. Define the phenomenon.
- (ii) Give the technical term for the points of contact between the two nerve cells.
- (iii) Name the parts numbered 1, 2 and 3.
- (iv) How does the arrangement of neurons in the spinal cord differ from that of the brain?
- (v) Mention two ways by which the spinal cord is protected in our body. [5]

### 2017

9. Name the kind of lens required to correct myopia. [1]
10. The statements given below are incorrect. Rewrite the correct statements by changing the underlined words of the statements.
  - (i) Deafness is caused due to the rupturing of the pinna.
  - (ii) Gyri and sulci are the folds of cerebellum. [1 × 2]
11. Given below are sets of five terms each. Rewrite the terms in correct order in a logical sequence.
  - (i) Cochlea, Malleus, Pinna, Stapes, Incus
  - (ii) Receptor, Spinal cord, Effector, Motor neuron, Sensory neuron. [1 × 2]
12. Choose the odd one out of the following terms given and name the category to which the others belong.

Aqueous humor, Vitreous humor, Iris, Central canal. [1]

13. Given below are groups of terms. In each group the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis.

Eye : Optic Nerve :: Ear : .....

[1]

14. Mention the exact location of the following

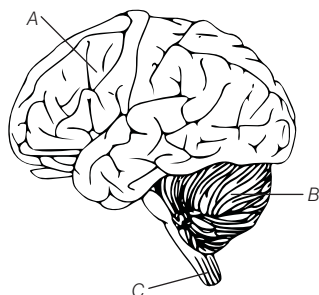
- (i) Myelin sheath (ii) Semicircular canals  
(iii) Eustachian tube

[3]

15. The given diagram is an external view of the human brain. Study the same and answer the questions that follows

- (i) Name the parts labelled A, B and C in the diagram.  
(ii) State the main functions of the parts labelled A and B.  
(iii) What are the structural and functional units of the brain? How are the parts of these units arranged in A and C?  
(iv) Mention the collective term for the membranes covering the brain.  
(v) What is the function of cerebrospinal fluid?

[5]



## 2016

16. Name the part of the brain that carries impulses from one hemisphere of the cerebellum to the other. [1]
17. In the set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term and name the category to which the remaining three belong.  
Malleus, Iris, Stapes, Incus. [1]
18. State the exact location of ciliary body. [1]
19. State the main function of eustachian tube. [1]

20. Differentiate between the rod cells and cone cells (on the basis of pigment). [1]

21. Give scientific reasons for the following statement. [1]

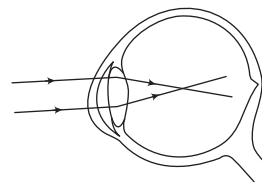
Injury to medulla oblongata leads to death.

22. Briefly explain the following terms.

- (i) Reflex action  
(ii) Power of accommodation  
(iii) Synapse

[3]

23. Given below is a diagram depicting a defect of the human eye, study the same and then answer the questions that follows.



- (i) Name the defect shown in the diagram.  
(ii) What are the two possible reasons that cause this defect?  
(iii) Name the type of lens used to correct this defect.  
(iv) With the help of a diagram show how the defect shown above is rectified using a suitable lens. [5]
24. (i) Draw a well-labelled diagram of the membranous labyrinth found in the inner ear.  
(ii) Based on the diagram drawn above in (i) give a suitable term for each of the following descriptions.  
(a) The sensory cells that help in hearing.  
(b) The part that is responsible for static balance of the body.  
(c) The membrane covered opening that connects the middle ear to the inner ear.  
(d) The fluid present in the middle chamber of cochlea.  
(e) The structure that maintains dynamic equilibrium of the body. [5]

## 2015

25. Which one of the following is mainly associated with the maintenance of the posture?  
(a) Cerebrum (b) Cerebellum  
(c) Thalamus (d) Pons [1]
26. Mention the exact location of the given structure.  
Organ of Corti [1]

- 27.** Given below is an example of a certain structure and its special functional activity. On a similar pattern fill in the blanks with suitable functions.  
Example: Chloroplast and Photosynthesis  
Eustachian tube and ..... [1]
- 28.** Give the biological/technical terms for the following.  
(i) A thin membrane covering the entire front part of the eye.  
(ii) The lens of eye losing flexibility resulting in a kind of long-sightedness in middle aged people. [2]
- 29.** Differentiate between rods and cones of retina (Type of pigment) [2]

## 2014

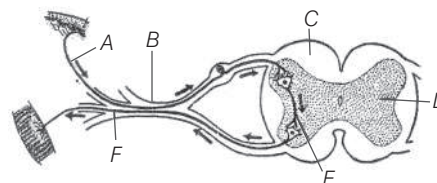
- 30.** Name the part of the brain associated with memory. [1]
- 31.** State the main function of cerebrospinal fluid. [1]
- 32.** Which of the following is not a natural reflex action?  
(a) Knee-jerk  
(b) Blinking of eyes due to strong light  
(c) Salivation at the sight of food  
(d) Sneezing when any irritant enters the nose [1]
- 33.** Give scientific/biological reasons for the following statements.  
A person after consuming alcohol walks clumsily.

*Or*

An alcoholic person walks unsteadily when drunk. [1]

- 34.** Name the ear ossicle which is attached to the tympanum. [1]
- 35.** State the main function of eustachian tube. [1]
- 36.** State the function of the suspensory ligament of the eye. [1]
- 37.** State the exact location of yellow spot. [1]
- 38.** Give technical term for the nerve, which transmits impulses from the ear to the brain. [1]
- 39.** Given below is the set of four terms in which one is odd. Identify the odd one in each set and name the category to which remaining three belong.  
Haemoglobin, glucagon, iodopsin, rhodopsin. [1]

- 40.** Given below is the set of four terms in which one term is odd. Identify the odd one in each set and name the category to which the remaining three belong.  
Cyton, photon, axon, dendron [1]
- 41.** Differentiate between the following pairs on the basis of what is mentioned within brackets.  
Spinal nerves and cranial nerves (number of nerves). [1]
- 42.** Differentiate between near vision and distant vision (shape of the eye lens). [1]
- 43.** Give scientific reasons for the following statement.  
We cannot distinguish colours in moonlight. [1]
- 44.** The diagram given below is a representation of a phenomenon pertaining to the nervous system. Study the diagram and answer the following questions.



- (i) Name the phenomenon that is being depicted.  
(ii) Give the technical term for the point of contact between the two nerve cells.  
(iii) Name the parts A, B, C and D.  
(iv) Write the functions of parts E and F.  
(v) How does the arrangement of neurons in the spinal cord differ from that of the brain? [5]

## 2013

- 45.** Name the cell body of a nerve cell. [1]
- 46.** Given below is the chemical found in human brain, write its special functional activity.  
Neurotransmitters. [1]
- 47.** State the exact location of corpus callosum. [1]
- 48.** Choose the correct answer from the four options given below.  
The ventral root ganglion of the spinal cord contains cell bodies of the  
(a) motor neuron (b) sensory neuron  
(c) intermediate neuron (d) association neuron [1]

- 49.** Given below is the group of terms. Arrange and rewrite the terms in the correct order so, as to be in a logical sequence.

Spinal cord, motor neuron, receptor, effector sensory neuron.

[1]

- 50.** Differentiate between the following pair on the basis of what is mentioned in bracket.  
Cerebrum and spinal cord (arrangement of nerve cell).

[1]

- 51.** Give biological reasons for the following.

The hand automatically shows the direction to turn a cycle without thinking.

[1]

- 52.** Given below is the set with four terms. With one odd term that cannot be grouped in the same category to which the other three belong. Identify the odd one and name the category to which the remaining three belong.

Semicircular canals, cochlea, tympanum, utricle

[1]

- 53.** State the exact location of incus.

[1]

- 54.** Given below is the structure found in human body, write its functional activity.  
Iris of the eye.

[1]

- 55.** Give biological reasons for the following.

Throat infections can lead to ear infections

[1]

## 2012

- 56.** Briefly explain the term synapse.

[1]

- 57.** Draw a well-labelled diagram of a neuron and mark the following parts

(i) Node of Ranvier      (ii) Nissl granules  
(iii) Cyton

[2]

- 58.** Choose the correct answer from the four options given below each statement.

A reflex arc in man is best described as movement of stimuli from

(a) receptor cell, sensory neuron, relaying neuron, effector muscles.

(b) receptor cell, efferent nerve, relaying neuron, muscles of the body.

(c) receptor cell, spinal cord, motor neuron, relaying neuron.

(d) receptor cell, synapse, motor neuron, relaying neuron.

[1]

- 59.** Given below is the set with four terms, in which one term is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong.

Cerebrum, cerebellum, thalamus, hypothalamus.

[1]

- 60.** Briefly explain the term reflex action.

[1]

- 61.** Give the technical term for the protective covering of brain and spinal cord.

[1]

- 62.** Choose the correct answer from the four options in the given statement.

The part of the human eye where rod cells and cone cells are located is

(a) retina

(b) cornea

(c) choroid

(d) sclera

[1]

- 63.** Oval window, tympanum, cochlea, auditory canal, ear ossicle (correct path through which a vibration of sound is transferred in the human ear).

[1]

- 64.** Give the biological/technical term for the following.

Eye lens losing flexibility results in a kind of long-sightedness in elderly people.

[1]

- 65.** Give the biological term for the structure that carries visual stimuli from retina to the brain.

[1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 When a parasympathetic nerve supply to the heart is disturbed, the heart rate will  
(a) decrease (b) increase  
(c) heart stops (d) heart beats without nervous control
- 2 Which part of the brain is considered as thermostate of the body?
- 3 Which of the following statements is correct about the nervous system in humans?  
I. The sympathetic nervous system promotes 'fight or flight' responses.  
II. Organs in the body are only controlled or influenced by either the sympathetic or the parasympathetic nervous system.  
III. The parasympathetic nervous system promotes food digestion and relaxation in the body.  
(a) I and II (b) I and III  
(c) II and III (d) I, II and III
- 4 The events listed below occur during contraction of the pupil of the eye in response to increased light intensity.  
(i) Impulses pass along motor neuron (ii) Contraction of circular iris muscles  
(iii) Stimulation of the retina (iv) Impulses pass along sensory neuron  
What is the correct order of these events?  
Codes  
First → Last  
(a) 1 4 2 3  
(b) 2 1 3 4  
(c) 3 1 4 2  
(d) 3 4 1 2
- 5 Diagram A shows the iris and pupil of a person's eye. Diagram B shows the same eye after a change in external conditions.



- Which change caused this response?  
(a) A decrease in light intensity (b) An increase in light intensity  
(c) Focusing on a distant object (d) Focusing on a nearby object
- 6 If someone receives a blow on the back of neck, what would be the effect on the person's CNS?

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Endocrine System

Coordination through chemicals is the another aspect of integration in higher living organisms. This coordination is especially involved at cellular level and the chemicals involved are majorly transported through blood. Their secretion is managed by specialised glandular structures. This special system of coordination and integration is called **endocrine system**. In this system, the networking occurs by means of chemical messengers called **hormones**. The science, associated with the study of structure, mechanism of action, functions, diagnosis and treatment of disorders caused by the endocrine gland is known as **Endocrinology**. **Thomas Addison** is the Father of Endocrinology.

## Exocrine Glands

Exocrine glands are subcellular structures that provide a system to produce and secrete chemical substances out and external to the body unlike endocrine glands. The secretions end up externally by passing through a ductal system, e.g. sweat, mammary, salivary, sebaceous glands, etc.

## Endocrine Glands and Hormones

The endocrine glands are **ductless glands**, i.e. lack of ducts. They pour their secretions into the surrounding blood for transport to the site of action or distantly located target organ. Their secretions are called **hormones** or **internal secretions**.

## Hormones

These are **non-nutrient chemicals**, which are produced in trace amounts and act as **intercellular messengers**. These are responsible for regulating the biological processes in the body. The organised endocrine glands also secrete a number of new molecules in addition to the hormones.

Vertebrates have large number of chemicals acting as hormones that provide coordination, while invertebrates possess very simple endocrine system with few hormones.

**Note** The first hormone secretin was discovered by **William M Bayliss** and **Earnest H Starling** in 1903.

### Chapter Objective

- Exocrine Glands
- Endocrine Glands and Hormones
- Human Endocrine System
- Pituitary Gland (Hypophysis)
- Thyroid Gland
- Pancreas
- Adrenal Glands (Suprarenals)
- Regulation of Hormones : Feedback Mechanism
- Comparative study of Nervous System and Endocrine System

**Differences between Endocrine and Exocrine Glands**

Endocrine glands	Exocrine glands
They do not have ducts.	They have ducts.
They secrete hormones.	They secrete enzymes, milk, saliva, etc.
They bring about chemical coordination of the body.	They perform various functions like salivation, lactation, etc.
e.g. thyroid	e.g. lacrimal gland (secretes tears) that lubricates eye surface and kills germs.

**General Characteristics of Hormones**

- Hormones are chemical regulators that are produced and poured directly into the bloodstream. They are carried throughout the body by the circulatory system.
- The site of their products and actions are different. They are low molecular weight molecules and diffuse readily through the cell membranes.
- After performing their function, the hormones are eventually carried to the liver by blood where they are either destroyed or converted to inactive substance by liver cells and exerted by kidneys.
- The excess or deficient secretion of hormones leads to serious health consequences as they help to cope up with the emergency conditions such as trauma, dehydration, etc.

**Chemical Nature of Hormones**

Hormones are organic compounds of diverse nature. Chemically hormones may be **proteinaceous** (FSH, LH, TSH, etc.), **peptides** (ACTH, oxytocin, vasopressin), **steroids** (sex hormones) or **amino acid derivatives** (thyroxine, epinephrine).

**Human Endocrine System**

The human endocrine system consists of the following endocrine glands

1. Pituitary gland
2. Thyroid gland
3. Pancreas (only endocrine part)
4. Adrenal glands

In humans, the complete endocrine system works under the influence of hypothalamus, which is located below the thalamus of forebrain. The structure and functions of major endocrine glands are discussed below

**Pituitary Gland (Hypophysis)**

It is the smallest endocrine gland, but serves very important role in the human endocrine system. It directly or indirectly controls almost all other endocrine glands of the body. It is also known as **master gland**.

**Origin**

It originates from the ectoderm of the embryonic germ layers.

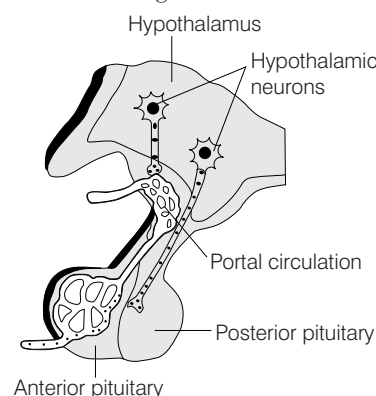
**Location and Structure**

It is **reddish-grey** in colour and is roughly oval in shape. It is about a size of a pea seed. The pituitary gland is located in a small bony cavity of the brain called **sella tursica**.

Anatomically, this gland is formed of two major portions, i.e.

**(i) Adenohypophysis****(ii) Neurohypophysis**

The adenohypophysis includes the **anterior** and **intermediate** lobe of pituitary, while neurohypophysis is the **posterior** lobe of this gland.



Diagrammatic representation of pituitary and its relationship with hypothalamus

**Hormones of Anterior Pituitary**

The anterior pituitary regulates several physiological processes including stress, growth, reproduction and lactation. The anterior pituitary is also known as **pars distalis**. The hormones secreted by this region are called **tropic hormones**. These type of hormones stimulate other endocrine glands to produce their specific hormone.

These hormones are given below with their functions

- Growth Hormone (GH)** It stimulates the somatotrophic cells of anterior lobe of pituitary gland to release its growth hormone called **somatotropin**. It stimulates body growth, protein, fat and carbohydrate metabolism. Oversecretion of this hormone during childhood causes **gigantism** (excessive growth of bones), whereas in adulthood, it causes **acromegaly** (abnormal thickness of bones). Its low secretion results in stunted growth, i.e. **pituitary dwarfism**.

- (ii) **Prolactin (PRL)** The prolactin releasing hormone stimulates lactotroph cells of the anterior lobe of pituitary gland to secrete prolactin. PRL regulates the growth of mammary glands and stimulates the production of milk in them.
- (iii) **Thyroid Stimulating Hormone (TSH)** It secretes Thyroid Stimulating Hormone (TSH) or thyrotropin. TSH stimulates the synthesis and secretion of thyroid hormones from the thyroid gland.
- (iv) **Adrenocorticotrophic Hormone (ACTH)** This is secreted when Adreno Corticotropin Releasing Hormone (ACRH) stimulates the corticotroph cells of anterior lobe of pituitary. This stimulates the synthesis and secretion of steroid hormones called **glucocorticoids** from the adrenal cortex.
- (v) **Gonadotropin Hormone** It secretes **Luteinising Hormone (LH)** and **Follicle Stimulating Hormone (FSH)**.
- **Luteinising Hormone (LH)** In males, it stimulates the synthesis and secretion of hormones called **androgens** from testis. In females, it induces ovulation of fully mature follicles (**Graafian follicles**)
  - **Follicle Stimulating Hormone (FSH)** In males, the FSH and androgens together regulate spermatogenesis. In females, this hormone stimulates the growth and development of ovarian follicles.

## Hormones of Intermediate Pituitary

The intermediate pituitary lobe is also known as **pars intermedia**. This portion of adenohypophysis secretes only one hormone, i.e. Melanocyte Stimulating Hormone (MSH).

MSH acts on melanocytes (melanin containing cells) and regulates the pigmentation of the skin.

## Hormones of Posterior Pituitary

The posterior lobe of pituitary releases two main hormones. These are

- (i) **Oxytocin** It acts on the smooth muscles of pregnant mother and stimulates a vigorous contraction of uterus at the time of childbirth. It also plays role in ejection of milk from the mammary glands in females. Hence, it is also known as the birth hormone.

- (ii) **Vasopressin/ADH** This hormone acts mainly at the kidney, stimulating the reabsorption of water and electrolytes by the distal tubules, thereby reducing the loss of water through urine (diuresis).

Deficiency of Antidiuretic Hormone (ADH) causes a type of diabetes known as **diabetes insipidus** in which person suffers from loss of water due to frequent urination resulting in excessive thirst and dehydration.

### CHECK POINT 01

- 1 Who is rewarded as father of endocrinology?
- 2 Name two exocrine glands.
- 3 Name two proteinaceous hormones.
- 4 Which gland is known as 'master gland'?
- 5 Write the functions of Follicle Stimulating Hormone (FSH).
- 6 Melanocyte stimulating hormone acts on which part of body?
- 7 Which hormone is called 'birth hormone'?

## Thyroid Gland

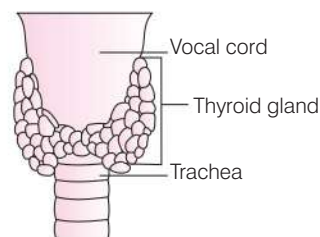
The thyroid gland is known to be the largest endocrine gland.

### Origin

It is endodermal in origin, i.e. originates from the endoderm of the embryo. The thyroid gland is bilobed and highly vascular organ.

### Location and Structure

It surrounds the front of the larynx and is composed of two lobes. Each of its lobe is located on either sides of the trachea in the neck interconnected with each other through a thin flap of connective tissue called **isthmus**.



Diagrammatic view of the position of thyroid gland (ventral side)

It is composed of follicles (round in shape) held together by loose connective tissue called **stromal tissues**. Each thyroid follicle is composed of follicular cells, enclosing a cavity.

## Hormones

The hormones secreted by thyroid gland are

- (i) **Tetraiodothyronine or thyroxine ( $T_4$ )** and **triiodothyroxin ( $T_3$ )**. Both these hormones are released from follicular cells of thyroid gland. They are named so, because they contain four and three iodine, respectively.  $T_3$  and  $T_4$  hormones have similar effects, thus these are collectively known as Thyroid Hormone (TH).
- (ii) **Calcitonin (CT)** This hormone is proteinaceous in nature. It acts on bone and kidneys to reduce blood calcium level.

## Disorders Caused by Thyroid Hormones

Following abnormalities may occur due to hypo or hyper secretion of thyroid hormones

- I. **Hypothyroidism** Insufficient or low secretion of thyroxine hormone may lead to following three conditions
  - (i) **Simple goitre** It occurs due to insufficient amount of iodine in food. Due to this disorder, the thyroid gland gets enlarged and swollen neck is one of its symptoms.
  - (ii) **Cretinism** Hypothyroidism in women at the time of pregnancy mainly affects the physical and mental growth of children, due to which he/she has retarded growth and mental development.
  - (iii) **Myxoedema** It occurs due to improper functioning of thyroid gland in adults. Symptoms include puffy appearance due to deposition of fat under skin (low BMR).
- II. **Hyperthyroidism** It is the condition during which rate of synthesis and secretion of thyroid hormone is increased to abnormally higher levels. It may occur due to cancer of the thyroid gland or due to development of nodules of the thyroid gland. It adversely affects the body physiology of an organism.

A condition called **exophthalmic goitre** is characterised by high metabolic rate causing excessive leanness.

### Functions of Thyroid Hormones

Thyroid hormones have serve several functions in the body, such as

- (i) These hormones regulate and maintain the **Basal Metabolic Rate (BMR)**, i.e. both  $T_3$  and  $T_4$  hormones increase the overall metabolic rate of the body.

- (ii) They support the process of formation of red blood cells and also help in controlling the metabolism of carbohydrates, proteins and fats.
- (iii) They influence the maintenance of water and electrolyte in our body.

### CHECK POINT 02

- 1 State the origin and location of thyroid gland.
- 2 Which amino acid gets iodinated to form  $T_3$  and  $T_4$  hormones?
- 3 Which hormone is responsible for regulating the normal basal metabolism?
- 4 State one main function of thyrocalcitonin hormone.
- 5 On the basis of change in thyroxine, how can you differentiate between cretinism and myxoedema?

## Pancreas

It is a composite gland that acts as both exocrine and endocrine gland. Such glands are also called **heterocrine gland**.

### Origin

It originates from the endoderm of the embryonic germ layers.

### Location

It lies below the stomach, in the loop of duodenum.

### Structure

It is elongated yellowish gland that consists of large number of acini and ducts. Besides these, pancreas consists of 1-2 millions of small group of specialised cells, called **Islets of Langerhans** (after the name of their discoverer **Paul Langerhans** in 1869). In normal human pancreas, these cells represent only 1-2% of the pancreatic tissue.

Each islet consists of major two types of cells as

- (i)  **$\alpha$ -cells** (about 25%) It secretes a peptide hormone called **glucagon**.
- (ii)  **$\beta$ -cells** (about 60%) It secretes another peptide hormone called **insulin**.

## Hormones

**Glucagon** and **insulin** have antagonistic effect on blood glucose level. This can be cleared from the functioning given below

- (i) **Glucagon** This peptide hormone plays an important role in maintaining the normal blood glucose levels. It brings about change of liver glycogen to blood glucose.

### Functions of Glucagon

- (a) It acts mainly on liver cells (hepatocytes) and stimulates glycogenolysis, which results in an increased blood sugar known as **hyperglycaemia**.
  - (b) Apart from this, glucagon also stimulates the process of gluconeogenesis which also contributes to hyperglycaemia. Glucagon is known as **hyperglycaemic hormone** because it reduces the cellular glucose uptake and utilisation.
  - (c) It reduces glycogenesis and also enhances lipolysis.
- (ii) **Insulin** This peptide hormone plays a major role in regulation of glucose level in the blood. It mainly acts on **hepatocytes** and **adipocytes** (cells of adipose tissue), increasing the cellular glucose uptake and utilisation. As a result, the movement of glucose takes place rapidly from blood to liver cells and cells of adipose tissues by decreasing the blood glucose level (**hypoglycaemia**).

### Functions of Insulin

- (a) Insulin stimulates the conversion of glucose to glycogen (glycogenesis) in the target cells.
- (b) Decreases gluconeogenesis.
- (c) Decreases glycogenolysis.
- (d) Also reduces the catabolism of proteins and fats.
- (e) Increases synthesis of fat in the adipose tissue from fatty acids.

### Abnormalities of Insulin Hormone

Low secretion of insulin hormone in humans is responsible for causing **diabetes mellitus** or **hyperglycemia**.

Symptoms include

- (i) The person starts losing glucose (sugar) in urine and has high level of glucose in the blood.
- (ii) A diabetic person loses weight and feels more thirsty due to loss of water by frequent urination.

Oversecretion of insulin results in lowering of sugar level in the blood known as **hypoglycemia** due to which a person may enter a state of coma or even death may occur.

### CHECK POINT 03

- 1 Why is pancreas referred to as heterocrine gland?
- 2 What are Islets of Langerhans?
- 3 What is meant by hyperglycemia?
- 4 How hypoglycemia is caused in human?
- 5 Why diabetic patient feels so thirsty?

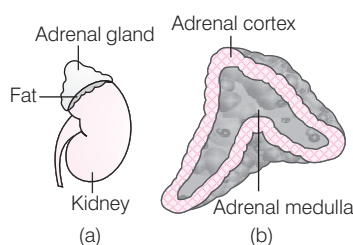
## Adrenal Glands (Suprarenals)

### Location

Our body has a pair of adrenal glands, each located at the anterior part of each kidney.

### Structure

Adrenal glands are conical, yellowish bodies composed of two types of tissues, i.e. adrenal cortex and adrenal medulla.



Diagrammatic representation of adrenal gland

### Adrenal Cortex

It is an external, firm and pale-yellowish tissue derived from the mesoderm of embryo. It is formed of three concentric layers, i.e. an inner, a middle and an outer layer. Hormones secreted by these three layers of adrenal cortex are collectively known as **corticoids**.

Three groups of steroid hormones are secreted by adrenal cortex such as

- (i) **Glucocorticoids** (Cortisol) It regulates the metabolism of carbohydrates, fats and proteins in the body.

#### Functions

- Cortisol stimulates the liver for the synthesis of carbohydrates from non-carbohydrate sources (like amino acids and glycerol). This process is known as **gluconeogenesis**.
  - Cortisol is involved in the maintenance of cardiovascular system and in proper functioning of kidney.
  - Cortisol produces anti-inflammatory reactions and functions in the suppression of immune response.
  - It stimulates the production of RBCs.
- (ii) **Mineralocorticoids** (Aldosterone) They regulate the balance of water and electrolytes in our body. Aldosterone is the major mineralocorticoid found in our body.

It mainly acts on renal tubules, stimulating the reabsorption of  $\text{Na}^+$  and water. It also stimulates the excretion of  $\text{K}^+$  and phosphate ions from the body.

**Functions**

Its main functions are to maintain electrolytes, body fluid volume, osmotic pressure and blood pressure of the body.

- (iii) **Sexocorticoids** (Androgen) Adrenal cortex produces a small quantity of androgenic steroids, i.e. sex hormone (androgens), both in males and females. These hormones are secreted as **DHEA** (Dihydroxy epiandrosterone), which acts as a precursor of both testosterone and oestrogen.

**Functions**

- It plays a major role in the growth of axial, pubic and facial hair during puberty.
- Development of acne in a young girl is due to the overproduction of these hormones.
- It plays an important role in the development of embryo (foetus).

## Abnormalities of Hormones from Adrenal Cortex

- **Hyposecretion of hormones** from adrenal cortex causes **Addison's disease**. Symptoms include loss of skin pigment, loss of weight, low blood sugar, sensitivity to cold and susceptibility to infections, etc.
- **Hypersecretion of cortisol** hormones from adrenal cortex causes **Cushing's syndrome**. Symptoms include high blood sugar, obesity, weakening of bones (osteoporosis), retention of salt and water in tissues, etc.
- **Hypersecretion of sexocorticoids** causes adrenal virilism in females. The female develops male secondary sexual characters such as appearance of beard, moustaches, etc.

## Adrenal Medulla

The adrenal medulla lies in the centre of the adrenal gland. It is an internal, soft, dark reddish-brown tissue derived from the ectoderm.

The adrenal medulla secretes two hormones, i.e.

- (i) **Adrenaline** (epinephrine)
- (ii) **Noradrenaline** (norepinephrine)

## Activation of Adrenaline and Noradrenaline

Both hormones belong to the category of compounds known as **catecholamines** and are secreted in response to any kind of stress, danger and during emergency situations like increased respiratory rate, heartbeat, etc.

The CNS at the time of stress or danger stimulates the adrenal medulla to release both these hormones. These are also known as **emergency hormones** or **hormones of fight or flight**.

## Functions of Adrenaline and Noradrenaline

These hormones serve following purposes

- (i) Increase alertness.
- (ii) Dilation of pupil.
- (iii) Piloerection (raising of hairs of hands and legs).
- (iv) Increase in heartbeat and rate of respiration.
- (v) Stimulate the breakdown of glycogen due to which the concentration of glucose increases in the blood.
- (vi) Stimulate breakdown of lipids and proteins.

## Regulation of Hormones : Feedback Mechanism

It is the mechanism of maintaining the normal balanced state between the rise and fall of hormones, i.e. to slow down the process, if excess amount of hormone is secreted and to speed up the process, if very low amount of hormone is released. The mechanism is usually negative feedback, although a few positive feedback mechanisms are also known.

## Negative Feedback Control

It is a closed loop in which synthesis of hormone stops or lowers, when its blood level rises above the normal. For example, if the level of glucose rises in the blood, it is detected by  $\beta$ -cells of the pancreas and it produces more insulin. This promotes absorption of glucose by the cells and its level is brought back to normal. The result is inhibition of insulin.

## Positive Feedback Control

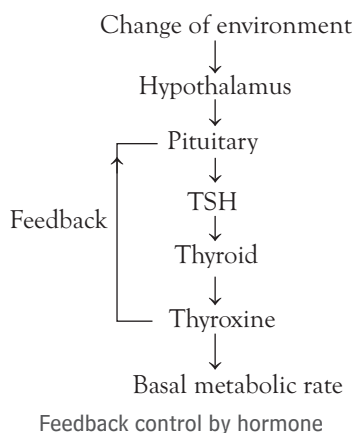
In this feedback, the production of hormone is further stimulated by its action, e.g. uterine contractions during childbirth stimulate the release of oxytocin into the mother's blood. This further intensifies uterine contractions, thus causing more oxytocin release. Production and release of oxytocin stop after the birth of the baby.

## Feedback Control by Thyroid Stimulating Hormone

Thyroid stimulating hormone stimulates the synthesis and secretion of thyroid hormones from thyroid gland.

The hypothalamus is stimulated by some external stimulus produces to thyroid releasing hormone. This stimulates anterior pituitary to secrete a specific hormone, i.e. Thyroid Stimulating Hormone (TSH).

TSH in turn stimulates thyroid gland to produce hormone thyroxine.



If the level of thyroxine in blood is high, it exerts a negative feedback effect on hypothalamus and anterior pituitary. If the level of thyroxine is less than normal, it stimulates hypothalamus to produce more Thyroid Stimulating Hormone-Releasing Factors (TSH-RF) (positive feedback). But, if thyroxine is present in more amount, the hypothalamus secretes less TSH-RF (negative feedback).

## Comparative Study of Nervous System and Endocrine System

We already know that both the endocrine and nervous system work in coordination with each other. However, significant differences exist between their activation, mechanism and responses.

Some of these differences are given in the table below

Features	Nervous system	Endocrine system
Signal	Electrical signals as nerve impulses. Chemical transfer of information by synapses.	Chemical signals only.
Signal speed	Rapid. Nerve impulse conduction occurs between 0.7 m/s –120 m/s.	Comparatively slower.
Effects generated	Localised but short-lived.	General effects can be short spanned or long lasting.
Potential for modifications	The responses can be improved from previous experiences.	No learning from previous responses.

### CHECK POINT 04

- 1 State the location of adrenal glands.
- 2 What are corticoids? Which part of adrenal gland produces them?
- 3 What is gluconeogenesis?
- 4 Expand DHEA.
- 5 State the symptoms of Addison's disease.
- 6 Which hormone is involved in the dilation of pupil?
- 7 Feedback mechanism is usually
  - (a) positive
  - (b) negative
  - (c) neutral
  - (d) None of these

## SUMMARY

- Endocrine system is needed to regulate the cellular functions continuously as the nerve fibres do not innervate all cells of the body, which is done with the help of special chemical messengers called hormones.
- Hormones are the non-nutrient chemical messengers produced in trace amounts by ductless glands called endocrine glands. These hormones act as intracellular messengers. In addition to endocrine glands, GI tract, liver and kidney also produce hormones.
- Chemically hormones are derived from iodothyronines, amines, peptides, proteins and steroids and the chemical nature of the molecule depends on them.
- Human endocrine system consists of various glands present in our body separated with each other with no anatomical links.
- Pituitary gland also called master gland is the regulating unit of hormonal system. The hormones secreted by anterior pituitary are growth hormone, gonadotropic hormones, prolactin, ACTH, melanin adrenocorticotrophic hormone, thyroid stimulating hormone and lipotropin. Posterior pituitary releases the hormones (ADH oxytocin secreted by hypothalamus) in the time of need.
- Thyroid gland is the largest endocrine gland made up of two lobes connected to each other by isthmus. It is composed of follicles and stromal tissues which is made up cuboidal epithelium. The hormones synthesised by these follicles are -thyroxine ( $T_4$ ), triiodo thyroxine ( $T_3$ ) and calcitonin.
- Adrenal glands are composed by adrenal cortex and adrenal medulla, adrenal cortex is responsible for secretion of 20 steroid hormones called corticoids. Which are mineralocorticoids, glucocorticoids and sexcorticoids on the other hand, adrenal medulla produces adrenaline and epinephrine. Catecholamines from adrenal medulla are responsible for the 3F 'fight' 'flight' and 'fright' during stressful condition, they are lipolytic, proteolytic and also promote glycogenolysis.
- Pancreas is a heterocrine gland. Its endocrine part consists of cells called Islets of Langerhans which is further composed of  $\alpha$ ,  $\beta$  and  $\delta$ -cells they secrete glucagon, insulin and somatostatin, respectively.
- Hormones involved in carbohydrate metabolism include-insulin, glucagon, epinephrine and cortisol.

# EXAM PRACTICE

## Multiple Choice Questions

1. Father of Endocrinology is  
 (a) Huxley (b) Thomas Addison  
 (c) Abel (d) Kimball and Murlin

Ans. (b)

2. Gigantism and dwarfism are the diseases related to  
 (a) prolactin hormone of mammary gland  
 (b) growth hormone of adenohypophysis  
 (c) luteinising hormone of pituitary gland  
 (d) thyroid stimulating hormone of thyroid gland

Ans. (b)

3. Gigantism and acromegaly are due to [2016]  
 (a) hyposecretion of thyroxine  
 (b) hyposecretion of growth hormone  
 (c) hypersecretion of thyroxine  
 (d) hypersecretion of growth hormone

Ans. (d)

4. Cretinism, mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc, are the results of  
 (a) hyperthyroidism (b) goitre  
 (c) hypothyroidism (d) Both (b) and (c)

Ans. (c)

5. Identify the correct statement.  
 (a) Hyperthyroidism adversely affects the body physiology  
 (b) Hypothyroidism causes cretinism  
 (c) Hypothyroidism causes goitre  
 (d) All of the above

Ans. (d)

6. Cretinism and myxoedema are due to  
 (a) hypersecretion of thyroxine  
 (b) hypersecretion of growth hormone  
 (c) hyposecretion of thyroxine  
 (d) hyposecretion of growth hormone [2014]

Ans. (c)

7. Pancreas acts as  
 (a) exocrine gland (b) endocrine gland  
 (c) Both (a) and (b) (d) holocrine gland

Ans. (c)

8. A gland which secretes both hormone and enzyme is [2013]  
 (a) pituitary (b) pancreas (c) thyroid (d) adrenal

Ans. (b)

9. Insulin is secreted by  
 (a) beta cells of pancreas (b) alpha cells of pancreas  
 (c) delta cells of pancreas (d) None of these

Ans. (a)

10. The child frightened by the loud noise, runs quickly to his mother.  
 Which substance helps in this response?  
 (a) Adrenaline (b) Insulin  
 (c) Amylase (d) Protease

Ans. (a)

11. Which of the following glands is known as master gland?  
 (a) Adrenal glands (b) Kidneys  
 (c) Pituitary (d) Pancreas

Ans. (c)

12. To maintain the constant steady state of our body, hormonal secretion is regulated by  
 (a) positive feedback  
 (b) negative feedback  
 (c) Both (a) and (b)  
 (d) Neither (a) nor (b)

Ans. (c)

## Fill in the Blanks

13. Complete the following table by filling in blank spaces (i) to (viii).

Gland	Substance produced	One important function
Islets of Langerhans	(i) .....	(ii) .....
(iii) .....	Adrenaline	(iv) .....
(v) .....	Thyroxine	(vi) .....
(vii) .....	LH	(viii) .....

Ans.

Gland	Substance produced	One important function
Islets of Langerhans	Insulin	Decreases sugar level in the body
Adrenal	Adrenaline	Increases heartbeat
Thyroid	Thyroxine	Regulates basal metabolism
Pituitary	LH	Stimulates production of progesterone

**14.** Fill in the blanks.

- (i) Nervous system and ..... are very closely associated.
- (ii) The glands with ducts are known as .....
- (iii) ..... gland stimulates secretion of different hormones and is also responsible for growth.

**Ans.** (i) endocrine system  
(ii) exocrine glands  
(iii) Pituitary.

**15.** Some diseases are given below. Fill the blanks with the name of the glands whose secretions are responsible for these diseases.

- (i) Acromegaly and .....
- (ii) Exophthalmia and .....
- (iii) Diabetes mellitus and .....
- (iv) Addison's disease and .....

**Ans.** (i) Pituitary  
(ii) Thyroid  
(iii) Pancreas  
(iv) Adrenal gland

### True-False

**16.** State the following statement as true or false. If false, write the correct form of statement by changing the first or last word only.  
Pituitary gland is both exocrine and endocrine in function.

**Ans.** The statement is false. Pancreas is both exocrine and endocrine in function.

**17.** State whether the following statements are true or false.

- (i) Chemically, hormones are always proteins.
- (ii) Conversion of glucose into glycogen is carried out by glucagon.
- (iii) The emergency hormone produced by adrenal gland is epinephrine.
- (iv) Adrenal gland is known as the master of all endocrine glands.
- (v) The beta cells of the pancreas secrete insulin. [2017]

**Ans.** (i) False  
(ii) False  
(iii) True  
(iv) False  
(v) True

### Match the Columns

**18.** Match the following columns.

Column I	Column II
A. PRL	1. Gonadotropins
B. TSH	2. Glucocorticoids
C. ACTH	3. Thyroid hormone
D. LH and FSH	4. Mammary glands

**Ans.** A-4, B-3, C-2, D-1

**19.** Match the following columns.

Column I	Column II
A. Cretinism	1. Hypersecretion of adrenal cortex
B. Diabetes insipidus	2. Hyposecretion of thyroxine
C. Exophthalmic goitre	3. Hyposecretion of growth hormone
D. Adrenal virilism	4. Hyposecretion of vasopressin
E. Dwarfism	5. Hyposecretion of adrenal cortex
	6. Hypersecretion of growth hormone
	7. Hypersecretion of thyroxine

[2018]

**Ans.** A-2, B-4, C-7, D-1, E-3

### a 1 Mark Questions

**20.** Define the term 'hormones'. [2014, 10]

**Ans.** The secretions from specific cells or glands in the body which are poured into blood and act on target specific sites are called hormones.

**21.** Name the gland that is also called hypophysis.

**Ans.** Pituitary gland.

**22.** Give a technical term for group of hormones which influence other endocrine glands to produce hormones. [2014, 12]

Or

Hormones which regulate the secretion of other endocrine glands. [2018]

**Ans.** Tropic hormones are the group of hormones, which influence other endocrine glands to produce hormones.

**23.** Explain the term tropic hormone. [2017]

**Ans.** These are the hormones which stimulate other endocrine glands to produce their specific hormones.

- 24.** Name the pituitary hormone which stimulates contraction of uterus during childbirth. [2017]  
**Ans.** Oxytocin hormone secretes from posterior pituitary gland and stimulates the contractions of uterus during childbirth.
- 25.** Choose the odd one out of the following terms given and name the category to which the other belong [2017]  
 ACTH, TSH, ADH, FSH  
**Ans.** Odd term—ADH  
 Category—Hormone of posterior pituitary gland.  
 Rest three are the hormones of anterior pituitary gland.
- 26.** State the location of the thyroid gland. [2016]  
**Ans.** In the front of neck region.
- 27.** Give the exact location of thyroid gland. [2012]  
**Ans.** **Thyroid gland** is located in the front part of the neck, attached to trachea below larynx.
- 28.** Differentiate between the following pair on the basis of what is given in bracket. [2017]  
 Simple goitre and exophthalmic goitre (cause of the disorder).  
**Ans.**
- | Simple goitre                             | Exophthalmic goitre                                 |
|---|---|
| It is caused by the deficiency of iodine. | It is caused by the over activity of thyroid gland. |
- [1]
- 29.** Name the hormones secreted by Islets of Langerhans. [2014]  
**Ans.** Insulin and glucagon are the hormones secreted by the Islets of Langerhans.
- 30.** Identify the hormone that releases glucose into the blood.  
**Ans.** Glucagon.
- 31.** State the exact location of adrenal gland.  
**Ans.** Adrenal glands are situated above each kidney, as a cap-like structure.
- 32.** Give biological reasons for the following statement  
 Some women have facial hair like beard and moustache. [2017]  
**Ans.** Some women have facial hair like beard and moustache due to the hypersecretion of sexcorticoids from adrenal gland.
- 33.** Which is the hormone that controls  $\text{Na}^+$  and  $\text{K}^+$  metabolism in the body?  
**Ans.** Aldosterone is responsible for controlling  $\text{Na}^+$  and  $\text{K}^+$  metabolism in the body.
- 34.** The outermost layer of adrenal cortex is responsible for secretion of which hormone?  
**Ans.** Mineralocorticoids.
- 35.** In the set of term given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term in the following and name the category to which the remaining three belong. Cortisone, somatotropin, adrenocorticotrophic hormone, vasopressin [2016]  
**Ans.** Odd term—Cortisone  
 Category—Pituitary hormone.
- 36.** Rewrite the given incorrect statement by changing the underlined words of the statement. [2017]  
 The Graafian follicle, after ovulation turns into a hormone producing tissue called corpus callosum.  
**Ans.** The Graafian follicle, after ovulation turns into a hormone producing tissue called corpus luteum. Corpus callosum is a large bundle of myelinated fibres which connects the right and left hemisphere of cerebrum.
- 37.** Briefly explain the term diabetes insipidus. [2013]  
**Ans.** Diabetes insipidus is the condition which occurs due to low secretion of hormone called vasopressin or antidiuretic hormone from the posterior lobe of pituitary gland. The disease is characterised by excretion of large amounts of urine and subsequent dehydration and thirst.

## **b** 2 Marks Questions

- 38.** Explain why hormonal responses are slower than reflex actions.  
**Ans.** Hormonal responses are slower than reflex actions because hormones which initiate and control the responses are chemicals transported by blood. On the contrary in reflex actions, the impulses are electrical in nature and are transmitted by specialised cells called neurons, that make up nerve tissue.

- 39.** When does the secretion of adrenocorticotropin take place in the body? What is the purpose of its secretion?

**Ans.** Adrenocorticotropin is secreted when Adrenocorticotropin Releasing Hormone (ACRH) stimulates the corticotroph cells of anterior lobe of pituitary gland. [1]  
It is released because its stimulation is responsible for the synthesis and secretion of glucocorticoids and mineralocorticoids from the adrenal cortex of adrenal gland. [1]

### **c** 3 Marks Questions

- 40.** Which hormones are secreted by the posterior pituitary gland? What function does each serve? Where are these hormones actually produced? How are these hormones transported to the region from where they are released?

**Ans.** Oxytocin and vasopressin are secreted by the posterior pituitary gland.  
Refer to the Hormones of posterior pituitary.

- 41.** Name the following.  
(i) A condition which results in abnormally long bones, long lower jaw bone due to the hypersecretion of a pituitary hormone.  
(ii) The endocrine cells present in pancreatic gland.  
(iii) The hormone responsible for water exchange in the renal tubules.

**Ans.** (i) Acromegaly  
(ii) Islets of Langerhans- $\alpha$ ,  $\beta$  and  $\delta$ -cells  
(iii) ADH/Vasopressin [1×3]

- 42.** Which hormonal deficiency is responsible for the following?

- (i) Diabetes mellitus  
(ii) Goitre  
(iii) Cretinism

**Ans.** (i) Diabetes mellitus is due to the deficiency of insulin.  
(ii) Goitre is due to the deficiency of thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ).  
(iii) Cretinism is due to the deficiency of thyroxine hormone. [1×3]

- 43.** (i) Expand the following biological abbreviation. TSH [2014]

- (ii) Describe what happens to hormones after they have brought about their effects on their target organs.

**Ans.** (i) TSH abbreviates for Thyroid Stimulating Hormone. [1]  
(ii) After they have performed their function, hormones are eventually carried to the liver by blood where they are either destroyed or converted to inactive substances by the liver cells and are excreted by the kidneys. [2]

### **d** 4 Marks Questions

- 44.** Differentiate between the following pairs.

- (i) Diabetes mellitus and diabetes insipidus [2012]  
(ii) Acromegaly and myxoedema

**Ans.** (i) Differences between diabetes insipidus and mellitus are

Diabetes insipidus	Diabetes mellitus
Low secretion of ADH.	Low secretion of insulin.
Patient suffers from loss of water.	Patient suffers from loss of glucose in urine.

[2]

- (ii) Differences between acromegaly and myxoedema are

Acromegaly	Myxoedema
It is caused due to oversecretion of growth hormone from pituitary gland in adults.	It is caused due to undersecretion of thyroxine from thyroid gland in adults.
Characterised by long bones of hand and legs which gives a person gorilla-like appearance.	Characterised by puffy appearance due to accumulation of fat in subcutaneous tissue.

[2]

- 45.** Give scientific reasons for the following statements.

- (i) Endocrine glands directly release their products into the blood.  
(ii) The hormones released by the posterior lobe of pituitary are not its own products.  
(iii) Pituitary gland is called master gland. [2012]  
(iv) Adrenal glands are also called glands of emergency.

- Ans.** (i) Endocrine glands are ductless glands and their products act at a distant site. Thus, their product directly releases into the blood.
- (ii) The hormones released by posterior lobe of pituitary are synthesised by the neurons in the hypothalamus and sent to the former *via* axons for release.
- (iii) Pituitary gland controls the secretion of hormones from other glands. Thus, it is called master gland.
- (iv) Adrenal glands are called gland of emergency because hormones of adrenal medulla increase the metabolism to prepare the animal to face immediate physical and emotional stress and emergency situations. [1×4]

### e 5 Marks Questions

**46.** A sample of urine was diagnosed to contain high content of glucose and ketone bodies. Based on this observation, answer the following.

- (i) Which endocrine gland and hormone is related to this condition?
- (ii) Name the cells on which this hormone acts.
- (iii) What is the condition called and how can it be rectified?

- Ans.** (i) Pancreas gland and insulin hormone are related to this condition. [1]
- (ii) Insulin hormone mainly acts on hepatocytes (liver cells) and adipocytes (cells of adipose tissue) and enhances cellular glucose uptake and utilisation. [2]
- (iii) Prolonged hyperglycemia leads to a complex disorder called diabetes mellitus. It is associated with the loss of glucose through urine and formation of harmful compounds known as ketone bodies. Diabetic patients are successfully treated with insulin therapy. [2]

**47.** How do you justify the statement that hormones of adrenal medulla are emergency hormones?

**Ans.** Hormones of adrenal medulla, i.e. adrenaline and noradrenaline belong to the category of compounds called catecholamines.

These are secreted in response to any kind of stress, danger and during emergency situations like fall in blood pressure or sugar, increased respiratory rate and heartbeat.

CNS at the time of stress or danger stimulates adrenal medulla to release these hormones. All these conditions need more energy for their action. Thus, these hormones prepare the body to face stress or danger and are called emergency hormones.

**48.** Complete the following table by filling in the numbered blanks with an appropriate term/answer. [2017]

Gland	Hormone produced	Function
Thyroid	A	B
C	D	Dilates pupil of eye
E	Insulin	F
G	ADH	H
I	J	Conversion of glycogen to glucose

**Ans.**

Gland	Hormone produced	Function
Thyroid	Thyroxine	It regulates the basal metabolism of the body
Adrenal medulla	Adrenaline	Dilates pupil of eye.
Beta cells of pancreas	Insulin	Lower the sugar level in the blood.
Posterior pituitary gland	ADH	Increases reabsorption of water from kidney.
Alpha cells of pancreas	Glucagon	Conversion of glycogen to glucose.

[½ × 10]

**49.** Complete the following paragraph by filling in the blanks (i) to (v) with appropriate words.

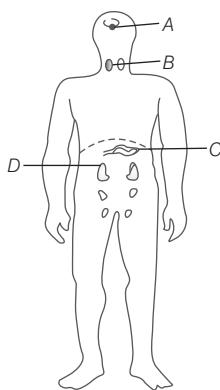
The amount of urine output is under the regulation of a hormone called (i) ..... secreted by the (ii) ..... lobe of the pituitary gland. If secretion of this hormone is reduced, there is an increased production of urine. This disorder is called (iii) ..... Sometimes excess glucose is passed with urine due to hyposecretion of another hormone called (iv) ..... leading to the cause of disease called (v) ..... [2016]

- Ans.** (i) ADH (ii) posterior  
(iii) diabetes insipidus (iv) insulin  
(v) glucosuria [5]

## Diagram Based Questions

**50.** Given below is the outline of the human body showing the important glands. [2016]

- Name the glands marked A-D.
- Name the hormone secreted by part B. Give one important function of this hormone.
- Name the endocrine part of the gland labelled C.
- Why is the part labelled A called the master gland? Which part of the forebrain controls the gland labelled A?
- Name the gland that secretes the 'emergency hormone'.



- Ans.**
- |                 |           |
|-----------------|-----------|
| (i) A—Pituitary | B—Thyroid |
| C—Pancreas      | D—Adrenal |
- Thyroid gland produces thyroxine which controls the endocrine part of the gland and basal metabolic rate of the body.
  - The part 'C' represents the Islets of Langerhans (i.e. the endocrine part of the pancreas) which secretes two hormones, namely insulin and glucagon.
  - Pituitary gland controls the secretions of other endocrine glands of the body. Its secretions are controlled by hypothalamus.
  - Adrenal gland produces adrenaline-the emergency hormone.

**51.** Observe the diagram given below and answer the following questions.

- The figure depicts a condition caused by deficiency of a hormone. Identify this condition.

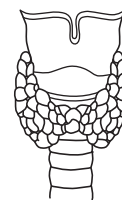


- Suggest the underlying cause for this condition.
- Name any two diseases resulting due to same cause.
- Where is the gland that causes this condition located?

- Ans.**
- Goitre.
  - Enlargement of thyroid gland due to iodine deficiency.
  - Cretinism and myxoedema.
  - Thyroid gland is situated in front of larynx.

**52.** The given diagram represents the location and structure of an endocrine gland. Study the same and answer the questions that follows [2017]

- Name the endocrine gland shown in the diagram.
- Name the secretion of the gland which regulates basal metabolism.
- Name the mineral element required for the synthesis of the above mentioned hormone.
- Name the disease caused due to undersecretion of the above mentioned hormone in children.
- Name the disease caused due to hypersecretion of the above mentioned hormone.



- Ans.**
- The given diagram is of thyroid gland.
  - Thyroxine hormone, secreted by the thyroid gland is responsible for the regulation of normal basal metabolism of the body.
  - Thyroxine requires iodine in order to be synthesised.
  - Undersecretion of thyroxine hormone causes cretinism in children.
  - Hypersecretion of thyroxine hormone can cause exophthalmic goitre.

# CHAPTER EXERCISE

## Multiple Choice Questions

- Given below are four statements about hormones. Identify the statement which is not related with the hormones.  
(a) The targets are located away from the source glands  
(b) They are secreted directly into the blood  
(c) Like catalysts they can be reused  
(d) Their production is in minute quantities
- Thyroid secretion is primarily regulated by  
(a) body temperature (b) iodine content of the body  
(c) glucagon (d) thyroid stimulating hormone

## Answers

1. (c) 2. (d)

## Fill in the Blanks

- Fill in the blanks with the correct alternative from those given in the brackets.  
(i) Cortex and medulla are two regions of ..... gland. (thyroid/adrenal)  
(ii) Cretinism is caused due to ..... of thyroxine. (undersecretion/oversecretion)  
(iii) Exophthalmic goitre occurs in ..... only. (adults/children)

## True-False

- Given below are a few statements. Identify them as true or false. If false, rewrite the correct word by striking out the single false word.  
(i) Pituitary is the longest gland in our body.  
(ii) Pars distalis produces six tropic hormones.  
(iii) Deficiency in the secretion of vasopressin leads to diabetes mellitus.  
(iv) The secretion of ADH is inhibited by diuretic substances like alcohol.

## Match the Columns

- Match the following columns.

Column I	Column II
A. $T_4$	1. Hypothalamus
B. FSH	2. Thyroid
C. GnRH	3. Pituitary
D. LH	4. Spermatogenesis

## 1 Mark Questions

- Give reason.  
People living in the hilly areas often have swollen necks.
- Justify, 'Glucagon is hyperglycemic hormone'.
- Given below are the four terms in which one term is odd and cannot be grouped into the category to which the other three belong. Identify the odd one and name the category to which the remaining three belong.  
ADH, TSH, NADP, ACTH

## 2 Marks Questions

- Why is chemical and hormonal coordination necessary?
- Name the disease in which there is a reduced renal absorption of water with a consequent elimination of a large volume of very dilute urine. What is its cause?

## 3 Marks Question

- Give reasons for the following.  
(i) Insulin is ineffective when taken orally.  
(ii) Thyroid is referred to as nature gland.  
(iii) Some adult women develop facial hairs.

## 4 Marks Questions

- Given below are some structures. Fill the blanks with words representing the suitable function or feature of given structure.  
(i) Adenohypophysis and .....  
(ii) Gigantism and .....  
(iii) Beta cells and .....  
(iv) Cushing's syndrome and .....  
13. Name the hormone responsible for the following functions.  
(i) Increase in heartbeat.  
(ii) Regulates basal metabolism.

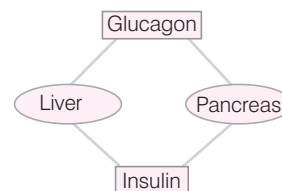
- (iii) Regulates the functioning of the male and female reproductive organs.
- (iv) Increased reabsorption of water in kidneys.

### 5 Marks Question

- 14.** (i) Which endocrine gland and its part is involved in the secretion of insulin?
- (ii) When does a doctor prefer insulin injections for a patient and what is the role of insulin in controlling level of glucose in blood?
- (iii) What precautions should be taken to prevent such disease?

### Diagram Based Question

- 15.** Study the diagram given below and then answer the questions that follows.



- (i) Name the cells of the pancreas that produce  
(a) glucagon                      (b) insulin
- (ii) State the main function of  
(a) glucagon                      (b) insulin
- (iii) Why is pancreas referred to as an 'exo-endocrine gland'?
- (iv) Why is insulin not given orally but is injected into the body?
- (v) What is the technical term for the cells of the pancreas that produce endocrine hormones?
- (vi) Where in the body is pancreas located?

# ARCHIVES\*

## (Last 7 Years)

Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

1. Give appropriate biological or technical term for the following.

Hormones which regulate the secretion of other endocrine glands. [1]

2. Match the items given in **Column I** with the most appropriate ones in **Column II** and rewrite the correct matching pairs

Column I		Column II	
A. Cretinism	1.	Hypersecretion of adrenal cortex	
B. Diabetes insipidus	2.	Hyposecretion of thyroxine	
C. Exophthalmic goitre	3.	Hyposecretion of growth hormone	
D. Adrenal virilism	4.	Hyposecretion of vasopressin	
E. Dwarfism	5.	Hyposecretion of adrenal cortex	
	6.	Hypersecretion of growth hormone	
	7.	Hypersecretion of thyroxine	

[5]

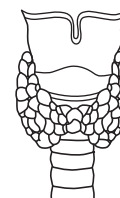
7. Choose the odd one out of the following terms given and name the category to which the others belong.  
ACTH, TSH, ADH, FSH [1]

8. Complete the following table by filling in the numbered blanks with an appropriate term/answer. [2017]

Gland	Hormone produced	Function
Thyroid	(i)	(ii)
(iii)	(iv)	Dilates pupil of eye
(v)	Insulin	(vi)
(vii)	ADH	(viii)
(ix)	(x)	Conversion of glycogen to glucose

[5]

9. The given diagram represents the location and structure of an endocrine gland. Study the same and answer the questions that follows [2017]



- (i) Name the endocrine gland shown in the diagram.
- (ii) Name the secretion of the gland which regulates basal metabolism.
- (iii) Name the mineral element required for the synthesis of the above mentioned hormone.
- (iv) Name the disease caused due to undersecretion of the above mentioned hormone in children.
- (v) Name the disease caused due to hypersecretion of the above mentioned hormone. [5]

### 2017

3. Name the following  
The pituitary hormone which stimulates contraction of uterus during childbirth. [1]

4. The statement given below is incorrect. Rewrite the statement by changing the underlined words of the statement. [1]

The Graafian follicle, after ovulation turns into a hormone producing tissue called corpus callosum.

5. Explain the term tropic hormone. [1]
6. Differentiate between the following pair on the basis of what is given in the bracket.  
Simple goitre and exophthalmic goitre (cause of disorder). [1]

### 2016

10. In the set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term in each set and name the

category to which the remaining three belong. Cortisone, Somatotropin, Adrenocorticotrophic hormone, Vasopressin [1]

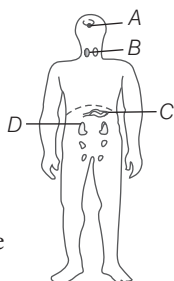
11. State the location of the following  
Thyroid gland [1]

12. Complete the following paragraph by filling in the blanks (i) to (v) with appropriate words.

The amount of urine output is under the regulation of a hormone called (i) ..... secreted by the (ii) ..... lobe of the pituitary gland. If secretion of this hormone is reduced, there is an increased production of urine. This disorder is called (iii) ..... . Sometimes excess glucose is passed with urine due to hyposecretion of another hormone called (iv) ..... leading to the cause of disease called (v) ..... . [5]

13. Given below is the outline of the human body showing the important glands.

- (i) Name the glands marked A-D.  
(ii) Name the hormone secreted by part B. Give one important function of this hormone.  
(iii) Name the endocrine part of the gland labelled C.  
(iv) Why is the part labelled A called the master gland? Which part of the forebrain controls the gland labelled A?  
(v) Name the gland that secretes the 'emergency hormone'. [5]



## 2015

14. The statements given below are false. Rewrite the correct form of the statements by changing the word which is underlined.

- (i) Cretinism is caused due to deficiency of adrenaline.  
(ii) Alpha cells of pancreas secrete insulin. [1 × 2]

15. Given below is an example of a certain structure and its special functional activity. On a similar pattern, fill in the blank with suitable function.

e.g. Chloroplast and photosynthesis

Thyroid gland and ..... [1]

16. Differentiate between vasopressin and insulin (deficiency disorder). [1]

## 2014

17. Give technical term for the following  
Group of hormones which influence other endocrine glands to produce hormones. [1]  
18. Name the hormone secreted by Islets of Langerhans. [1]  
19. Choose the correct answer from the four options given below.  
Cretinism and myxoedema are due to  
(a) hypersecretion of thyroxine  
(b) hypersecretion of growth hormone  
(c) hyposecretion of thyroxine  
(d) hyposecretion of growth hormone [1]  
20. Explain the following biological abbreviation TSH. [1]  
21. Briefly explain the term 'hormones'. [1]  
22. State the exact location of adrenal gland. [1]

## 2013

23. Choose the correct answer from the four options given below.  
A gland which secretes both hormone and enzyme is  
(a) pituitary (b) pancreas  
(c) thyroid (d) adrenal [1]  
24. Briefly explain the term 'diabetes insipidus'. [1]

## 2012

25. Name the hormone that helps to increase the reabsorption of water from the kidney tubules. [1]  
26. State the function of  $\beta$ -cells of pancreas. [1]  
27. Give the exact location of thyroid gland. [1]  
28. Differentiate between the following pairs on the basis of what is mentioned in bracket.  
Diabetes mellitus and diabetes insipidus (reason/cause) [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

(Q. No. 1-3). Choose the correct option.

- 1 Match each hormone (Column I) with its effect on target cells (Column II) and the gland where it is produced (Column III). Then, choose the correct option from the codes given below.

Column I	Column II	Column III
A. Thyroxine	i. lowers blood glucose	P. Testes
B. Insulin	ii. stimulates ovary	Q. Adrenal medulla
C. Epinephrine	iii. triggers fight or flight	R. Posterior pituitary
D. ADH	iv. promotes male traits	S. Pancreas
E. Androgen	v. regulates metabolism	T. Anterior pituitary
F. FSH	vi. boost water retention	U. Thyroid gland

## Codes

- (a) A-(v)-U, B-(i)-T, C-(iii)-R, D-(iv)-S, E-(vi)-P, F-(vi)-Q  
 (b) A-(v)-U, B-(i)-S, C-(iii)-Q, D-(vi)-R, E-(iv)-P, F-(ii)-T  
 (c) A-(v)-U, B-(ii)-S, C-(i)-T, D-(iv)-P, E-(iii)-Q, F-(i)-R  
 (d) A-(iii)-P, B-(i)-Q, C-(ii)-R, D-(iv)-S, E-(vi)-T, F-(v)-U
- 2 Which of the following statements are true/false?  
 I. Calcitonin regulates the metabolism of calcium.  
 II. Oxytocin stimulates contraction of uterine muscles during birth.  
 III. Grave's disease is caused by the malfunctioning of adrenal gland.  
 IV. ADH stimulates absorption of water and increases the urine production.  
 (a) I and III are true; II and IV are false  
 (b) I and II are true; III and IV are false  
 (c) I and IV are false; II and III are true  
 (d) I, II and IV are true; only III is false
- 3 Feeling the tremors of an earthquake, a scared resident of seventh floor of a multistoreyed building starts climbing down the stairs rapidly. Which hormone is responsible for initiation of this action?  
 (a) Thyroxine (b) Adrenaline (c) Glucagon (d) Gastrin
- 4 'Hormones are called information molecules'. Justify the statement with example.
- 5 In areas where dietary intake of iodine is low, people had swollen necks. What would you say about this occurrence ?

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Reproductive System

The biological process by which organisms produce young ones (offsprings) similar to themselves is called **reproduction**. It helps to maintain the continuity of life on earth because no organism lives forever. Reproduction therefore, helps in the increase of population of the species. It transfers the characteristics of parents into their offsprings. Reproduction can be of the following two major types

- (i) **Asexual reproduction** This type of reproduction produces individuals without the fusion of gametes. It occurs in unicellular and lower organisms, e.g. *Amoeba*, *Paramecium*, lower plants, etc.
- (ii) **Sexual reproduction** This type of reproduction involves the fusion of gametes, i.e. sex cells (single-celled or haploid) of male and female get fused to produce new cell called **zygote** (double-celled or diploid). It multiplies mitotically to give rise to multicellular organisms like animals and higher plants.

## Human Reproduction

Humans are sexually reproducing **viviparous** (i.e. give birth to young ones) organisms. They show prominent **sexual dimorphism** with male and female differing from each other by a number of primary and secondary sex characters. Primary sex characters are present since birth, e.g. external genitalia in males and females. Organs producing gametes are called **reproductive organs**. These are divided into following two main parts

- (i) **Primary sex organs** These include the gonads of both males (testes) and females (ovaries), which are responsible for producing gametes, i.e. sperms (in males) and eggs (in females).
- (ii) **Secondary sex organs** These include all the structures, that do not produce gametes but help in the process of reproduction. These structures have distinct roles from fertilisation to growth, development and birth of the baby, e.g. penis, uterus, etc.

### Puberty

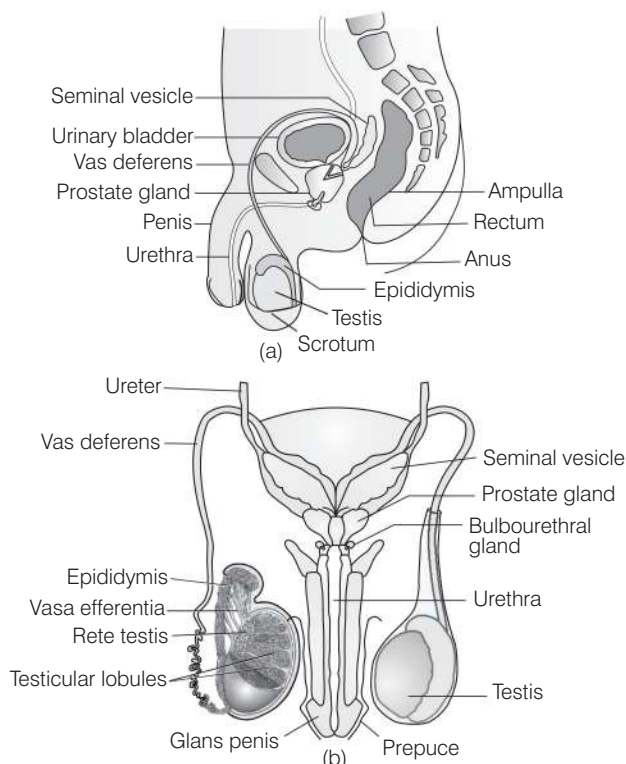
The onset of reproductive life is called puberty. It is the time when reproductive organs start maturing to become fully functional and start producing male and female gametes. After puberty, secondary sexual characters start becoming visible. In males, puberty starts at the age of 11-16 years and changes like broadening of chest and shoulders, growth of moustaches and beard, enlargement and erection of penis and broadening of pectoral girdle occurs in them. In females, puberty starts at the age of 10-14 years and changes like enlargement of breasts, growth of axillary and pubic hairs, start of menstrual cycle and broadening of pelvic girdle occurs in them.

### Chapter Objective

- Human Reproduction
- Male Reproductive System
- Female Reproductive System
- Menstrual Cycle
- Fertilisation
- Implantation
- Foetal Membranes
- Placenta
- Gestation
- Parturition (Childbirth)

## Male Reproductive System

It is located in the pelvic region. The structure present in this system are either paired or unpaired.



The male reproductive system : (a) Sectional view of male pelvis, (b) Anterior view

It consists of the following organs

### Primary Sex Organs

**Testes** are the primary sex organs in men. Their description is given ahead

#### Testes

These are the **male gonads**, i.e. the site where the male gametes or sperms are made. A pair of testes is situated outside the abdominal cavity within the **scrotum**.

Each testis is divided into 200-300 compartments called **testicular lobules**. Each lobule contains 1-3 highly convoluted **seminiferous tubules**, blood vessels and nerves embedded in loose connective tissue.

#### Scrotum

It is a pouch-like structure of pigmented skin arising from the lower abdominal wall and hanging between the legs. Scrotum keeps the temperature of testes about  $2-2.5^{\circ}\text{C}$  lower than the internal body temperature, which is essential for the production of sperms, i.e. spermatogenesis.

### Seminiferous Tubule

It is the structural and functional unit of testis in which sperms are produced. Each seminiferous tubule is lined on its inside by two types of highly specialised cells as given below

- (i) **Sertoli cells** (nurse cells)
- (ii) **Male germ cells** (spermatogonia)

The Sertoli cells are tall, pyramidal cells which provide nutrition to the developing germ cells. Male germ cells multiply to produce sperm cells.

The region outside the seminiferous tubules called **interstitial spaces** contain small blood vessels and masses of cells called **interstitial cells** or **Leydig cells**. These cells synthesise and secrete the testicular hormones called **androgens** or **testosterone**. Leydig cells are endocrine in function and thus, regulate and maintain male sex characteristics.

## Secondary Sex Organs

They consist of the following

### Accessory Duct System

These ducts store and transport the sperms from the testis to the outside through urethra. The male sex accessory ducts include **tubuli recti**, **rete testis**, **vasa efferentia** (intratesticular ducts), **epididymis**, **vas deferens** and **urethra** (extratesticular ducts).

**Epididymis** is a long tube, which is greatly coiled and tightly packed to form an elongated flattened body. It is located along the posterior surface of each testis.

Sperms undergo physiological maturation acquiring increased motility and fertilising capacity (i.e. **capacitation**) in epididymis. After that they pass down to the tail of epididymis, where they stay for a very short period before entering the two **vas deferens**.

The vas deferens ascends to the abdomen and loops over urinary bladder. It receives a duct from seminal vesicle to form **ejaculatory duct**. The duct passes through the prostate gland and opens into the **urethra**.

The urethra originates from the urinary bladder and extends through the penis to its external opening called **urethral meatus**.

### Accessory Glands

The three accessory glands in males are

- (i) **Seminal vesicles** These are paired tubular glands found between the posterior surface of urinary bladder and rectum (part of large intestine). They are

responsible for producing a milky fluid known as **semen**.

- (ii) **Prostate gland** It is an almond-shaped structure found surrounding the urethra near its origin from bladder.

It secretes a white alkaline fluid into the semen to neutralise the acidic pH of vagina.

- (iii) **Cowper's glands** (Bulbourethral gland) These glands secrete mucus and alkaline fluid into the urethra which helps in the lubrication of penis.

### External Genitalia (Penis)

It is the external copulatory organ in males located in front of scrotum. It serves as a passage for both semen and urine to move out from the body.

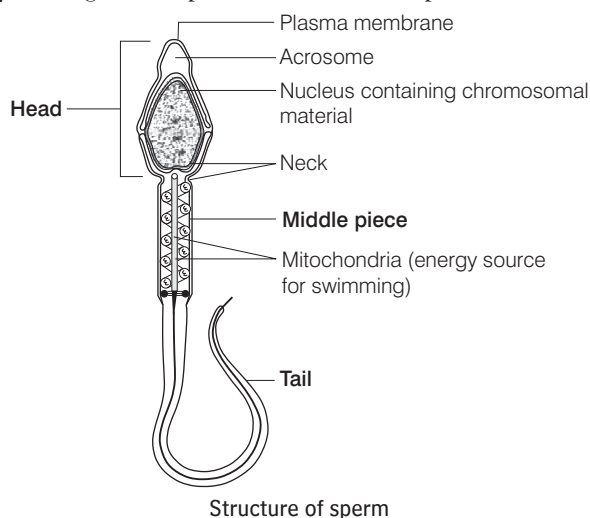
The process of expulsion of semen from the urethra is called **ejaculation**.

### Semen

The secretions of accessory sex glands and mucus are added to the sperms to form seminal fluid or semen or seminal plasma. These secretions provide medium for the transmission of sperms, give nourishment and activate sperms to keep them viable and motile.

### Sperm

A mature sperm cell or spermatozoa is a microscopic, tadpole-shaped structure of about  $2.5\ \mu\text{m}$  in diameter and  $60\ \mu\text{m}$  long. It comprises of three main parts



- (i) **Head** It is an oval-shaped flat structure. It is composed of a large nucleus, which contains genetic material (DNA) and a small cap-like structure known as **acrosome**. Acrosome secretes hydrolytic enzyme,

which facilitates the entry of sperm into the egg by dissolving the wall of egg cell.

- (ii) **Middle piece** It is cylindrical in shape and is known as powerhouse of the sperm cell because it possesses mitochondria that provides energy (in the form of ATP) to the sperm to swim into the female reproductive tract.

- (iii) **Tail** It is a long, slender structure, which acts as the locomotory organ of the sperm.

### Pathway of Sperm Transport in Male

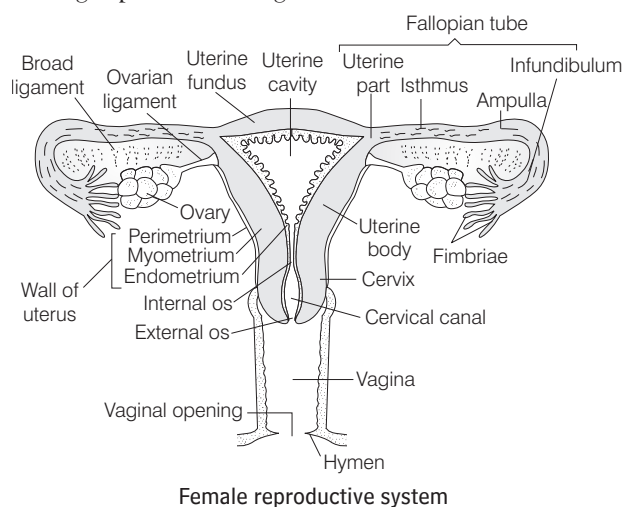
Seminiferous tubules (sperms) → Network of tubules → Efferent duct → Epididymis → Vas deferens or sperm duct → Urethra

#### CHECK POINT 01

- 1 Name the male reproductive cells of mammals.
- 2 Name the cells that produce male hormones.
- 3 Name the sac in which testes are present in man.
- 4 What makes sperm viable and motile?
- 5 What is ejaculation?
- 6 Give one function of semen.

### Female Reproductive System

The reproductive system of females comprises of the following reproductive organs



### Primary Sex Organs

Ovaries are the primary sex organs in females.

#### Ovaries

These are two small oval-shaped bodies, responsible for producing female gametes, i.e. **ova** (egg cells). These are

located near kidneys and stay attached to the lower cavity of abdomen through mesovarium of ovarian ligaments.

Oogenesis is the process of production of mature ovum from the ova producing cells. A mature egg is contained in a cellular sac-like structure known as **follicle**. It gets enlarged in size and becomes **Graafian follicle**. **Ovulation** is the process in which Graafian follicle ruptures to release the egg cell from the ovary.

The remaining part of Graafian follicle (after release of egg) persists for a short time, after which it gets converted into **corpus luteum**. It is a yellow mass of endocrine tissue responsible for secreting hormone **progesterone**, which prepares uterus for pregnancy. In the absence of pregnancy, corpus luteum degenerates.

## Secondary Sex Organs

These are as follows

### Accessory Ducts

The following parts constitute the accessory ducts

- (i) **Oviducts** (Fallopian tubes) These are two small tubes, around 10-12 cm long, located on either sides of the uterus near the kidney. The cilia of **fimbriae** of oviducts funnel are responsible for picking up and pushing the released egg into the oviduct. Oviducts receive the ovum and provide appropriate conditions for its fertilisation with sperm and also transports it to the uterus.
- (ii) **Uterus** It is a hollow pear-shaped organ located in the pelvic cavity between the urinary bladder and rectum. It is also known as **womb** because it is the place where development of embryo takes place.
- (iii) **Vagina** It is the muscular tube-like structure meant to receive male penis during copulation and also acts as a passage for the baby during childbirth. The opening of vagina is normally covered by a membrane called **hymen**.

### Cervix (Neck)

It is the lower part of uterus, which is very narrow. The sperms enter into the uterus through this part.

### Accessory Glands

- (i) A pair of vestibular or **Bartholin's gland** occurs one on each side of the vaginal orifice, which moisten the vagina. They are small rounded bodies. These glands correspond to the Cowper's gland of the male and secrete a clear, viscous fluid during sexual excitement. This fluid serves as a lubricant during copulation and parturition.

- (ii) Two **mammary** or **milk producing glands** (breast) are present in each normal female. These are responsible for the secretion of milk.

## External Genitalia (Vulva)

These are the external genital organs of females. These include mons pubis, labia majora, labia minora and clitoris. The most anterior structure of vulva is the **mons pubis**. It is covered with skin and pubic hairs. The two longitudinal folds of skin are called **labia majora** (labia means 'lips'), which forms the boundary of vulva. It is equivalent to male scrotum.

In the uppermost angle of vulva, in front of the urethral opening a small erectile structure called **clitoris** is present. It is highly sensitive because of the presence of numerous nerve endings and is equivalent to male penis.

## Menstrual Cycle

It is a series of changes occurring in the wall of uterus (endometrium) of human females, that prepares the uterus to receive a fertilised egg (i.e. for pregnancy). The first menstruation begins at puberty, i.e. at an age of around 12-13 years and is known as **menarche**. It continues till the age of 40-45 years and then stops (**menopause**).

The complete period from menarche to menopause is known as the **reproductive period** in females. This period is marked by a characteristic event repeated every month in the form of menstrual flow. It continues from the day of the onset of the flow to the next onset, i.e. after around 27-28 days.

It gets temporarily stop during pregnancy. The complete period of menstrual cycle is divided into following four main phases

- (i) **Menstrual phase** This is the first phase that lasts for around 3-5 days. Periodic discharge of blood is seen during this phase due to the shedding of the uterine wall.
- (ii) **Follicular phase** It is the formation of a new egg in follicle. It lasts for around 5-12 days. This is the period in which secondary follicle changes into Graafian follicle (as the follicle grows) and again reactivates the wall of uterus (to become thickened and supplied with lot of blood vessels) by producing hormone called **oestrogen**.
- (iii) **Ovulatory phase** In this period, the rupture of Graafian follicle, i.e. ovulation occurs releasing the egg to travel down the oviduct. It occurs on about 13-14th day of the menstrual cycle.

(iv) **Luteal phase** It continues for around 10 days. During this phase, uterus lining gets thickened to receive fertilised egg and the remaining part of the Graafian follicle transforms into the corpus luteum, an endocrine gland/tissue that produces **progesterone** hormone.

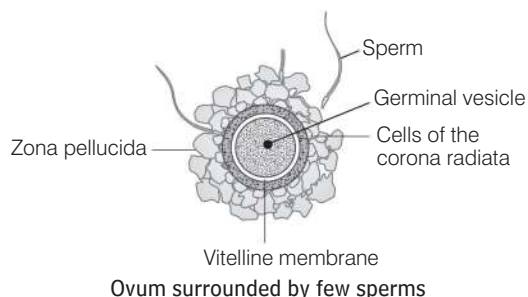
(a) If there is no fertilisation during this period, the corpus luteum degenerates and causes shedding of the uterus lining again on the 28th day.

(b) If the egg gets fertilised, it gets attached to the uterus. The menstrual flow does not occur because the level of progesterone (hormone secreted by corpus luteum) increases, which prevents the growth and maturation of another follicle.

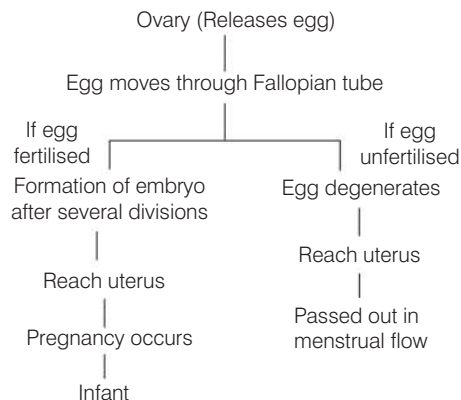
## Ovum (Egg)

It is microscopic about 100-130  $\mu\text{m}$  in diameter, non-motile gamete having the genetic material in the nucleus. The ovum possesses three coverings, i.e. inner plasma membrane, i.e. oolemma or **vitelline membrane**, middle **zona pellucida** and outer cellular **corona radiata**.

The cytoplasm of ovum is called **ooplasm**. Ovum is alecithal (i.e. yolk is absent) and contains a large haploid nucleus called germinal vesicle or **pronucleus**.



## The Pathway of Egg Transport in Female



### CHECK POINT 02

- 1 Name the structure of human reproductive system in which ova are formed.
- 2 Name the hormone released by corpus luteum.
- 3 State the function of Bartholin's glands in human female reproductive system.
- 4 Why uterus is also known as womb?
- 5 Name the four phases of menstrual cycle.
- 6 Give one function of progesterone.

## Fertilisation

It is the process of fusion of male gamete (sperm) and the female gamete (ovum) in order to produce a zygote. Process of fertilisation in human is internal, i.e. takes place in the Fallopian tube.

The discharge of semen by male through penis into the vagina (near the cervix of the uterus) of the female during coitus is called **insemination**. Out of millions of sperms released, only few are able to reach the upper parts of the oviducts, rest of them die on their way and get absorbed.

The most active and motile sperm enters the uterus and reaches the Fallopian tube, where it penetrates the ovum (egg). In doing so, the tail is left outside and only the head part that contains nucleus enters the egg.

After the entry of sperm into the ovum, the (haploid) nucleus of egg and sperm fuse together. As a result, a zygote is formed which is a diploid cell.

## Implantation

It is the attachment of developing embryo within the uterus. The mitotic division starts as the zygote moves through the oviduct towards the uterus, forming 2, 4, 8, 16 daughter cells called **blastomeres**. This process is called **cleavage**. The embryo with 8-16 blastomeres formed at the end of fourth day is called **morula**. The morula continues to divide and transforms into fluid-filled embryo called **blastocyst**.

The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast**, which is nutritive in function and the inner group of cells attached to trophoblast called the **inner cell mass**.

The trophoblast layer then gets attached to the endometrium. The inner cell mass differentiates into the **embryo**. The trophoblast cells produce enzymes that allow the blastocyst to digest the uterine endometrium and producing a pit in which the developing embryo settles. The endometrium grows over it to cover the blastocyst. This is called **implantation** and it leads to pregnancy. **Pregnancy** is the state of carrying the unborn young one inside the body.

## Foetal Membranes

The foetal membranes are called **extraembryonic membranes** because they are not a part of the body of the embryo.

These membranes play some role in supporting the life of pre-embryo, the embryo and the foetus. These membranes are formed from the trophoblast. These include

- (i) **Amnion** It is a thin membrane that covers the embryo. It later expands to become fluid-filled (it is also called amniotic fluid) amniotic sac that fully encloses the embryo. It provides an aqueous environment in which the embryo is protected from shocks and adhesion.
- (ii) **Allantois** It is a tiny sausage-shaped pouch, which arises from the gut of the embryo near the yolk sac. It supplies the blood vessels to the placenta and is involved in nutrition and excretion.
- (iii) **Chorion** It completely encloses the developing embryo and extraembryonic tissues. The chorion facilitates the transfer of nutrients, gases and wastes between the embryo and the mother's body.
- (iv) **Yolk sac** It is a membrane that surrounds the yolk. It is the first extraembryonic membrane to make appearance in mammal, but gets reabsorbed before the embryo is formed.

## Placenta

It is a temporary association between the foetal membrane and the maternal tissues. It gives nutritive support to the developing embryo through the **umbilical cord**. It contains blood vessels which connect the placenta to the uterus, through which the growing embryo or foetus gets its nutrition and  $O_2$  supply. Placenta allows diffusion of waste products (excreted by foetus) such as urea,  $CO_2$  and other waste products into mother's body for elimination. Placenta also acts as an endocrine gland. It produces hormones like oestrogen and progesterone.

These hormones help to maintain the pregnancy. Presence of progesterone in urine confirms pregnancy.

## Gestation

It is the time period during which the embryo remains in the uterus (after the last day of menstruation to the day of childbirth). The gestation period is of about 9 months or 280 days in human females.

## Parturition (Childbirth)

It is the process of delivery of a baby which occurs due to the vigorous contractions of the uterus at the end of pregnancy.

**Oxytocin** hormone, is responsible for these contractions in human female resulting into the childbirth.

## Twins

These are the offsprings produced by same pregnancy. Twins can be either of two main types as discussed below

- (i) **Fraternal Twins** (produced from two eggs) These twins are produced when two eggs are released from ovaries at a time and both may get fertilised to produce two individuals. These twins may be either both boys or both girls or can be one boy and one girl.
- (ii) **Identical Twins** (produced from one egg) These are produced when a single fertilised egg, gets split and separates into two parts during early stage of cell division. Each of these two splits their parts and then behaves like an independent egg and produces one complete individual each. Since they are being produced from a single egg, they are either both boys or both girls. Identical twins resemble each other except for certain things such as fingerprints, birth marks and handwritings.

## CHECK POINT 03

- 1 Define insemination.
- 2 What number of blastomeres are contained in morula?
- 3 Which layer of blastocyst is nutritive in function?
- 4 Give one function of chorion.
- 5 Which structure connects the placenta with embryo?
- 6 What is the gestation period in human female?

# SUMMARY

- Reproduction is the process to produce new organisms of the same species.
- Reproduction is of two types, i.e. asexual and sexual. Asexual reproduction means to reproduce without the production of gametes. Sexual reproduction involves the fusion of gametes.
- Organs to produce gametes are gonads. Humans are unisexual organisms, i.e. have different male and female sexes and each sex has reproductive organs (gonads) and accessory structures.
- Human male reproductive system includes a pair of testis, seminal vesicle, prostate gland, Cowper's gland and penis.
- Human female reproductive system includes ovary, oviducts, uterus, cervix, accessory glands (Bartholin's gland and mammary glands), vagina and external genitalia.
- Menstrual cycle in females refers to the cyclic changes occurring in the wall of the uterus which prepares it for pregnancy. It is divided into four main phases-(i) Menstrual phase, (ii) Follicular phase, (iii) Ovulatory phase and (iv) Luteal phase.
- Fertilisation is a process of fusion of male and female gametes which occurs at Fallopian tube after discharge of semen during the sexual act.
- Implantation It is the phenomenon of attachment and development of embryo inside the uterus.
- Embryonic membranes are amnion, allantois, chorion and yolk sac.
- Placenta is an intimate connection between all foetal membranes and the wall of the uterus.
- Parturition is an act of expulsion of developed foetus from mother's uterus after completion of gestation period (280 days in humans).
- Twins are offsprings produced by a single pregnancy.
- Fraternal twins are produced from two separate eggs fertilised by sperms. Children produced are not identical.
- Identical twins are produced when single egg gets fertilised and divides into two cells. These cells act as single separate zygote cells. These could be either both boys or girls and are identical.

# EXAM PRACTICE

## Multiple Choice Questions

1. Seminal plasma, the fluid part of semen is not contributed by

(a) seminal vesicle (b) prostate  
(c) urethra (d) bulbourethral gland

Ans. (c)

2. Testes produce the hormone

(a) oestrogen (b) oxytocin  
(c) progesterone (d) testosterone

Ans. (d)

3. The middle piece of sperm provides

(a) nucleus (b) energy  
(c) locomotion (d) food

Ans. (b)

4. The site of maturation of human sperms is the

[2014]  
(a) seminiferous tubule (b) interstitial cells  
(c) epididymis (d) prostate gland

Ans. (c)

5. A single highly coiled tube where sperms are stored, get concentrated and mature is known as

[2015]  
(a) epididymis (b) vas efferentia  
(c) vas deferens (d) seminiferous tubule

Ans. (a)

6. Which of the following is not a part of the female reproductive system in human beings? [2017]

(a) Uterus (b) Ovary  
(c) Ureter (d) Fallopian tube

Ans. (c)

7. Ovulation occurs

[2017]  
(a) at the beginning of menstrual cycle  
(b) in the mid of the menstrual cycle  
(c) at the end of the menstrual cycle  
(d) during any time of the menstrual cycle

Ans. (b)

8. Which one of the following is the correct route during the transport of sperm in male (human)?

(a) Vas deferens → Epididymis → Urethra  
(b) Epididymis → Vas deferens → Urethra  
(c) Epididymis → Urethra → Vas deferens  
(d) Urethra → Epididymis → Vas deferens

Ans. (b)

9. Which of the following is not a part of the female reproductive system in humans?

(a) Ovary (b) Uterus  
(c) Vas deferens (d) Fallopian tube

Ans. (c)

10. Which of the following is not true for the process of ovulation in human?

(a) The egg is released from Graafian follicle  
(b) The egg is fertilised in Fallopian tube  
(c) The egg passes through fimbriated funnel of Fallopian tube  
(d) The fertilised egg passes out of female's body

Ans. (d)

11. Finger-like projections of the oviduct funnel are called

(a) cilia (b) fimbriae  
(c) cervix (d) clitoris

Ans. (b)

12. Given below is a statement or question followed by four choices. Select and rewrite the correct answer to the given statement.

The onset of menstruation in the female is termed as

(a) ovulation (b) menarche  
(c) menopause (d) parthenogenesis

Ans. (b)

13. Fertilisation is the process of fusion of male gamete and the female gamete to produce a/an

(a) embryo (b) infant (c) zygote (d) child

Ans. (c)

14. The association between the foetus and mother is called

(a) embryonic membrane (b) placenta  
(c) amnion (d) chorion

Ans. (b)

15. The period of intrauterine development of the embryo is known as

(a) embryonic development  
(b) gestation period  
(c) parturition  
(d) implantation

Ans. (b)

## Fill in the Blanks

**16.** Complete the following by using suitable words

- (i) Humans are .....organisms.
- (ii) The unit of testis is ..... .
- (iii) The testosterone hormone is secreted by the ..... cells.
- (iv) The male copulatory organ is ..... .
- (v) The part where fertilisation occurs in human female is ..... .
- (vi) The shedding out of the endometrium along with blood is called ..... .
- (vii) The follicle which contains the mature ovum is called ..... .
- (viii) The process of releasing of egg from the ovary is called ..... .
- (ix) The process of development of ovum in the ovary is called ..... .
- (x) The structure which helps to penetrate egg membrane of the ovum is ..... .
- (xi) The umbilical cord connects ..... and ..... .
- (xii) The embryo inside the uterus is protected from jerks or mechanical shocks by ..... .
- (xiii) The period of complete development of the foetus till birth is termed ..... .
- (xiv) The expulsion of the foetus from the body of the mother is called ..... .
- (xv) A hormone secreted in a female to facilitate parturition is ..... .

- Ans.** (i) unisexual (ii) seminiferous tubule  
 (iii) interstitial (iv) Penis  
 (v) oviduct/Fallopian tube (vi) menstruation  
 (vii) Graafian follicle (viii) ovulation  
 (ix) oogenesis (x) acrosome  
 (xi) foetus, placenta (xii) amniotic fluid  
 (xiii) gestation (xiv) parturition  
 (xv) oxytocin

## True-False

**17.** Identify the true/false statements. Correct each false statement to make it true.

- (i) Change of voice and discharge of semen are the signs of puberty in human male.
- (ii) Vas deferens transports the sperms from epididymis to the urethra.
- (iii) Androgens are produced by Sertoli cells.
- (iv) Leydig cells are found in ovary.
- (v) Oviducts and Fallopian tubes are the same thing.

- (vi) Vagina is equivalent to the male penis.
- (vii) Vas deferens forms sperms.
- (viii) Seminal vesicle secretes seminal fluid.
- (ix) Ovulation occurs on around 13-14th day of menstrual cycle.
- (x) Head of the sperm contains nucleus.
- (xi) Insemination is discharge of semen into vagina.
- (xii) Testosterone hormone is responsible for childbirth.
- (xiii) Gestation is the process of fixing of the zygote to the uterine wall. [2011]

- Ans.** (i) True  
 (ii) True  
 (iii) False. Androgens are produced by Leydig cells.  
 (iv) False. Leydig cells are found in testes.  
 (v) True  
 (vi) False. Clitoris is equivalent to the male penis.  
 (vii) False. Testes forms sperms.  
 (viii) True.  
 (ix) True  
 (x) True  
 (xi) True  
 (xii) False. Oxytocin hormone is responsible for childbirth.  
 (xiii) False. Implantation is the process of fixing of the embryo to the uterine wall.

## Match the Columns

**18.** Match the following columns.

Column I	Column II
A. Expulsion of semen	1. Spermatogenesis
B. Prostate gland	2. Milk
C. Mammary gland	3. Ejaculation
D. Production of sperms	4. Alkaline fluid

**Ans.** A-3, B-4, C-2, D-1

**19.** Match the following columns.

Column I	Column II
A. Acrosome	1. Attachment of embryo in the uterus
B. Gestation	2. Time during which the embryo remains in the uterus
C. Parturition	3. Sperm's head
D. Implantation	4. Childbirth

**Ans.** A-3, B-2, C-4, D-1

20. Match the following columns.

Column I (Structure)	Column II (Function)
A. Corpus luteum	1. Increases the force of uterine contraction.
B. Seminiferous tubules	2. Secretion of progesterone.
C. Oxytocin	3. Serves as the connection between foetus and uterine wall.
D. Endometrium	4. Nutrition of foetus.
E. Umbilical cord	5. Produces male gametes in large number.

**Ans.** A – 2, B – 5, C – 1, D – 4, E – 3

### **a** 1 Mark Questions

21. Given below is the type of organ found in males, write its special functional activity in the blank given.  
Seminiferous tubules and .....

[2010]

**Ans.** Seminiferous tubules and spermatogenesis.

22. What is inguinal canal?

**Ans.** The inguinal canal is the passage, which allows the descend of testes from abdomen to scrotum along with their ducts, blood vessels, nerves, etc.

23. Name the cells of the testes that produce male hormones.

[2011]

**Ans.** Interstitial cells (Leydig cells) are the cells that produce male hormones.

24. Discuss the role of Sertoli cells in spermatogenesis.

**Ans.** Sertoli cells provide nutrition to the developing sperms, i.e. germ cells.

25. Choose the odd one out from the following terms given and name the category to which others belong.

Prostate gland, Cowper's gland, seminal vesicle, seminiferous tubules

[2018]

**Ans.** Odd term Seminiferous tubules

Category Accessory glands of male reproductive system

26. State the main function of seminiferous tubule.

[2012]

**Ans.** Seminiferous tubule in males is responsible for the production of sperms.

27. There are five terms given below. There is a word which is an odd one. Write down the category of the group having identified the odd one out, as shown in the example.

Cowper's gland, urethral gland, lachrymal gland, seminal vesicles, prostate gland.

[2014]

**Ans.**

Category	Odd one
Accessory glands (man)	Lachrymal gland

28. Mention the exact location of following  
Prostate gland

[2017, 12]

**Ans.** Prostate gland is found surrounding the urethra of human male.

29. Mention the exact location of epididymis.

[2018]

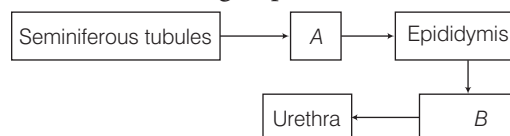
**Ans.** Epididymis is a highly coiled structure that lies closely attached to the testis of its side in the scrotal sac.

30. State the exact location of seminal vesicle.

[2014]

**Ans.** Seminal vesicle is found between the urinary bladder and rectum in males.

31. The path of sperm transport is given below. Provide the missing steps in blank boxes.



**Ans.** A–Efferent duct, B–Vasa deferentia.

32. Choose the odd one in the following  
Ovum, corpus luteum, scrotal sacs, ovary

**Ans.** Scrotal sacs.

33. Given below is the set of five terms. Rewrite the terms in logical sequence as directed at the end of statement.

Vagina, ovary, uterus, oviduct, cervix. (pathway of egg after ovulation)

[2010]

**Ans.** Ovary → oviduct → uterus → cervix → vagina.

34. In set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term in set and name the category to which the remaining three belong.

Ovary, Fallopian tube, Ureter, Uterus

[2016, 12]

**Ans.** Odd–Ureter

Other three belong to female reproductive system.

**35.** Name the hormone secreted by Graafian follicle.

**Ans.** Oestrogen.

**36.** The statement given below is incorrect. Rewrite the correct statement by changing the underlined words of the statement. [2017]

The Graafian follicle, after ovulation turns into a hormone producing tissue called corpus callosum.

**Ans.** Corpus luteum.

**37.** Differentiate between the following pairs on the basis of what is mentioned within the bracket.

(i) Sperm duct and Fallopian tube (function) [2016]

(ii) Corpus luteum and Corpus callosum (function) [2014]

**Ans.** **Sperm duct** It carries sperms from testis to seminal vesicle.

**Fallopian tube** Union of male and female gamete takes place in this tube.

**Corpus luteum** is the remain of Graafian follicle which secretes female sex hormone, e.g. progesterone.

**Corpus callosum** is the region that connects the left and right cerebral hemisphere of forebrain.

**38.** Give the biological/technical term for the following [2013]

The onset of menstruation in a young girl.

**Ans.** **Menarche** is the phenomenon of onset of menstruation in a young girl.

**39.** Differentiate between menarche and menopause.

**Ans.** Differences between menarche and menopause are

Menarche	Menopause
It is the onset of first menstrual cycle in human female.	It is the phase in human female when ovulation menstruation stop.
It occurs between 10-14 years of age.	It occurs between 40-45 years of age.

**40.** Give scientific reason for the following statement.

When ovum gets fertilised, menstrual cycle stops temporarily in a woman.

**Ans.** Fertilisation leads to pregnancy in human female. Thus, menstrual cycle stops.

**41.** Choose the correct answer to the following statement out of the choices given after statement. The technical term for the fertilised egg is (placenta/zygote/morula) [2010]

**Ans.** Zygote is the technical term used for fertilised egg.

**42.** How the entry of only one sperm and not many is ensured during fertilisation?

**Ans.** Sperm fuses with the egg membrane layer of the ovum and induces changes in the membrane that blocks the entry of additional sperms.

**43.** Give the technical term for the following.

Fixing of developing zygote (blastocyst) on the uterine wall. [2015]

**Ans.** Implantation

**44.** Name the layer of cells forming the outer wall of the blastocyst.

**Ans.** Trophoblast/trophoectoderm.

**45.** Give the exact location of amnion. [2011]

**Ans.** Amnion is found around the embryo in the uterus.

**46.** What is the significance of amniotic fluid? [2015]

**Ans.** Amniotic fluid is significant for the developing foetus in the mother's womb. As, it protects the foetus from jerks.

**47.** Give biological explanation for the following The placenta is an important structure for the development of a foetus. [2018]

**Ans.** Placenta is a disc-shaped organ formed inside the female body which remains attached to the uterine wall. It gives nutritive support to the developing embryo through a cord known as **umbilical cord**. It contains blood vessels which connect the placenta to the uterus through which a growing embryo or foetus gets its nutrition and  $O_2$  supply.

**48.** Arrange and rewrite the terms in the correct order so as to be in a logical sequence.

Implantation, Fertilisation, Parturition, Ovulation, Gestation (stages leading to formation of foetus and birth). [2012]

**Ans.** Ovulation → Fertilisation → Implantation → Gestation → Parturition.

**49.** Given below is a set of five terms. Rewrite the terms in correct order in a logical sequence.

Uterus, Parturition, Fertilisation, Gestation, Implantation. [2017]

**Ans.** Fertilisation → Uterus → Implantation → Gestation → Parturition (Mechanism of childbirth)

**50.** Differentiate between ovulation and parturition.

**Ans.** **Ovulation** is the release of ovum from the ruptured Graafian follicle.

**Parturition** is the expulsion of the child from the mother's uterus.

**51.** Name the structure formed by the villi of the embryo and the uterus of the mother. [2015]

**Ans.** Placenta

**52.** Give the biological/technical term for the structure which connects the placenta with the foetus. [2013]

**Ans.** Umbilical cord is the structure which connects the placenta with the foetus.

**53.** Give the biological/technical term for the phase in the menstrual cycle in which the remnant of follicle in the ovary turns to corpus luteum. [2012]

**Ans.** Luteal phase is the phase in the menstrual cycle in which the remnant of follicle turns to corpus luteum in the ovary which produces hormone progesterone.

**54.** Account for the following briefly.  
Twins may or may not be identical.

**Ans.** Twins may not be identical as in the case of fraternal twins, which are produced from two eggs. Twins may be identical in case of identical twins, which are produced from a single egg.

**55.** Given below is a group of terms. In group, the first pair indicates the relationship between the two terms. Rewrite and complete the second pair on a similar basis. [2017]

Foetus : Amnion :: Heart :

**Ans.** Pericardium

## **b** 2 Marks Questions

**56.** Explain puberty. When is it attained?

**Ans.** Puberty is the age, when the reproductive organs become functional. Male attains puberty at the age of 11-16 years, while females at the age of 10-14 years.

**57.** Why testes are lodged in the scrotum hanging outside the body?

**Ans.** Temperature in the scrotum is about 2-3°C lower than that in the abdomen. Lower temperature is ideal for the development and survival of spermatozoa.

**58.** State the function of interstitial cells.

**Ans.** Interstitial cells are found in seminiferous tubules. They secrete the male sex hormone testosterone into the blood and maintains male sex characteristics.

**59.** State the main function of the following [2016]  
(i) Leydig cells (ii) Corpus luteum [1 × 2]

**Ans.** (i) Leydig cells produce testosterone (the male hormone).

(ii) Corpus luteum produces and secretes progesterone (the female hormone).

**60.** List any two functions of uterus.

**Ans.** Functions of uterus are

- (i) It gives the suitable environment for the implantation of embryo.
- (ii) It contains amniotic fluid which protects the embryo from shock and jerks. [1 × 2]

**61.** Give appropriate biological or technical term for the following.

- (i) The onset of menstruation in a young girl. [2018]
- (ii) The fluid which surrounds the foetus. [2018]

**Ans.** (i) Menarche

(ii) Amniotic fluid [1 × 2]

**62.** Give appropriate biological technical terms for the following [2017]

- (i) The accessory gland in human males whose secretion activates the sperms.
- (ii) The kind of twins formed from two fertilised eggs.
- (iii) Period of complete intrauterine development of the foetus. [2017]

**Ans.** (i) Seminal vesicle (ii) Fraternal twins  
(iii) Gestation

**63.** Give the biological term for the following [2016]

- (i) Complete stoppage of menstrual cycle in females.
- (ii) The canal through which the testes descend into the scrotum just before the birth of a male baby.

**Ans.** (i) Menopause (ii) Lingual canal [1 × 2]

**64.** Give technical term for the following [2014]

- (i) Thin-walled sac of skin that covers the testes.
- (ii) The permanent stoppage of the menstrual cycle in a woman aged 50 years.

**Ans.** (i) Scrotum is the thin-walled sac of skin that covers the skin.

(ii) Menopause is the permanent stoppage of menstrual cycle in a woman aged 50 years. [1 × 2]

**65.** Differentiate between

- (i) Sperm and ovum (ii) Morula and blastocyst

**Ans.** (i) The differences between sperm and ovum are

Sperm	Ovum
It is the male gamete.	It is the female gamete.
It is motile in nature.	It is non-motile.

- (ii) The differences between morula and blastocyst are

Morula	Blastocyst
The embryo with 8-16 blastomeres is called morula.	The morula divides and transforms into blastocyst.
It further forms blastocyst.	It further forms embryo.

[1 × 2]

- 66.** Differentiate between the following pairs on the basis of what is indicated in brackets.

(i) Testosterone and oestrogen (organ which secretes)

[2018]

(ii) Ureter and urethra (function)

[2018]

**Ans.** (i) Testosterone is secreted by testis while oestrogen is secreted by ovary.

(ii) Ureter conducts urine formed in kidney to the urinary bladder.

Urethra is a membranous tube through which urine emptied from bladder is conducted to the exterior.

[1 × 2]

- 67.** Is it true that the foetus inside the mother's uterus breathe? If yes, how?

**Ans.** No, the foetus does not breathe inside the mother's uterus. It exchanges gases with the help of placenta.

- 68.** Define the following terms.

(i) Fertilisation (ii) Ovulation

**Ans.** (i) **Fertilisation** is the union of sperm and ova to produce a zygote.

(ii) **Ovulation** is the release of ovum from Graafian follicle in the ovary.

[1 × 2]

### **C** 3 Marks Questions

- 69.** Write two major functions each of testes and ovaries.

**Ans.** Testes and ovaries are the primary sex organs in the males and females, respectively that produce gametes. Each testis bears large number of seminiferous tubules, which are the spermatogenic tissues of the testis. Similarly, ovaries bear the Graafian follicle or the ovarian follicles, which ultimately give rise to ovum. The testes secrete testosterone and the ovaries secrete oestrogen and progesterone.

- 70.** Give the function of the following

- (i) Seminal vesicles  
(ii) Sperm ducts  
(iii) Prostate glands

**Ans.** (i) Seminal vesicles—Site of sperm production.

(ii) Sperm ducts—To carry semen to urethra.

- (iii) Prostate gland—Secrete an alkaline fluid into the semen to neutralise the acidic pH of vagina.

[1 × 3]

- 71.** Describe the cellular structure of a seminiferous tubule.

**Ans.** A seminiferous tubule is made up of a single layer of **male germ cells** and large **Sertoli cells**. The male germ cells undergo spermatogenesis to produce spermatocytes, spermatids and sperms while the Sertoli cells provide nutrition to the developing sperms. The region outside the seminiferous tubules called interstitial spaces have blood vessels and **Leydig cells**. Leydig cells synthesise and secrete the male sex hormones called **androgens** (testosterone).

- 72.** Explain the reason.

(i) The umbilical cord is the lifeline of the foetus.

(ii) A woman cannot conceive after menopause.

(iii) Chances of pregnancy to occur are most favourable around 14-15th day of the menstrual cycle.

**Ans.** (i) The umbilical cord is a tough structure that serves as the blood vascular connection between the foetus and uterine wall. The maternal blood carries nutrients, oxygen, hormones and water to the placenta, where they are absorbed and passed on to the embryo through the blood vessels of the umbilical cord. Therefore, it is the lifeline of the foetus.

(ii) After menopause, no ovulation occurs, i.e. no egg is available for fertilisation. So, a woman cannot conceive.

(iii) On about 14-15th day of the menstrual cycle, the follicle ruptures (ovulation) and the released egg travels down the oviduct. Therefore, chances of pregnancy to occur are most favourable around this period of the menstrual cycle.

[1 × 3]

- 73.** What are the events that take place in the ovary and uterus during follicular phase of the menstrual cycle?

**Ans.** Refer to text on page 229.

- 74.** A human female experiences two major changes, menarche and menopause during her life. Mention the significance of both the events.

**Ans.** In human females, initiation of menstruation at puberty (between age 9-15 years) is called **menarche**. Menstrual cycle ceases after around 40-50 years of age, that is termed as **menopause**. **Menarche** signifies the maturation and ability of the female reproductive system to bear child.

It marks the capability of the ovaries to produce mature oocyte (female gamete) that can now be fertilised by the sperm and the capability of uterus in supporting the foetal growth and development.

Menopause signifies the end of child bearing age. At this age supply of healthy eggs is very low, the levels of the hormones secreted by the ovaries decline and the menstruation stops. The uterus no longer remains conducive for foetal growth.

**75. Differentiate between the following**

- Sexual reproduction and asexual reproduction
- Embryo and foetus
- Gestation and parturition

**Ans.** (i) Differences between sexual and asexual reproduction are

Sexual reproduction	Asexual reproduction
It involves the gametes.	No gamete formation.
Two individuals are involved.	One individual involved in this reproduction.

- (ii) Differences between embryo and foetus are

Embryo	Foetus
It is the early stage of development.	After two months of gestation the embryo is called foetus.
Features are not developed properly.	It has recognisable appearance of main features of fully developed man.

- (iii) Differences between gestation and parturition are

Gestation	Parturition
It is the period in which an embryo develops inside the uterus.	It is the childbirth after the gestation.

[1 × 3]

**d 4 Marks Question**

**76. Describe the functions of the following**

- Epididymis
- Vas deferens
- Vagina
- Sertoli cells

**Ans.** (i) **Epididymis** Maturation of spermatids to functional spermatozoa takes place here and the sperms are stored temporarily till ejaculation.

(ii) **Vas deferens** It stores and transports the sperms from the testes to the outside through urethra.

(iii) **Vagina** It receives the semen from the male penis and serves as the birth canal during parturition.

(iv) **Sertoli cells** It provides nutrition to the developing sperms, i.e. germ cells.

[1 × 4]

**e 5 Marks Questions**

**77. Answer briefly.**

- How does the sperm penetrate through the zona pellucida in human ovum?
- Name the embryonic membrane involved in the formation of placenta in humans.
- What happens to the zygote after fertilisation?
- Name the female sex hormones and structures which secrete them.
- How is the foetus protected?

**Ans.** (i) Sperm penetrates through zona pellucida with the help of secretions from acrosome.

(ii) Chorion is involved in the formation of placenta in humans.

(iii) After fertilisation, the zygote divides to form multiple-celled embryo which is implanted in the uterus for further development.

(iv) Oestrogen is produced by ovarian follicle and placenta. Progesterone is produced by corpus luteum, ovary and placenta.

(v) The human foetus is protected by the amnion layer having amniotic fluid.

[1 × 5]

**78. Differentiate between the following**

- Cowper's gland and prostate gland
- Implantation and gestation
- Identical and fraternal twins
- Sperm and semen
- Graafian follicle and corpus luteum

**Ans.** (i) Cowper's gland and prostate gland (nature of secretion)

Cowper's gland	Prostate gland
Produces a mucoid fluid which serves as lubricant.	It produces a white alkaline fluid which neutralises acidic nature of female reproductive tract.

- (ii) Implantation and gestation

Implantation	Gestation
Attachment of embryo to the wall of the uterus.	Full term of development of embryo in uterus.

- (iii) Identical and fraternal twins

Identical twins	Fraternal twins
They are produced from one egg.	They are produced from two eggs.
They are both boys or both girls.	They may be both boys or both girls or one boy and one girl.

(iv) Sperm and semen

Sperm	Semen
It is the male gamete.	It is milky alkaline fluid produced by the male reproductive system.
It is formed by the testis.	It is formed by the accessory glands.

(v) Graafian follicle and corpus luteum.

Graafian follicle	Corpus luteum
It is a fully developed ovarian follicle containing a mature ovum.	It is a yellow mass formed after the release of an egg from the Graafian follicle which acts as an endocrine gland.

[1 × 5]

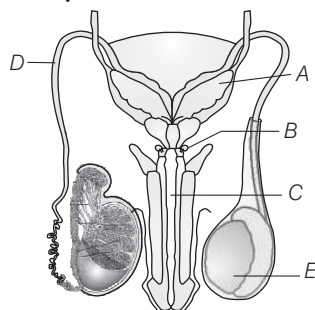
**79.** Copy and complete the following by filling in the blanks (i) to (v) with appropriate words.

The human female gonads are ovaries. A maturing egg in the ovary is present in a sac of cells called ..... (i). As the egg grows larger, the follicle enlarges and gets filled with a fluid and is now called the ..... (ii) follicle. The process of releasing the egg from the ovary is called ..... (iii). The ovum is picked up by the oviductal funnel and fertilisation takes place in the ..... (iv). In about a week, the blastocyst gets fixed in the endometrium of the uterus and this process is called ..... (v). [2014]

**Ans.** The human female gonads are ovaries. A maturing egg in the ovary is present in a sac of cells called (i) **ovarian follicle**. As the egg grows larger, the follicle enlarges and gets filled with a fluid and is now called the (ii) **Graafian follicle**. The process of releasing the egg from the ovary is called (iii) **ovulation**. The ovum is picked up by the oviductal funnel and fertilisation takes place in the (iv) **oviduct**. In about a week, the blastocyst gets fixed in the endometrium of the uterus and this process is called (v) **implantation**.

## Diagram Based Questions

**80.** Given below is the outline of the male reproductive system.

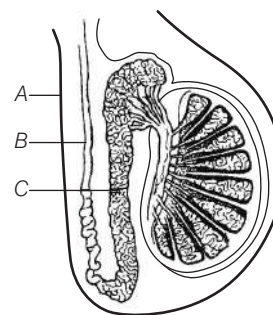


- Name the parts labelled *A* to *E*.
- State the functions of the parts labelled *A* and *D*.
- Name the cells of part *E* that produce testosterone.
- Why is the structure *E* present outside the body in the scrotal sacs?
- What is semen? [2010]

**Ans.** (i) Parts labelled from *A* to *E* are  
*A* – Seminal vesicle  
*B* – Prostate gland  
*C* – Urethra  
*D* – Sperm duct/Vas deferens  
*E* – Testis

- Functions of different labelled parts are  
**Part A** Secretion of seminal vesicle serves as a medium for the transportation of the sperms.  
**Part D** Sperm duct/Vas deferens carry the sperms to urethra.
- Leydig cells or interstitial cells of part *E* produce testosterone (male sex hormone).
- Testes (*E*) are located in scrotal sacs because it keeps the temperature 2-3°C less than the normal body temperature, which is required for the maturation of sperms.
- Refer to text on the page 228. [1 × 5]

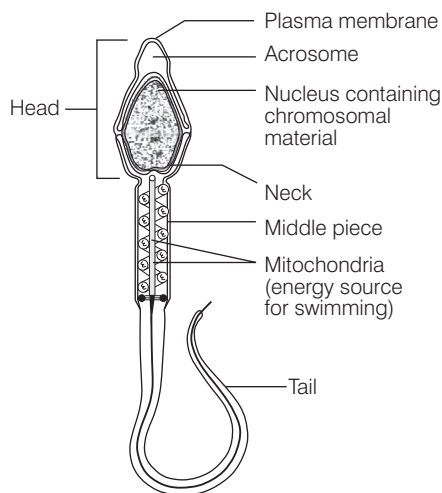
**81.** The diagram shown is the longitudinal section of a testis of man. Study it carefully and answer the questions that follows [2017]



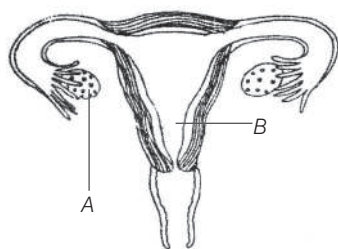
- Label the parts labelled *A*- *C* in the diagram.
- In which part of the testis are the sperms produced?
- State the functions of the parts labelled *A* and *C* in the diagram.
- Name the cells that secrete testosterone.
- Draw a neat, labelled diagram of a sperm.

**Ans.** (i) *A* – Scrotum  
*B* – Sperm duct (vas deferens)  
*C* – Epididymis

- (ii) Sperms are produced in seminiferous tubules.
- (iii) **A** (Scrotum) It provides optimal temperature for developing sperms.
- C** (Epididymis) Sperms are stored in epididymis, till they get matured and become motile.
- (iv) **Interstitial cells** (Leydig's cells) secrete testosterone.
- (v)



- 82.** Study the diagram given below and answer the questions that follows



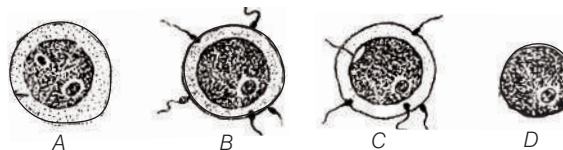
- (i) Name the part labelled **A**. Name any two hormones produced by the labelled part **A**.
- (ii) What happens to the part labelled **B**.
- (a) If fertilisation takes place
- (b) If fertilisation does not take place
- (iii) Where does fertilisation occur? [2012]

- Ans.** (i) Part **A** – Ovary.  
Two hormones produced by ovary are
- (a) Oestrogen
- (b) Progesterone.
- (ii) (a) If fertilisation takes place, part **B** (uterus) gets prepared to receive the embryo. The endometrial lining gets thickened and highly vascularised.
- (b) If fertilisation does not take place, the endometrial lining of uterus (part **B**) erodes out

to cause bleeding. It is known as menstruation or menstrual flow.

- (iii) Fertilisation occurs in the Fallopian tube/oviduct.

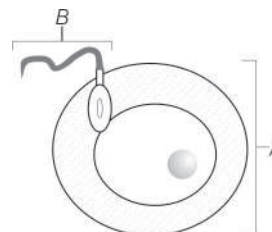
- 83.** Given below are diagrams showing different stages in the process of fertilisation of an egg in the female reproductive tract.



- (i) Use the alphabets given below in each diagram to show the correct order in the process of fertilisation.
- (ii) Where in the female reproductive system does this process normally take place?
- (iii) What is the biological term used for the product of fusion?
- (iv) What is the chromosome number of (a) the egg (b) the fused product?
- (v) Draw a neat labelled diagram of a mature human sperm. [2008]

- Ans.** (i) Correct order in the process of fertilisation is  $D \rightarrow B \rightarrow C \rightarrow A$ .
- (ii) This process normally takes place in Fallopian tube.
- (iii) The biological term for the product of fusion is zygote.
- (iv) The chromosome number of the egg is  $n$  and the chromosome number of the fused product, i.e. zygote is  $2n$ .
- (v) Refer to fig on page 228.

- 84.** The diagram below represents two reproductive cells **A** and **B**. Study the same and then answer the questions that follows. [2011]

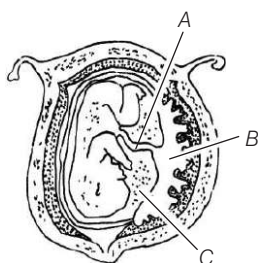


- (i) Identify the reproductive cells **A** and **B**.
- (ii) Name the specific part of the reproductive system where the above cells are produced.
- (iii) Where in the female reproductive system do these cells unite?

- (iv) Name the main hormones secreted by the (A) ovary (B) testes.  
 (v) Name an accessory gland found in the male reproductive system and state the function of its secretion. [2011]

**Ans.** (i) The reproductive cells are  
 A–Egg/ovum B–Sperm  
 (ii) Ovum is produced in ovary while sperm in testis.  
 (iii) These cells (sperm and ovum) unite in the oviduct (Fallopian tube), i.e. fertilisation takes place.  
 (iv) Ovary produces progesterone and oestrogen.  
 Testis produces testosterone.  
 (v) Seminal vesicle is an accessory gland. Its secretion provides a medium for the transportation of sperms.

- 85.** The diagram given below is that of a developing human foetus. Study the diagram and then answer the questions that follows [2016]



- (i) Label the parts labelled A–C in the diagram.  
 (ii) Mention any two functions of the part labelled B in the diagram.  
 (iii) Explain the significance of the part labelled C in the diagram.  
 (iv) Define the term gestation. What is the normal gestation period of the developing human embryo?  
 (v) Mention the sex-chromosomes in a male and female embryo.

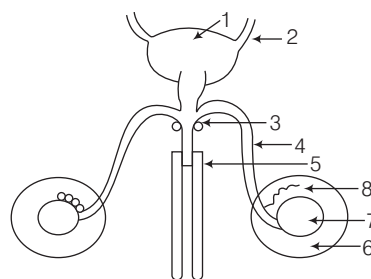
**Ans.** (i) A–Umbilical cord  
 B–Placenta  
 C–Amniotic fluid

- (ii) (a) Placenta supplies nutrition and oxygen to the developing foetus.  
 (b) It also produces endocrine hormone hCG needed for normal foetus growth.  
 (iii) Amniotic fluid is a good shock absorber, so it protects the foetus.

- (iv) **Gestation** It is the time taken by fertilised egg to develop into fully formed baby. It approximately takes 40 weeks in human.

(v) Male XY, Female XX

- 86.** The diagram given below shows the male urinogenital system of a human being. Study the diagram and answer the questions that follows [2015]

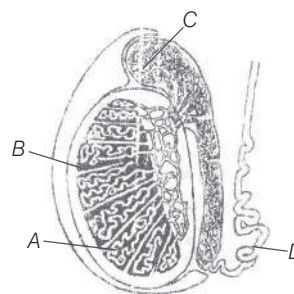


- (i) Label the parts numbered 1 to 8.  
 (ii) Name the corresponding structure of part (4) in female reproductive system.  
 (iii) What is the role of part 7?

**Ans.** (i) 1 – Urinary bladder  
 2 – Ureter  
 3 – Prostate gland  
 4 – Vas deferens  
 5 – Urethra  
 6 – Scrotum  
 7 – Testis  
 8 – Epididymis

- (ii) Fallopian tube  
 (iii) The testis forms the important part of male reproductive organ. It is responsible for the sperm formation and testosterone production.

- 87.** Given below is a diagram of the lateral section of a testis of a man. Study the same and answer the questions that follows [2013]



- (i) Label the parts labelled A and B of the diagram.

- (ii) State the functions of the parts labelled *A* and *C*.
- (iii) What is the significance of the testes being located in the scrotal sac outside the abdomen?
- (iv) What is the role played by the inguinal canal?
- (v) What is semen? [2013]

**Ans.** (i) Parts labelled as *A* and *B* are

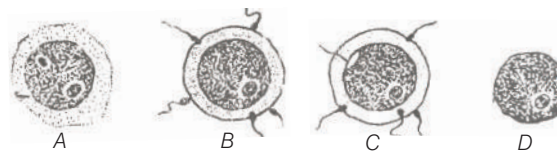
*A* – Seminiferous tubule

*B* – Testicular lobes

- (ii) **Function of Part A** (Seminiferous tubules) The cells of seminiferous tubules keep on dividing and produce sperms by the process called spermatogenesis.  
**Function of Part C** (Epididymis) It helps in transportation of sperms from seminiferous tubules into vas deferens and it also helps the sperm to attain maturity.
- (iii) Testes are located in scrotal sac because it provides 2-3°C less temperature than the normal body temperature, which is required for the maturation of sperms. So, when it is too hot the skin of scrotal sac gets loose and testes are away from the body and on the other hand when it is cold, the skin gets contracts and the testes are closer to the body for warmth.
- (iv) Inguinal canal facilitates the movement of testis from abdominal cavity into scrotal sac or *vice-versa*.
- (v) Semen is an alkaline combination of sperms and seminal fluid.

**88.** Given below are diagrams showing the different stages in the process of fertilisation of an egg in the human female reproductive tract.

Study the diagrams and answer the questions



- (i) Arrange the letters given below each diagram in a logical sequence to show the correct order in the process of fertilisation.
- (ii) Where does fertilisation normally take place? What is 'implantation' that follows fertilisation?
- (iii) Mention the chromosome number of the egg and zygote in humans.
- (iv) Explain the term 'gestation'. How long does gestation last in humans?
- (v) Draw a neat, labelled diagram of a mature human sperm. [2018]

**Ans.** (i)  $D \rightarrow C \rightarrow B \rightarrow A$

- (ii) Process of fertilisation takes place in the Fallopian tubes of female reproductive organs.  
After fertilisation, implantation takes place. It is the phenomenon of attachment of developing embryo within the uterus. It leads the state of pregnancy.
- (iii) Human egg contains 23 chromosomes (haploid), while zygote contains 46 chromosomes (diploid).
- (iv) Gestation is the time period during which the embryo remains in the uterus (after the last day of menstruation to the day of childbirth). It is of about 9 months or 280 days in human females.
- (v) Refer to fig. on page 228.

# CHAPTER EXERCISE

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## Multiple Choice Questions

1. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. It serves the purpose of
  - (a) escaping any possible compression by the visceral organs
  - (b) providing more space for the growth of epididymis
  - (c) providing a secondary sexual feature for exhibiting the male sex
  - (d) maintaining the scrotal temperature lower than the internal body temperature
2. Sertoli cells are found in
  - (a) heart
  - (b) liver
  - (c) germinal epithelium
  - (d) seminiferous tubules
3. Sperm's acrosome is derived from
  - (a) Golgi bodies
  - (b) endoplasmic reticulum
  - (c) lysosome
  - (d) mesosome
4. The tube that leads from the ovary to the uterus is
  - (a) uterus
  - (b) Fallopian duct
  - (c) umbilical cord
  - (d) placenta
5. Rupture of the follicle and release of the ovum from the ovary is called
  - (a) menstruation
  - (b) ovulation
  - (c) spermiation
  - (d) fertilisation
6. Implantation takes place in
  - (a) uterus
  - (b) Fallopian tube
  - (c) ovary
  - (d) hymen

7. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus?
  - (a) Chorion
  - (b) Allantois
  - (c) Yolk sac
  - (d) Amnion
8. Which one of the following hormones is not a secretory product of human placenta?
  - (a) Human chorionic gonadotropin
  - (b) Prolactin
  - (c) Oestrogen
  - (d) Progesterone
9. The endometrium is the lining of
  - (a) bladder
  - (b) vagina
  - (c) uterus
  - (d) oviduct

## Answers

1. (d)    2. (d)    3. (c)    4. (b)    5. (b)    6. (a)  
7. (d)    8. (b)    9. (c)

## Fill in the Blanks

10. A. Complete the following sentences by writing the correct words.
  - (i) Only one parent is required in case of ..... reproduction.
  - (ii) ..... marks the beginning and attainment of sexual maturity.
  - (iii) Facial hairs in males are examples of .....characters.
  - (iv) Seminiferous tubules produce ..... .
  - (v) The secretion of.....gland makes the semen alkaline.
  - (vi) Labia minora and labia majora are the parts of ..... .
  - (vii) ..... is the state of carrying the unborn young one inside the body.
  - (viii) Immediately after implantation, the inner cell mass differentiates into an outer layer called ... and an inner layer called ..... .

- B. Copy and complete the following by filling in the blanks A-D with appropriate words.

After one month of pregnancy, the embryo's ...A... is formed. By the end of the ...B... month of pregnancy, the foetus develops limbs and digits. By the end of ...C... most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed. By the end of ...D... the body is covered with fine hair, eyelids separate, and eyelashes are formed.

### True-False

11. Identify the statements as true/false.
- Vas deferens transports sperms into urethra.
  - Cowper's gland opens into the urethra.
  - The cilia lining the oviduct, push the released ovum into the uterus.
  - Women after the age of 45 years normally cannot produce children.
  - Menarche is the stoppage of menstruation.
  - Fertilisation occurs in cervix.
  - Cervix is also known as birth canal.
  - Gestation period in humans is about 7 months.
  - Sperm head contains mitochondria.
  - Tail of the sperm acts as the locomotary organ of the sperm.
  - Twins are the offsprings produced by the alternate pregnancies.
  - Fraternal twins are produced from two eggs.

### Match the Columns

12. Match the following columns.

Column I	Column II
A. Ovulation	1. Complete stoppage of menstrual cycle
B. Menopause	2. Formation of ovum
C. Oogenesis	3. Formation of sperm
D. Spermatogenesis	4. Release of ovum

13. Match the following columns.

Column I	Column II
A. Scrotal sac	1. Parturition
B. Prostate gland	2. Fertilisation
C. Epididymis	3. Maturation of spermatozoa
D. Oviduct	4. Alkaline fluid
E. Oxytocin	5. Temperature regulation

### 1 Mark Questions

- Write the function of mammary gland.
- The opening of vagina is often covered partially by a membrane. Name it.
- Given below are the terms. Rewrite the terms in the correct order, so as to be in logical sequence. Luteal phase, follicular phase, menstrual phase, ovulatory phase.
- In which part of the human sperm, acrosome is found?
- Name the powerhouse of the sperm cell.
- Name the layers formed during embryonic development.

### 2 Marks Questions

- Define sexual dimorphism.
- In what ways, primary reproductive organs are different from secondary or accessory reproductive organs?
- Choose the odd one in the following
  - Ovary, Fallopian tube, ureter, uterus.
  - Puberty, menopause, menstruation, menarche, reproductive age.
- Mention atleast two functions of semen.
- Write the sequence of the regions through which a mature sperm travels from the seminiferous tubules upto the urethral opening.
- What is placenta? Explain how it is formed.

### 3 Marks Questions

- Write a short note on accessory glands in females.
- Briefly explain the fate of an egg in female, if it remains unfertilised.
- What is sexual reproduction? Give two important features of the human reproductive system.
- Give the functions of
  - Ovary
  - Oviduct
  - Scrotum

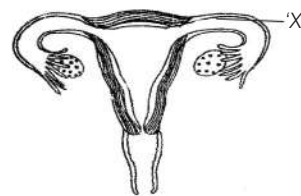
- 30.** Name the following
- The structure in which testes are present in man.
  - The period of intrauterine development of embryo.
  - The canal through which testes descend into scrotum just before birth in a human male child.
- 31.** Millions of sperms are produced but only one sperm fertilises the egg. Is it true? Explain.

#### 4/5 Marks Questions

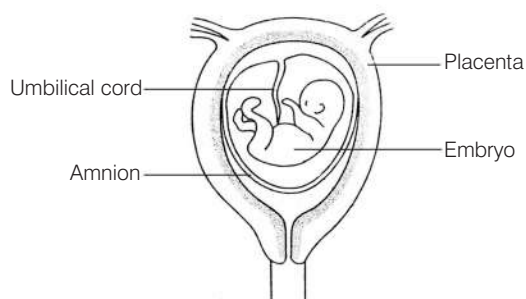
- 32.** Give functions of
- Acrosome
  - Amniotic fluid
  - Amnion
  - Umbilical cord
- 33.** Answer briefly
- Name the cells responsible for maintaining the male sex characteristics.
  - Name the accessory gland that activates sperm inside the sperm duct.
  - Name the accessory gland responsible for the secretion of milk in females.
  - Name the female reproductive organ that acts as a passage for the body during childbirth.
  - Name the first milk secreted after the birth of the child.
- 34.** The sexual characteristics appear at the time of puberty. Explain. Also give the significance of sexual dimorphism in animals.

#### Diagram Based Questions

- 35.** Given below is a diagrammatic representation of the ventral sectional view of the female reproductive system.



- Redraw the same on your answer sheet and then label the following parts  
*A* – Right ovary  
*B* – Uterus  
*C* – Placenta  
*D* – Embryo  
*E* – Amnion  
*F* – Oviducal funnel
  - State the main function of the  
 (a) Placenta  
 (b) Amniotic fluid
  - Using the symbol 'X' indicate the region in the diagram where fertilisation occurs.
- 36.** The given diagram is of a developing embryo in a mother's womb.



- Write the functions of placenta, amnion and umbilical cord.
- Which part in the given diagram helps in the respiration of foetus?
- Define parturition.

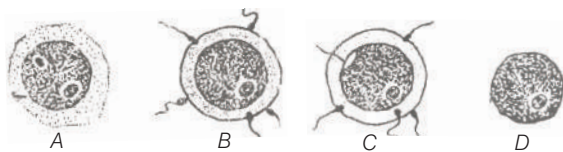
# ARCHIVES\*

## (Last 8 Years)

Collection of Questions Asked in Last 8 Years' (2018-2011) ICSE Class 10th Examinations

### 2018

- Choose the odd one out from the following terms given and name the category to which others belong.  
Prostate gland, Cowper's gland, seminal vesicle, seminiferous tubules [1]
- Mention the exact location of epididymis. [1]
- Give appropriate biological or technical term for the following.
  - The onset of menstruation in a young girl. [1]
  - The fluid which surrounds the foetus. [1]
- Differentiate between the following pairs on the basis of what is indicated in brackets.
  - Testosterone and oestrogen (organ which secretes) [1]
  - Ureter and urethra (function) [1]
- Give biological explanation for the following.  
The placenta is an important structure for the development of a foetus. [1]
- Given below are diagrams showing the different stages in the process of fertilisation of an egg in the human female reproductive tract.  
Study the diagrams and answer the questions



- Arrange the letters given below each diagram in a logical sequence to show the correct order in the process of fertilisation.
- Where does fertilisation normally take place? What is 'implantation' that follows fertilisation?
- Mention the chromosome number of the egg and zygote in humans.
- Explain the term 'gestation'. How long does gestation last in humans?
- Draw a neat, labelled diagram of a mature human sperm. [5]

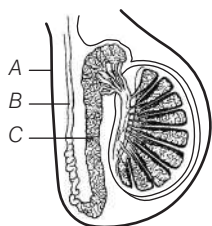
### 2017

Choose the correct alternative from the choices given below each statement so, as to complete its meaning.

- Which of the following is not a part of the female reproducing system in human beings?
  - Uterus
  - Ovary
  - Ureter
  - Fallopian tube [1]
- Ovulation occurs
  - at the beginning of menstrual cycle
  - in the mid of the menstrual cycle
  - at the end of the menstrual cycle
  - during any time of the menstrual cycle [1]
- The statement given below is incorrect. Rewrite the correct statement by changing the underlined words of the statement.  
The Graafian follicle, after ovulation turns into a hormone producing tissue called corpus callosum. [1]
- Given below is group of terms. In the group first pair indicates the relationship between the two terms.  
Rewrite and complete the second pair on a similar basis.  
Foetus : Amnion : : Heart : \_\_\_\_\_ [1]
- Given below is a set of five terms. Rewrite the terms in correct order in a logical sequence.
  - Uterus, parturition, fertilisation, gestation, implantation. [1]
  - Graafian follicle, uterus, oviducal funnel, Fallopian tube, ovum. [1]
- Mention the exact location of the prostate gland. [1]
- Give appropriate biological/technical terms for the following
  - The accessory gland in human males whose secretion activates the sperms.
  - The kind of twins formed from two fertilised eggs.
  - Period of complete intrauterine development of the foetus. [1 × 3]

- 14.** The diagram shown is the longitudinal section of a testis of man. Study it carefully and answer the questions that follows

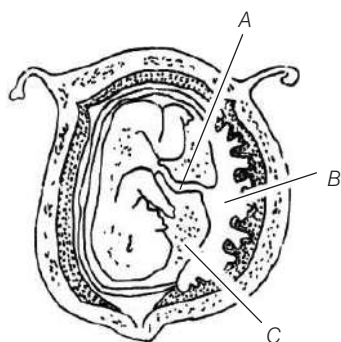
[5]



- Label the parts numbered A-C in the diagram.
- In which part of the testis are the sperms produced?
- State the functions of the parts labelled A and C in the diagram.
- Name the cells that secrete testosterone.
- Draw a neat, labelled diagram of a sperm.

## 2016

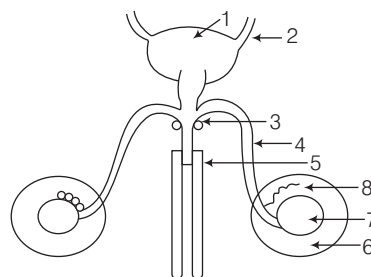
- 15.** Differentiate between the following pair on the basis of what is mentioned within the bracket.  
Sperm duct and Fallopian tube (Function) [1]
- 16.** In the set of terms given below, there is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd term in set and name the category to which the remaining three belong.  
Ovary, Fallopian tube, ureter, uterus [1]
- 17.** Give the biological term for the following
- Complete stoppage of menstrual cycle in females.
  - The canal through which the testes descend into the scrotum just before the birth of a male baby. [1 × 2]
- 18.** State the main function of the following
- Leydig cells
  - Corpus luteum [1 × 2]
- 19.** The diagram given below is that of a developing human foetus. Study the diagram and then answer the questions that follows [5]



- Label the parts labelled A-C in the diagram.
- Mention any two functions of the part labelled B in the diagram.
- Explain the significance of the part labelled C in the diagram.
- Define the term gestation. What is the normal gestational period of the developing human embryo?
- Mention the sex-chromosomes in a male and female embryo.

## 2015

- 20.** Name the structure formed by the villi of the embryo and the uterus of the mother. [1]
- 21.** Choose the correct answer from the four options given below  
A single highly coiled tube where sperms are stored, gets concentrated and mature is known as  
(a) epididymis (b) vas efferentia  
(c) vas deferens (d) seminiferous tubule [1]
- 22.** Briefly explain the significance of amniotic fluid. [1]
- 23.** Give the biological term for the following
- Fixing of developing zygote on the uterine wall. [1]
  - The permanent stoppage of menstruation at about the age of 45 years in a female. [1]
- 24.** The diagram given below shows the male urinogenital system of a human being. Study the diagram and answer the questions that follows



- Label the parts numbered 1 to 8.
- Name the corresponding structure of part (4) in female reproductive system.
- What is the role of part 7. [5]

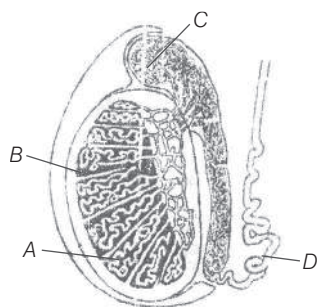
## 2014

- 25.** Differentiate between the following on the basis of what is mentioned within brackets.  
Corpus callosum and corpus luteum (Function) [1]
- 26.** The site of maturation of human sperms is the  
(a) seminiferous tubule (b) interstitial cells  
(c) epididymis (d) prostate gland [1]

- 27.** State the exact location of seminal vesicle. [1]
- 28.** Select the odd one out of the following terms given below. And also write the category for remaining terms.  
Cowper's gland, urethral gland, lachrymal gland, seminal vesicles, prostate gland. [1]
- 29.** Give technical term for the following  
(i) Thin-walled sac of skin that covers the testes.  
(ii) The permanent stoppage of the menstrual cycle in a woman aged 50 years. [1 × 2]
- 30.** Copy and complete the following by filling in the blanks (i) to (v) in the appropriate words.  
The human female gonads are ovaries. A maturing egg in the ovary is present in a sac of cells called ... (i) ... . As the egg grows larger, the follicle enlarges and gets filled with a fluid and is now called the ... (ii) ... follicle. The process of releasing the egg from the ovary is called ... (iii) ... . The ovum is picked up by the oviducal funnel and fertilisation takes place in the ... (iv) ... . In about a week the blastocyst gets fixed in the endometrium of the uterus and this process is called ... (v) ... . [5]

## 2013

- 31.** Give the biological/technical term for the structure which connects the placenta with the foetus. [1]
- 32.** Give the biological/technical term for the following  
The onset of menstruation in a young girl. [1]
- 33.** Given below is a diagram of the lateral section of a testis of a man. Study the same and answer the questions that follows



- (i) Label the parts A and B of the diagram.  
(ii) State the functions of the parts labelled A and C.  
(iii) What is the significance of the testes being located in the scrotal sac outside the abdomen?  
(iv) What is the role played by the inguinal canal?  
(v) What is semen? [5]

## 2012




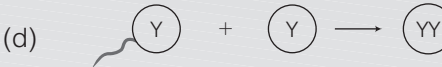
- 34.** State the main function of seminiferous tubule. [1]
- 35.** Give the exact location of the prostate gland. [1]
- 36.** Given below is the set with four terms in which one term is an odd one and cannot be grouped in the same category to which the other three belong. Identify the odd one in the set and name the category to which the remaining three belong.  
Ovary, ureter, Fallopian tube, uterus [1]
- 37.** Give the biological/technical term for the phase in the menstrual cycle in which the remnant of follicle in the ovary turns to corpus luteum. [1]
- 38.** Given below is the set of five terms, in given case rewrite the terms in logical sequence as directed at the end of statement.  
Implantation, parturition, ovulation, gestation, fertilisation. (Stages leading to formation of foetus and birth) [1]

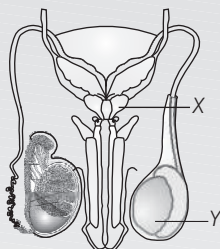
## 2011

- 39.** Give the exact location of amnion. [1]
- 40.** State whether the following statement is true or false. If false, rewrite the correct statement by changing the first or last word only.  
Gestation is the process of fixing of the zygote to the uterine wall. [1]
- 41.** Name the cells of the testes that produce male hormones. [1]

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 On which date is a woman most likely to ovulate, if the first day of menstrual loss was 1 February?  
 (a) 6 February (b) 14 February (c) 28 February (d) 1 March
- 2 Which diagram shows the sex chromosomes when a sperm fertilises an egg to produce a baby girl?
- (a)  (b) 
- (c)  (d) 
- 3 Refer to the figure given below



- Which of the following correctly describes a functional difference between X and Y?
- (a) X is a gonad and Y is a gland  
 (b) Both X and Y are glands, but X is an endocrine gland, while Y is an exocrine gland  
 (c) Y secretes male sex hormones, but X does not  
 (d) X serves to store sperms, while Y serves to produce other constituents of semen
- 4 Which of the following statements on the reproduction of humans are correct?
- I. All eggs fertilised externally.  
 II. One female egg can be fertilised by many sperms.  
 III. After fertilisation, the embryo will develop into a young baby.  
 IV. Males produce sperms and females produce eggs.
- (a) I and II (b) I and III (c) II, III and IV (d) III and IV
- 5 What would be the correct sequence of stages during fertilisation? Mention correctly.
- (a) 1–Binding, 2–Attachment, 3–Fusion, 4–Penetration  
 (b) 1–Attachment, 2–Binding, 3–Penetration, 4–Fusion  
 (c) 1–Penetration, 2–Binding, 3–Attachment, 4–Fusion  
 (d) 1–Fusion, 2–Penetration, 3–Binding, 4–Attachment



\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 305.

# Population and Its Control

## Population

It is a group of organisms of the same species occupying a particular space at a particular time. It can be defined as the summation of all living organisms of the same species or group in a geographical area, where they live and inbreed among themselves.

Presently, the population throughout the world has seen an alarming increase. The rising human population has become most serious problem and put challenges for mankind by creating deficiency of the resources. In this chapter, we will study about population, its related aspects and thereafter, its effects on resources and how to control population size.

## Terms Related to Population

- (i) **Population density** It is the measurement of population per unit area or per unit volume, at a given time.
- (ii) **Growth rate of population** It is defined as the difference between the birth rate and death rate in a given population at a given time. If the birth rate is higher than death rate, the population increases. If birth rate is lower than death rate the population declines.
- (iii) **Population growth** It is the change in the population over a period of time. It is the collection of interbreeding organisms of a particular species. Technically, population growth refers to any species, but is always used for humans.

The population growth is affected by

- (a) **Emigration** The number of people moving out of a particular region or country.
- (b) **Immigration** The addition of new people to already existing population in a region from other areas or countries. Population growth can cause following problems
  - Decrease in natural resources
  - Decrease in per capita income
  - Decrease in health condition

## Chapter Objective

- Population
- Population Explosion
- Effects of Population Explosion
- Population in India
- Population Control
- Methods of Contraception
- Medical Termination of Pregnancy (MTP)/ Induced Abortion

- (iv) **Demography** It is the scientific statistical study of human population. There are five demographic factors in a population, which work continuously to determine three phenomena of demography, i.e. size, composition and distribution.

These are literacy, mortality, marriage, migration and social mobility.

- (v) **Census** It is the procedure of systematically acquiring and recording information about the members of given population. Census is an official counting or survey and study of human population after every 10 years.

## Population Explosion

A rapid increase in the size of population over a relatively short period is called **population explosion**. The combination of a continuing high birth rate and low death rate is the major cause of population explosion. Population in the world is currently up growing at a rate of around 1.13% per year and 1.2% per year in India.

## Terms Related to Population Explosion

Several terms related to the population explosion are given below

- (i) **Birth rate** (Natality) It is defined as the total number of live births per 1,000 individuals of a population per year. It results in increased population size and population density.  
The actual birth rate which is obtained under existing conditions is termed as realised natality or fertility rate and is inversely related to environmental resistance.
- (ii) **Death rate** (Mortality) It is defined as the total number of deaths per 1,000 individuals of a population per year.  
It results in decrease in population size and population density, but decrease in death rate results in increased population growth rate.
- (iii) **Infant mortality** It is the death of a child less than one year of age. It is measured as the number of deaths of children under one year of age per 1000 live births.
- (iv) **Maternal mortality** It is the death of either a pregnant woman or death of woman within 42 days of delivery, spontaneous abortion or termination providing death is associated with pregnancy or its treatment.

## Major Causes of Sharp Rise in Population Worldwide

Population increase is directly associated with the following factors

- (i) **Increased birth rate** Increase in the number of people in reproductive age due to advanced medical help is the most common reason of extensive population growth.
- (ii) **Large scale immunisation** The control of communicable and non-communicable diseases by the antibiotics or the prophylactic vaccinations, has reduced the number of deaths. Improved medical attention and awareness also contribute to the rise in population.
- (iii) **Education and awareness** The awareness about the (reproduction related aspects), methods of disease prevention and hygiene has helped in the rise of population.
- (iv) **Improved food and nutrition** Due to new agricultural practices, the food production has improved and new storage methods have reduced the food wastage.  
More food reduces the death of individuals due to starvation and improvement in nutritional quality keeps an individual healthy and free from diseases.
- (v) **Role of government policies** Many steps have been implemented by government as in India to reduce the number of unnecessary deaths, which include clean public toilets, clean roads, proper drainage systems, regular check ups of all facilities, etc.

**Note** If no control on population growth rate is observed, the populations in the next 700 years would increase so much that only 1 sq. foot of earth would be available per person.

## Effects of Population Explosion

The rising human population causes following problems

### 1. Over-Exploitation of Resources

Any material either natural or artificial used by humans for their growth, development and welfare is known as **resource**. The rising human population is creating pressure on the limited resources. The six main resources under pressure in context of rise in population are

- (i) **Food** An important necessity for all living beings is food. Many advance methods have been applied to increase the yield of good quality food, but they are not enough because population increases by geometric progression, i.e. 1, 2, 4, 8..., whereas food

production occurs by an arithmetic progression, i.e. 1, 2, 3, 4, 5, 6..... . A level would therefore be reached where the entire world would suffer from food shortage.

- (ii) **Water** The availability of clean, contamination-free drinking water will become more scarce with the growing population.
- (iii) **Forests** Vast areas of the forests have already been cleared for human settlements like housing, schools, hospitals, etc. Forests are reservoirs of many valuable resources and also maintains the balance in ecosystem.
- (iv) **Land** It is required for buildings, farming, roads, etc. The area of land is fixed on the earth and will not increase as per our demand. Usable land is becoming less available with growing population.
- (v) **Energy** It is required for cooking, industrial processes, transportation, etc. Energy is obtained from fossil fuels, which are non-renewable (these resources are lost forever once used completely). At present coal and petroleum are two main energy sources. As population increases their reserves are fast depleting.
- (vi) **Minerals** These are utilised by many industries to produce different materials required by us. Increased population has raised the utilisation of minerals like iron, copper, aluminium, etc., at a faster rate.

## 2. Population Growth due to Urbanisation

Urbanisation is also an effect of population increase. With increase in population, people move from small rural area to urban area in search of work and opportunities. This shift of population from rural area to urban area is called urbanisation. Urbanisation put challenges on natural resources.

- Due to increase in population in urban areas, agriculture land is used for residential and other purposes like schooling, hospital, etc.
- Due to urbanisation there is an increase in demand of fuels, electricity, food, etc., which threatens the extinction of natural resources like coal, petroleum, etc.
- Urbanisation is also responsible for raising living standards of the people. This results in accumulation of more household goods, electric equipments, clothes, vehicles, etc.

## Sustainable Development

To avoid these problems of depletion of natural resources, concept of sustainable development should be followed.

It is the process of development to sustain natural systems and their yields, which can be maintained for a long time without any damage to the environment. The concept of sustainable development encourages growth that meet the current basic human needs, while preserving the resources for the needs of the future generations.

The sustainable development can be achieved by taking following measures

- (i) Process of recycling and reusing natural resources.
- (ii) Increase use of renewable resources such as solar energy, wind power, etc.
- (iii) Sensible use of available natural resources.

### CHECK POINT 01

- 1 Give the basic difference between emigration and immigration.
- 2 Name the five demographic factors in a population, which work continuously to determine three phenomena of demography.
- 3 What is census?
- 4 What will happen if there will be no control on population growth in coming 700 years?
- 5 What do you mean by urbanisation?
- 6 Mention two measures to achieve sustainable development.

## Population in India

The population of India is rising at an alarming rate. At present, India is the second most populated country in the world. It has only 2.42% of the world's land, but supports more than 15.5% of world's population. Current Indian population is a little more than 1.21 billion.

## Major Causes of Population Explosion in India

The factors responsible for the increase in population in India are as follows

- (i) Illiteracy and lack of recreation due to which many people in rural areas do not know the functioning of reproductive system.
- (ii) In India, people belief that children are the gift of God and a sign of prosperity. Therefore, people belonging to lower society make no effort to avoid pregnancy.
- (iii) People believe that male child is usually of great help to the aged parents. So, they continue to give birth till they have a male child.

- (iv) Low economic conditions, due to which children become helping hands for their parents, which also affects their education and food availability.
- (v) The high mortality rate in infants makes people think it is safer to produce more children.
- (vi) Religious and social customs make some families unable to accept family planning norms.

**Note** July 11, every year is celebrated as **World Population Day** to create awareness among people about the growing population and how it affects our environment.

## Consequences of Population Explosion in India

Overpopulation has lead to various serious problems. Some of these are given below as

- (i) **Shortage of food supply** If the population keeps on increasing and the production of food does not increase in a similar proportion, it will lead to shortage of food.
- (ii) **Unemployment** Overgrowing population is a main and the foremost reason for unemployment. As number of people will increase, the job need will also increase.  
Therefore, more number of people will remain unemployed, if sufficient number of jobs are not available.
- (iii) **Education** With increasing population, more people need to be educated. This creates difficulties for the Government in order to provide education to all.
- (iv) **Poverty** Family tends to become poor, if there are more persons in it and the income is less. Therefore, poverty increases with the birth of each child in the family.
- (v) **Decreased open spaces** Because all the members in family require adequate space for living. So, more houses are constructed which results in decrease of open spaces.
- (vi) **Pollution** The increased population leads to all kinds of pollution, i.e. land, air, soil and water.
- (vii) **Over-exploitation of resources** It is done to meet the requirements of growing population.

Overall large population (overpopulation) of a country is the result of having large families where the quality of life also goes down.

## Disadvantages of Large Family

There are several disadvantages of large family, like

- (i) Economic pressure on the parents with poor housing and clothing condition.
- (ii) Health condition of the mother deteriorates due to frequent pregnancies.
- (iii) Lesser attention of the parents towards various needs of the children.
- (iv) Children suffer from malnutrition.
- (v) Insufficient education to the children, etc.

### CHECK POINT 02

- 1 What percentage of India's population constitutes of the world's population?
- 2 How high mortality rate in infants is a cause of population explosion in India?
- 3 World population day is celebrated on .....
- 4 Give one serious consequence of overpopulation.
- 5 State one disadvantage of large family.

## Population Control

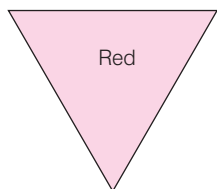
To overcome the consequences of overpopulation, it is mandatory to control the rate of population growth. Control measures in the form of awareness about family planning, contraceptions, etc., can be done.

## Measures to Control Population Explosion

To prevent the adverse effect of overcrowding and population explosion, following measures must be taken

- (i) **Improved education facilities** It is necessary for each person of the society to be well-educated for understanding all the criteria and impacts of population explosion. Awareness and education motivate people to take steps in right direction.
- (ii) **Sex education** Reproductive or sex education must be provided to the people at young age.  
The orthodox belief to have atleast one male child can be modified by education in small towns. Spacing between the children is also a good measure. The concept of small family, happy family should be made widespread.
- (iii) **Marriageable age** In order to check the population growth, the age of marriage must be raised which will be a more effective means for control of the population. In India, the marriageable age for boys is 21 and for girls is 18.

- (iv) **Family planning** It was introduced in 1951 in India. The department which plays a significant role in controlling population and is committed to provide advice and help about family planning is known as **Family Welfare Centre Department**.



Sign of family welfare

The inverted **red triangle** has become a popular sign in India for family welfare.

The prevention or regulation of conception can be done by using different methods or devices so as to limit the number of offsprings. This is called **birth control** or **contraception** methods.

## Contraception or Birth Control

The regulation of conception by preventive methods or devices that limit the number of offsprings is called birth control. These devices are called **contraceptives**.

An ideal contraceptive should be

- (i) User-friendly
- (ii) Easily available
- (iii) Effective
- (iv) Reversible with no or least side effects.
- (v) Should not interfere with the sexual drive/desire and/or the sexual act of the user.

## Methods of Contraception

Contraception can be achieved by the following methods

### 1. Natural Contraception

These methods are based on the principle of avoiding chances of egg meeting the sperm. Some of them are as follows

- (i) **Periodic abstinence** In this, the couples avoid coitus (intercourse) from day 10-17 of the menstrual cycle, because ovulation occurs mostly during this time (it is called the **fertile period**) to avoid conception.
- (ii) **Coitus interruptus or Withdrawal** In this method, the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.

- (iii) **Lactational amenorrhea** It refers to the stoppage of menstruation during the period of lactation following parturition. Because ovulation does not occur in this period, the chances of conception are minimum or nil.

## 2. Barrier Methods

These methods prevent sperms and ovum from physically meeting in order to prevent fertilisation. These methods are available for both males and females.

These are as follows

- (i) **Condoms** These are made of thin rubber or latex sheath and are used to cover the penis in males and vagina and cervix in females. These are used just before coitus, so that ejaculated semen would not enter female reproductive tract.
- (ii) **Cervical caps, diaphragms and vaults** These are also made of rubber and are inserted into the female reproductive tract to cover the cervix during intercourse. They prevent conception by blocking entry of sperms through cervix. These are reusable.
- (iii) **Spermicides** These are chemicals applied at the surface of vagina before intercourse. These contain spermicides (that kill spermatozoa) such as lactic acid, citric acid, boric acid, zinc sulphate and potassium permanganate. Spermicides available in the form of creams, jellies and foams.

## 3. Intrauterine Devices (IUDs)

These devices contain either copper or progesterone, and are inserted by doctors in the uterus through vagina. These are a form of long reversible contraceptive method. IUDs prevent the implantation of blastocyst (embryo). They may be Lippe's loop and copper-T.

## 4. Oral Contraceptives

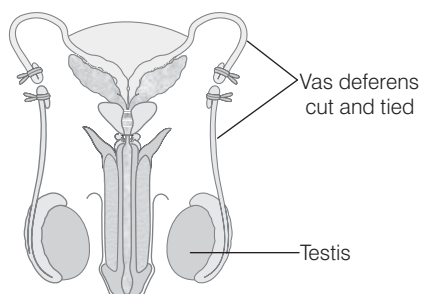
These are the preparations of hormones either progestogens or progestogen-oestrogen combinations in the form of **pills** (tablets), used by the females. They alter or inhibit ovulation and fertilisation.

## 5. Surgical (Sterilisation) Methods

These are the terminal methods used by male/female partner to prevent any more pregnancies. These are the permanent methods, which block the transport of gametes and thereby prevent contraception.

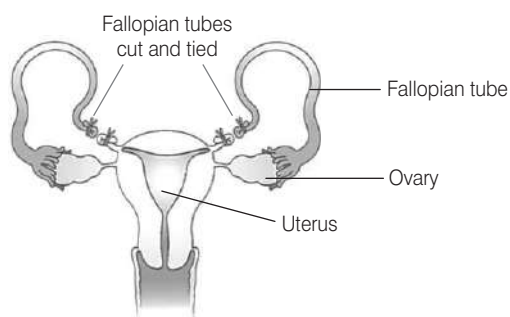
It is available in the form of **vasectomy** in men and **tubectomy** in women.

- (i) **Vasectomy** A small part of the vas deferens is removed or tied up through a small incision on the scrotum in **males**.



Vasectomy in male

- (ii) **Tubectomy** A small part of the Fallopian tube is removed or tied up through a small incision in the abdomen or vagina in female.



Tubectomy in female

Both these techniques are known to be highly effective but poorly reversible.

## Medical Termination of Pregnancy (MTP)/ Induced Abortion

Intentional or voluntary termination (abortion) of pregnancy before full term or before the foetus becomes viable is called **Medical Termination of Pregnancy (MTP)**.

Various factors that lead to MTPs are

- (i) To get rid of unwanted pregnancies due to casual unprotected intercourse or failure of the contraceptive used during coitus or rape.
- (ii) In case, where continuation of pregnancy is harmful to either foetus, mother or even both.

**Note** MTP was legalised in 1971. MTP is considered relatively safe upto 12 weeks of pregnancy (during first trimester). It becomes more risky after the period of 12 weeks. It is a last resort available in the absence of other options.

### CHECK POINT 03

- 1 When was family planning introduced in India?
- 2 Lactational amenorrhea is reliable upto how much time?
- 3 Name one barrier contraceptive for males.
- 4 What do birth control pills contain?
- 5 Name a permanent method of contraception in female.
- 6 What is the main purpose of MTP.

# SUMMARY

- Population is defined as summation of all living organisms of the same species or group in a geographical area where they live and inbreed among themselves.
- Population density It is the measurement of population per unit area or per unit volume, at a given time.
- Growth rate of population It is defined as the difference between the birth rate and death rate in a given population at a given time.
- Population growth It is the change in the population over a period of time.
- Demography is the statistical study of human population.
- Population explosion is a sudden increase in the population in a relatively small period of time. It occurs due to increased health facilities and better living conditions.
- Birth rate (Nativity) It is the total number of live births per 1,000 individuals of a population per year. It results in increased population size and population density.
- Death rate (Mortality) It is the total number of deaths per 1,000 individuals of a population per year. It results in decrease in population size and population density, but decrease in death rate results in increased population growth rate.
- Measures to control population explosion are
  - (i) Improved education facilities
  - (ii) Sex education
  - (iii) Check on marriageable age
  - (iv) Family planning
- Birth control is an only solution of checking population growth. These methods are categorised as follows
  - Natural methods of birth control involve avoiding chances of meeting of sperm and ovum. It can be done by periodic abstinence, coitus interruptus and lactational amenorrhea, etc.
  - Barrier methods are based on prevention of ovum and sperms coming closer. It is done by using condoms, diaphragms, cervical caps, vaults, spermicides, etc.
  - Intrauterine Devices (IUDs) are the devices introduced into the uterus in order to suppress the motility and fertilising ability by releasing ions such as  $\text{Cu}^{2+}$  which makes uterus unsuitable for implantation. These include lippes loop, Cu-T, LNG-20, progestasert, etc.
  - Oral contraceptives are hormonal preparations in the form of pills. These can alter or inhibit ovulation and implantation, e.g. saheli, mala-D, mala-N, etc.
  - Surgical or Sterilisation methods are used in male/female to prevent pregnancy. They are available as tubectomy in men and vasectomy in females.
  - Medical Termination of Pregnancy (MTP) is the intentional termination of pregnancy before reaching full term.

# EXAM PRACTICE

## Multiple Choice Questions

1. Birth rate is the number of lives birth  
(a) per 100 people per decade  
(b) per 1000 people per year  
(c) per 1000 people per decade  
(d) per 100 people per year
2. Identify the major cause of population explosion from those given below  
(a) Literacy (b) High natality rate  
(c) Low natality rate (d) None of these

Ans. (b)

Ans. (b)

3. Identify a non-renewable natural resource that is overexploited due to increased population.  
(a) Coal  
(b) Petroleum  
(c) Both (a) and (b)  
(d) Wind

Ans. (c)

4. Ideal contraceptive should not be  
(a) user-friendly (b) effective  
(c) expensive (d) easily available

Ans. (c)

5. Copper releasing IUDs are used for suppressing the  
(a) activity of ova  
(b) activity of the uterus  
(c) motility of the sperms  
(d) motility of ova

Ans. (c)

6. Choose the correct answer from each of the four options given below  
Surgical method of sterilisation in a woman involves cutting and tying of [2017]  
(a) ureter (b) uterus  
(c) urethra (d) oviduct

Ans. (d)

7. MTP is advised by the doctor upto the pregnancy of  
(a) 12 weeks (b) 15 weeks  
(c) 20 weeks (d) 22 weeks

Ans. (a)

## Fill in the Blanks

8. Fill the corresponding blank with its appropriate word/s.  
(i) The actual birth rate obtained under existing conditions is termed as ..... and it is ..... proportional to environmental resistance.  
(ii) Population increases in ..... ratio, while the food production occurs in ..... ratio.  
(iii) Population control can be achieved by..... and .....  
(iv) Family planning is denoted by .....inverted triangle.  
(v) Pregnancy can be avoided by the use of .....  
(vi) The full form of IUCDs is .....  
(vii) Periodic abstinence is to avoid coitus from ..... day of menstrual cycle.

- Ans. (i) realised natality, inversely  
(ii) geometric, arithmetic.  
(iii) sex education, family planning.  
(iv) red-coloured.  
(v) contraceptions.  
(vi) Intrauterine Contraceptive devices.  
(vii) 10-17th day.

## True-False

9. State whether the following statements are true or false. If false, rewrite the correct statement by changing the first or last word only.  
(i) Death rate is defined as total number of death per 1,000 individuals of population per year.  
(ii) Mortality is the number of deaths per thousand of the population per decade. [2007]  
(iii) The number of people moving out from a country is called immigration.  
(iv) Large families are happy families as they have adequate supply of all the basic amenities.  
(v) Vasectomy is the surgical method of sterilisation in men. [2005]  
(vi) Diaphragms are the barrier method for preventing pregnancy.  
(vii) Saheli is an IUD developed by CSIR as an effective contraceptive.  
(viii) Tubectomy is the surgical method of sterilisation in man. [2017]

- Ans.** (i) True.  
(ii) False. Mortality is the number of deaths per thousand of the population per year.  
(iii) False. The number of people moving out from a country is called emigration.  
(iv) False. Large families do not get adequate supply of all basic amenities due to which they do not remain happy.  
(v) True (vi) True (vii) False  
(viii) False. Vasectomy is the surgical method of sterilisation in males whereas tubectomy is the surgical method of sterilisation in females.

## Match the Columns

- 10.** Match the following columns.

Column I	Column II
A. Increased growth rate	1. Recycling and reuse
B. Population explosion	2. Excess of population
C. Sustainable development	3. Birth rate exceeds death rate

- Ans.** A – 3, B – 2, C – 1

## **a** 1/2 Marks Questions

- 11.** Give the biological/technical terms for the following  
Statistical study of human population. [2014, 12]

- Ans.** Demography is the statistical study of human population. [1]

- 12.** Name the term used for the number of individuals inhabiting per unit area. [2016]

- Ans.** Population density [1]

- 13.** Explain the term growth rate of population. [2017]

- Ans.** Growth rate of population It is defined as the difference between the birth rate and death rate. [1]

- 14.** Give appropriate biological or technical term for the following.

The difference between the birth rate and the death rate. [2018]

- Ans.** Growth rate [1]

- 15.** Explain the term natality. [2015]

- Ans.** Natality It is defined as the ratio of the number of births to the size of the population. It is also termed as birth rate. [1]

- 16.** Differentiate between the following pairs on the basis of what is mentioned in brackets.  
Demography and population density (definition) [2017]

- Ans.** Difference between demography and population density is as follows

Demography	Population density
The scientific statistical study of human population is called demography.	It is the measurement of population per unit area at a given time.

[1]

- 17.** Give reason for the following

There is a need to check the present rate of urbanisation. [2017]

- Ans.** There is need to check present rate of urbanisation to reduce the pressure on resources such as forest, fossil fuels, etc. [1]

- 18.** Write any two major reasons for the population explosion in the world. [2013]

- Ans.** Two major reasons for the population explosion in the world are as follows

- (i) Abundance of food  
(ii) Decreased death rate. [ $\frac{1}{2} \times 2$ ]

- 19.** Write any two major reasons for the population explosion in India. [2015, 14, 12]

Or

State two reasons for the increase of population in India.

- Ans.** Two major reasons for the population explosion in India are

- (i) Illiteracy  
(ii) High birth rate [ $\frac{1}{2} \times 2$ ]

- 20.** What is the present rate of growth of population of India and world.

- Ans.** The present rate of growth of population of India is 1.2% per year and 1.13% per year in the world. [1]

- 21.** What are the age restrictions for marriage for boys and girls in India. [2009]

- Ans.** Age restriction for marriage for boys is 21 years and for girls is 18 years in India. [1]

- 22.** Define overpopulation.

- Ans.** When the population growth rate is higher than the national income, the per capita income tends to decline. This is regarded as a state of overpopulation. [2]

**23.** Give biological explanation for the following.

Education is very important for population control. [2018]

**Ans.** It is necessary for each person of the society to be well-educated for understanding all the criteria and impacts of population explosion.

Reproductive or sex education must be provided to the people at young age. People should be educated about the advantages of small family which can help in controlling population.

**24.** The present population growth rate in India is alarming. Suggest two ways to check it.

**Ans.** Ways to check population growth rate are

- (i) By increasing marriageable age and by promoting use of birth control measures.
- (ii) By educating people about the consequences of uncontrolled population growth. [1 × 2]

**25.** The need to limit the size of the family is more vital today than ever before. Give two reasons.

**Ans.** Due to growth in population every year, the country has to spend more on food, clothing and housing. A large population produces more wastes causing pollution and upsetting the ecological balance. [2]

**26.** List the effects of following on human population of an area

- (i) Immigration
- (ii) Emigration

**Ans.** (i) Immigration is the permanent movement of people from outside to an area thus, it increases the population.  
(ii) Emigration involves permanent movement of people from an area to other. It has negative (decreasing) impact on population. [1 × 2]

**27.** Differentiate between natality and mortality. [2012]

**Ans.** Differences between natality and mortality are

Natality	Mortality
It refers to the number of births during a given period in the population that are added to initial density.	It refers to the number of deaths in the population during a given period.
It increases the number of individuals in a population under given environmental conditions.	It decreases the number of individuals due to death in a population under given environmental conditions.

[1]

**28.** Differentiate between the following pair on the basis of what is mentioned in bracket.

Vasectomy and tubectomy (explain) (part cut and tied). [2015, 13]

**Ans.** Differences between vasectomy and tubectomy are

Vasectomy	Tubectomy
It is the sterilisation strategy in males.	It is the sterilisation strategy in females.
It involves surgical cutting of part of vas deferens in males and ligation of cut ends to prevent sperm transfer.	It involves surgical cutting of part of Fallopian tube in females and ligation of the cut ends to prevent fertilisation.

[1 × 2]

**29.** Is the use of contraceptives justified?

**Ans.** Use of contraceptives is justified because it helps to control the growth of population and prevents STDs (Sexually Transmitted Diseases). The unwanted pregnancies can also be avoided by the use of contraceptives. [1]

**30.** Comment on the essential features required for an ideal contraceptive.

**Ans.** An ideal contraceptive should

- (i) be easily available.
- (ii) effective and reversible with least or no side effects.
- (iii) no interference with the sexual drive/desire or the sexual act of the user.
- (iv) be user-friendly. [½ × 4]

**31.** Name the following

- (i) A contraceptive device consisting of a small thimble-shaped cup that is placed over the uterus to prevent the entrance of spermatozoa .....
- (ii) Removal of gonads, often referring to the removal of male testes is called .....

**Ans.** (i) cervical cap (ii) castration [2]

## **b** 3 Marks Questions

**32.** Write any six factors which have contributed to a rapid rise of human population in recent time in the world.

**Ans.** (i) Better healthcare for all age groups.  
(ii) Food shortage minimised due to green revolution.  
(iii) Widespread immunisation against fatal diseases.  
(iv) Reduced death-rate due to better medical facilities.  
(v) Proper nutrition specially to the growing children.  
(vi) More children reach the reproductive age.

[½ × 6]

- 33.** List any three consequences of population explosion in India.

**Ans.** Population explosion/overpopulation has led to some serious problems which are as follows

**Education** It is one of the consequence of overpopulation as government tend to face difficulties in providing education to all.

**Poverty** If there are more persons in a family and the income is less, the family becomes naturally poor. It also results in social unrest.

**Unemployment** Overgrowing population is the foremost reason for unemployment. As number of people will increase the job need will also increase and if sufficient number of jobs are not available, more number of people will remain jobless. [1×3]

- 34.** Given below are hypothetical figures in regard to population (in crores) of two countries *A* and *B* during the last three decades.

Country	1971	1981	1991
<i>A</i>	6.4	9.6	10.6
<i>B</i>	15.7	15.7	15.3

Fill in the blanks by the data given above.

- Rate of growth of population of country ..... has increased tremendously between years .... and .....
- The country ..... shows negative population growth between years ..... and .....
- The country ..... shows zero population growth between years ..... and .....

**Ans.**

(i)	<i>A</i>	1971	1981
(ii)	<i>B</i>	1981	1991
(iii)	<i>B</i>	1971	1981

[1×3]

- 35.** How can the knowledge of reproduction process help people in limiting the size of their families? Give two concrete examples.

**Ans.** Knowledge of reproduction process can help people in limiting the size of their families. This can be illustrated by following examples [1]

- By becoming aware, people will get rid of the belief that children are God's gift. This would help in changing their mindsets and they would then understand the importance of small family. [1]
- By understanding the reproduction process, a person can understand how different methods of contraception work. They would be in a better position to take decision on a particular contraception method. [1]

- 36.** Is sex education necessary in schools? Why?

**Ans.** Yes, sex education is necessary in schools because

- Students should become part of such education, so that they overcome hesitation and gain confidence to discuss any query with their teacher or parents.
- Counselling and awareness regarding reproductive organs, safe and hygienic sexual practices will play an important role to make people reproductively healthy.

- 37.** Describe three manners in which fertilisation of human ovum by a sperm can be prevented.

**Ans.** Fertilisation of human ovum by a sperm can be prevented by the following methods

- Condoms are the barriers made of thin rubber or latex sheath. These are used to cover the penis in the male or vagina and cervix in females. [1]
- Diaphragm, cervical caps and vaults are the barriers made of rubber that are introduced in the female reproductive tract to cover cervix. [1]
- Spermicidal creams, jellies and foams are introduced in vagina to kill the sperms. [1]

### **C** 4/5 Marks Questions

- 38.** Name the following

- Group of organisms living in a geographically localised area with capacity of interbreeding.
- The size of a population in relation to the per unit area at any given time.
- A rapid increase in size of a population influenced by certain factors.
- The percentage ratio of natality and mortality in a unit population at a unit time.

**Ans.**

- Population
- Population density
- Population explosion
- Vital index [1×4]

- 39.** What are the reasons for the population explosion?

**Ans.** Refer to text on page 253-254. [4]

- 40.** Our resources cannot keep pace with the growing population. Give examples in support of this statement.

**Ans.** Coal It is an important fuel which is mainly used in the industries and for power generation. The rising population means there is an increased demand for different items produced in factories. Additionally, there is increased demand of electricity. But coal is an

exhaustible resource and the pace at which we are consuming it would result in the finishing of coal reserves in the near future.

**Petroleum** It is another example of fossil fuel. The petroleum reserve inside the earth would finish in about 150 years with rising population.

**Land** It is limited in supply and all the land cannot be transformed into farmland. Increase in population means there is an increased demand for food, which can only be produced by farming on land. We can increase farm production to certain extent by using modern technologies but we cannot increase the land under cultivation beyond certain limits. [5]

**41.** The present population growth rate in India is alarming. Suggest ways to check it.

**Ans.** The present population growth rate in India is alarming. Such an alarming growth rate could lead to an absolute scarcity of even the basic requirements, i.e. food, shelter and clothing, inspite of significant progress made in those areas.

Following are some important ways to overcome this problem of population growth in India

- (i) By raising marriageable age of the females to 18 years and that of males to 21 years.
- (ii) By promoting use of birth control measures to motivate smaller families.
- (iii) By providing incentives to couples with small families.
- (iv) By educating people about consequences of uncontrolled population growth. [1 × 4]

**42.** We see advertisements like 'Saheli' as a method of family planning.

- (i) What is the principle behind using it as a method to control population growth?
- (ii) How will you convince people who say it is religiously wrong to use them to avoid pregnancy?
- (iii) Mention the advantages of using pills as contraceptives.

**Ans.** (i) The basic principle of using this is to control population growth. It is the easiest way of inhibiting ovulation and implantation. Pills have to be taken for 21 days starting within the first five days of menstrual cycle. These pills inhibit the motility and secretory activity of oviducts. [1]

- (ii) If we can aware people that population is increasing day-by-day due to which, resources are diminishing and becoming unavailable to the

existing population. We can convince people to avoid pregnancy. [1]

(iii) Advantages of using pills are as follows

- It reduces premenstrual symptoms and pain associated with menstruation.
- It reduces the risk of ovarian and uterine cancer as well as ovarian cysts and pelvic inflammatory disease in women. [2]

- 43.** (i) Why are awareness campaigns related to population explosion necessary in India ?
- (ii) Give the names of any two natural methods of conception. Also discuss the principle they are based on.
- (iii) On what principle are surgical methods of conception are based on ?
- (iv) In last few years, which areas of improvement in India have helped in population explosion.

**Ans.** (i) These campaigns help people to understand the problems faced by families and nation due to increasing population. Also, the benefits of having small family are known.

(ii) Lactational amenorrhea and periodic abstinence. These methods work on the principle of avoiding the chance meeting between ovum and sperm.

(iii) The surgical methods of contraception prevent gamete transport.

(iv) Some of the areas of improvement leading to population explosion are increased food production, better medical facilities, better education, etc. [1 × 4]

**44.** Classify the following contraceptive measures into different methods of birth control.

- |                 |                    |
|-----------------|--------------------|
| (i) Saheli      | (ii) Condoms       |
| (iii) Diaphragm | (iv) Cervical caps |

**Ans.** (i) Oral pills

(ii) Barrier method

(iii) Barrier method

(iv) Barrier method. [1 × 4]

**45.** Discuss the mode of action and advantages/disadvantages of hormonal contraceptives.

**Ans. Mode of Action of Hormonal Contraceptives**

The hormones releasing IUDs, make the uterus unsuitable for implantation and the cervix hostile to the sperms. Progesterone can also be used as injections and implants (slow release of hormones) to inhibit ovulation.

**Advantages of Hormonal Contraceptives**

Administration of progesterone or progesterone-oestrogen combinations or IUDs within 72 hours of intercourse have been found to be effective as emergency contraceptives as they could be used to avoid possible pregnancy due to rape or casual unprotected intercourse.

**Disadvantages of Hormonal Contraceptives**

- (i) IUDs are suggested as ideal contraceptives for the females but they can have serious side effects.
- (ii) Can cause allergic reaction.
- (iii) If displaced, can cause tissue damage and profuse bleeding.
- (iv) IUDs can damage the normal hormonal balance and later even if desired, pregnancy may not be achieved.
- (v) Artificial intake can disrupt normal hormonal interactions in the body system.

[5]

- 46.** Write the full form of MTP. In what circumstances it is recommended?

**Ans.** Full form of MTP is Medical Termination of Pregnancy.

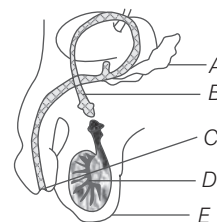
**Circumstances** It is recommended for a woman has become pregnant and the couple does not want to have the child or if there is definite evidence of any serious genetic disease in the embryo based on a special test. This method should not be considered a contraceptive method, but as a last step that can be taken. This operation (induced abortion) should be performed only by a trained doctor at a hospital.

Abortion is legally permitted (only within 12 weeks of pregnancy) and can be requested by any desirous female at any government hospital at no cost. For this, even husband's consent is not necessary.

[5]

**Diagram Based Questions**

- 47.** The diagram given below represents a surgical sterilisation method in males. Study the same and answer the questions that follows.



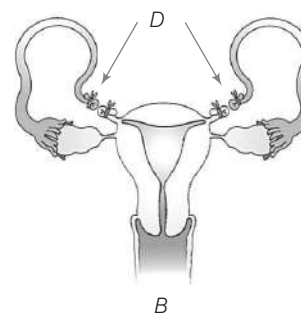
- (i) Name the parts marked *A*, *B*, *C*, *D* and *E*.
- (ii) Give the name of the surgical method represented in the diagram.
- (iii) Which part is ligated or cut?

**Ans.** (i) Parts labelled from *A* to *E* are marked as

- A* – Seminal vesicle
- B* – Sperm duct or vas deferens
- C* – Urethra
- D* – Testis
- E* – Scrotum

- (ii) Vasectomy
- (iii) Sperm duct or vas deferens is the part that is ligated and cut.

- 48.** Observe the figure given below and answer the following questions



- (i) Name the process represented by figure *B*.
- (ii) List atleast one advantage of these processes.
- (iii) Name the part ligated in this process and why?

**Ans.** (i) Figure *B* represents tubectomy.

- (ii) It helps to control population number.
- (iii) Part ligated in females is oviduct (Fallopian tube) in order to prevent the fusion of egg with the sperms, thus avoiding pregnancy.

# CHAPTER EXERCISE

## Multiple Choice Questions

1. Identify the factor directly responsible for rapid rise in the world population during 20th century.  
(a) Increased food production  
(b) Improved transportation  
(c) Education and awareness  
(d) Antibiotics and vaccinations
2. A mother of a 1 year old daughter wanted to space her second child. What could be the method for this?  
(a) An IUCD  
(b) Tubectomy  
(c) Oral pills like Saheli  
(d) Both (a) and (c)
3. Chemical method of birth control is  
(a) diaphragm  
(b) spermicide  
(c) condom  
(d) None of the above

## Answers

1. (a) 2. (d) 3. (b)

## Fill in the Blanks

4. Fill in the blanks to complete the following statements.  
(i) The size of a population for any species depends on .....  
(ii) An expected reason for population explosion is the increased number of individuals in ..... age.  
(iii) Government of India legalised MTP in ..... .

## True-False

5. Correct the following statements.  
(i) Emigration is the number of individuals who enter into a habitat from elsewhere.  
(ii) Periodic (around every 100 years) enumeration of a population is census.  
(iii) Urbanisation is threatening the extinction of non-renewable natural resources.

- (iv) Sustainable development permits the excess use of available resources.
- (v) Saheli, an oral contraceptive pill was developed by CDRI, Lucknow.
- (vi) Surgical methods of contraception prevent gamete formation.

## Match the Columns

6. Match the following columns.

Column I	Column II
A. Mala-D	1. Chemical Method
B. LNG-20	2. oral contraceptive
C. Spermicide	3. IUCDs
D. Vasectomy	4. Surgical method

## 1 Mark Questions

7. Rewrite the correct form of the statement by inserting a suitable word/words at the right place. Do not delete any word already given in the statement.

Death rate is the number of deaths of the given population per year.

8. What is population explosion?
9. How do hormonal pills work as contraceptives?

Or

How do oral contraceptive pills act in a human female? Explain.

10. Give reason.

Sterilisation techniques are generally foolproof methods of contraception with least side effects. Yet, this is the last option for the couples. Comment.

## 2 Marks Questions

11. Mention two reasons for the high birth rate in India.
12. What is the role of government policies in population explosion?
13. Explain spermicides. Also mention their use and mode of contraceptive action.

- 14.** Spacing between children is considered as a good practice for population control. Comment.

### **3 Marks Questions**

- 15.** Explain the following terms.  
(i) Death rate or mortality  
(ii) Sustainable development
- 16.** How rising population is a pressure on natural resources?
- 17.** List any three advantages of small family.

### **4/5 Marks Questions**

- 18.** (i) Write a short note on sustainable development.  
(ii) A census is an important parameter of population number. Comment. [4]
- 19.** Give a suitable term for the following  
(i) The difference between birth rate and death rate.  
(ii) In a population, individuals present in different age groups.  
(iii) Condoms, cervical caps and diaphragm  
(iv) Induced abortion  
(v) A movement of population from its area that reduces the number of particular species. [5]

# ARCHIVES\*

## (Last 7 Years)

Collection of Questions Asked in Last 7 Years' (2018-2012) ICSE Class 10th Examinations

### 2018

1. Give appropriate biological or technical term for the following.  
The difference between the birth rate and the death rate. [1]
2. Give biological explanation for the following.  
Education is very important for population control. [1]

### 2017

3. Differentiate between the following pairs on the basis of what is mentioned in brackets.  
Demography and population density (definition) [1]
4. Choose the correct answer from each of the four options given below  
Surgical method of sterilisation in a woman involves cutting and tying of  
(a) ureter (b) uterus (c) urethra (d) oviduct [1]
5. State whether the following statement is true or false. If false, rewrite the correct form of the statement by changing the first word only.  
Tubectomy is the surgical method of sterilisation in man. [1]
6. Explain the term growth rate of population. [1]
7. Give reason for the following  
There is a need to check the present rate of urbanisation. [1]

### 2016

8. Name the number of individuals inhabiting per unit area. [1]

### 2015

9. Give the biological/technical term.

The number of persons living per square kilometer at any given time. [1]

10. Differentiate between the following parts on the basis of what is mentioned within brackets.  
Tubectomy and vasectomy (part cut and tied) [1]
11. Explain the term 'natality'. [1]
12. State two reasons for the increase of population in India. [1]

### 2014

13. Write any two major reasons for the population explosion in India. [1]
14. Give the biological/technical term for the following  
Statistical study of human population. [1]
15. Give the technical term for a method of a contraception in which the sperm duct is cut and ligated. [1]

### 2013

16. Write any two major reasons for the population explosion in the world. [1]
17. Differentiate between the following pair on the basis of what is mentioned in bracket.  
Vasectomy and tubectomy (explain). [1]

### 2012

18. Differentiate between the natality and mortality (definition). [1]
19. Write any two major reasons for the population explosion in India. [1]
20. Give the biological /technical term for the following  
Statistical study of human population. [1]

\* Explanations/Answers to all these questions are given in the Chapter Theory and Exam Practice.

# CHALLENGERS\*

## A Set of Brain Teasing Questions for Exercise of Your Mind

(Q.-No. 1-4). Choose the correct option.

- 1 Birth control methods may be hormonal, mechanical or surgical. Choose the correct option that contains example of these birth control methods.

	Hormonal	Mechanical	Surgical
(a)	Condom	Spermicide	Rhythm
(b)	Intrauterine Device (IUD)	Rhythm	Condom
(c)	Pill	IUD	Vasectomy
(d)	Vasectomy	Pill	Spermicide

- 2 Which method of contraception can provide protection against transmission of AIDS, syphilis and gonorrhoea?

- (a) Condoms (b) Female sterilisation (tying oviducts)  
(c) Male sterilisation (cutting sperm ducts) (d) Oral contraceptive pills

- 3 Which of the following is not a problem due to urbanisation?

- (a) Pollution (b) Sanitation and sewage  
(c) Mental health diseases (d) Illiteracy

- 4 The table shows the average pregnancy rates amongst couples using different methods of contraception.

Contraception method	Average number of pregnancies per 1000 couples per year
Condom	55
Contraceptive pill	4
Rhythm method	125
Spermicide	80

Which type of contraception is the least reliable?

- (a) Chemical (b) Hormonal (c) Mechanical (d) Natural

- 5 A female was advised to undergo MTP, because it was diagnosed by her doctor that her foetus has developed from a zygote formed by an XX-egg fertilised by Y-carrying sperm. Why was she advised to undergo MTP?

- 6 A rapid increase in population of the world is seen between 1900-2000.

It was less than a billion in 1900 and then 7 billion today. Write down the contribution of medical science for this drastic increase of population size.

- 7 Some great authors has said that a population explosion is far more dangerous than an atomic explosion. Justify this statement.

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 306.

# Human Evolution

Evolution is the sequence of gradual changes from simple life forms to complex life forms, i.e. from primitive organisms that lived over millions of years ago to new organisms that exist today. Human beings are the most recent and most highly evolved among these organisms. In this chapter, we will study various theories of evolution and evolution of human.

## Theories of Evolution

A number of theories have been put forward to explain the pattern of evolution leading to formation of new species. The important theories of evolution are described below

### Lamarck's Theory of Evolution (Lamarckism)

- **Jean Baptiste de Lamarck** proposed his idea of evolution in 1809 in his book *Philosophie Zoologique*. It is popularly known as **the inheritance of acquired characters**.
- He proposed that the changes in structure or function of any organ acquired during the lifetime of an organism in response to changes in surrounding environment are inherited by its offsprings. These acquired characters are keep on adding up over a period of time. These changes lead to the origin of new species.

### Postulates of Lamarckism

Lamarckism is based on following postulates

- (i) **Tendency to increase in size** Organism and their organs have natural tendency to continuously increase in size, generation after generation.
- (ii) **Direct effects of the environment** Continuous changes in the environmental conditions directly influence the nature, habits, ways of living of an organism and their structural organisation.
- (iii) **Use and disuse of organs** Changes in the environment create new needs in living organisms. To meet these new needs, certain organs are being used greatly and certain organs are lesser used or disused. The continuous use of an organ keeps it functional and makes them stronger and more efficient. Continuous disuse of an organ leads to gradual reduction in its size and final disappearance.

### Chapter Objective

- Theories of Evolution
- Lamarck's Theory of Evolution (Lamarckism)
- Darwin's Theory of Natural Selection (Darwinism)
- Human Evolution
- Characteristics of Human
- History of Human Evolution

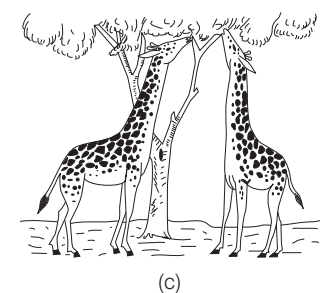
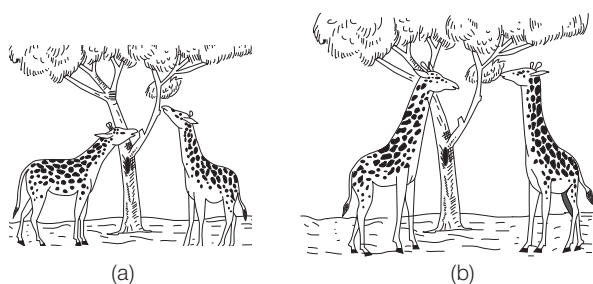
- (iv) **Inheritance of acquired characters** The characters acquired by an organism during its lifetime are inherited by the next generation. In every generation some new characters were acquired and older characters keep on improving. After several generations, the species gets modified into a new one.

## Evidences of Lamarckism

There are following evidences of Lamarckism

- (i) **Evolution of long neck in giraffe** Lamarck postulated that the ancestors of giraffe had short neck and forelimbs who used to graze on grass. Due to changed environment, these areas became arid. The vegetation was gradually replaced by tall trees. To obtain leaves for food they had to stretch their neck and forelimbs which resulted in elongation of these parts.

Constant stretching led to the elongation of neck and forelimbs in giraffe. This change was transmitted to the next generation. This in due course of time resulted in present day long neck of giraffe.



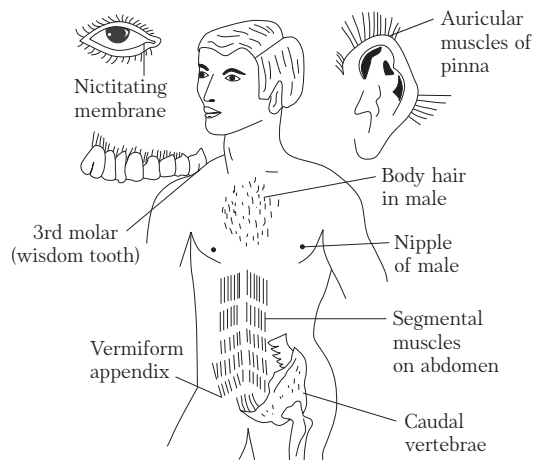
Evolution of long neck in giraffe

- (ii) **Vestigial organs** The organs which are present in reduced form and do not perform any function in the body are called vestigial organs. They correspond to the fully developed functional organs of related animals. They are believed to be the remnants of organs which were complete and functional in their ancestors, e.g. nipples in male, splint bones in hindlimb of horse, etc.

In human beings, there are about 90 vestigial organs. Some of these are as follows

- (a) **Wisdom teeth** The third pair of molars are vestigial in humans. They erupt late in life and sometimes they even fail to erupt.
- (b) **Vermiform appendix** The human appendix is the remnant of caecum. It is large and functional in herbivore animals. It contains bacteria that produce cellulase enzyme for the digestion of cellulose. The presence of non-functional appendix in man indicates that the ancestors of man had a diet rich in cellulose. The changed food habits over time led to the reduction of these organs in present day man.
- (c) **Muscles of pinna** External ear of human is called pinna. Many mammals move their pinna for collecting sound waves from the atmosphere.

This part is non-functional in humans.



Vestigial organs in human body

## Criticism of Lamarckism

Lamarckism or theory of inheritance of acquired characters was discarded due to the following reasons

- (i) Blind, deaf and lame parents do not produce abnormal (blind, deaf or lame) offsprings.
- (ii) Wounds of parents do not appear in their offsprings.
- (iii) Despite of use of iron shoes to keep their feet short by Chinese women, their young ones at birth have normal feet size.
- (iv) **Weismann** removed the tail of mice continuously for 22 generations, but he was failed to obtain tailless mice till 22nd generation.

## Darwin's Theory of Natural Selection (Darwinism)

**Charles R Darwin** (1809–1882) was a British naturalist. He postulated the 'theory of origin of species by natural selection' which is based on several facts, observations and deductions. It is popularly known as Darwinism. Of the various theories, Darwinism is the most widely accepted theory because it provides a convincing explanation. During his voyage on Galapagos Islands by HMS Beagle ship, Darwin observed various types of plants and animals. The credit of 'Natural Selection Theory' goes to **Charles Darwin** and **Alfred Russel Wallace**.

In 1859, Charles Darwin published his observations and conclusions in a book '**Origin of Species**'.

### Postulates of Darwinism

Darwin's theory of organic evolution by natural selection is based on following principles

- (i) **Overproduction** (Rapid multiplication) All organisms possess enormous fertility. They multiply in a geometric proportion with some organisms producing very large number of species. Despite of this high rate of reproduction of a species, its number remains constant under fairly stable environment.

#### Some Examples of Overproduction of Some Animals

Organism	Eggs/Young ones (whole number)
Female Salmon	28000000 eggs/season
Oyster	60-80 million eggs/yr
Codfish (Ovaries)	10 million eggs
Elephant	6 offsprings/entire life
Rabbit	24 offsprings/yr

- (ii) **Struggle for existence** The limited resources present in an environment are the main cause of struggle for existence, which may occur at following three levels
  - (a) **Intraspecific struggle** It is the struggle among the individuals of same species for their common requirements like food, shelter, mate, breeding places, etc. Intraspecific struggle is very severe, e.g. young trees in a forest, cannibalism (eating individual of its own species), human wars, etc.
  - (b) **Interspecific struggle** It is the struggle between the individuals of different species for their similar requirements like food and space. For example, a frog feeds on insects and is preyed upon by snakes while kite feeds on both frogs as well as snakes.

- (c) **Environmental struggle** It is the struggle of living forms against the environmental conditions like extreme heat, cold, drought, earthquakes, storms, disease, volcanic eruption, etc.

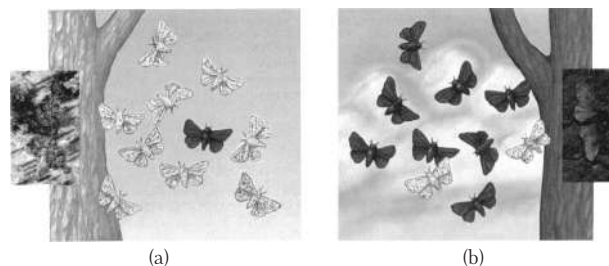
- (iii) **Appearance of variations** All individuals are dissimilar in some of their characters except the identical twins. This dissimilarity is mainly due to the variations. These are the small or large differences among the individuals. Variations allow some individuals to better adjust with their environment.
- (iv) **Natural selection or Survival of the fittest** The organisms which are provided with favourable variations would survive, while the unfit are destroyed. Originally it was an idea of **Herbert Spencer** (1820-1903) who used the phrase 'survival of the fittest' first time, while **Darwin** named it natural selection. Survival of the fittest refers to the idea that the natural selection tends to favour those organisms that are most fit to survive with the reproductive age in a particular environment and to produce offsprings. A popular example of natural selection is industrial melanism.

### Industrial Melanism

Industrial melanism in peppered moth (*Biston betularia*) is an example of natural selection. In England 1850s, before industrialisation there were more white-winged moths on trees than dark-winged or melanic forms. But after industrialisation, i.e. in 1920, dark-winged moths became more than white-winged moths.

This is because during industrialisation, the tree trunks covered by white lichens became dark due to air pollution (dust and soot particles).

Due to this, white-winged moths could be easily seen and eaten by the predators as they failed in camouflaging (hide or disguise the presence of a person, animal or object). This shows that in a mixed population, those that can better adapt, survive and increase in population size.



(a) Original population; 10% dark-coloured phenotypes  
(b) Several generations later; 80% dark-coloured phenotypes

## Evidences of Natural Selection

It has the following evidences

- (i) Rate of reproduction, limitation of resources, competition and struggle for existence can be seen in nature normally.
- (ii) Abundance of variation is evidenced by the absence of two similar individuals except monozygotic twins, which also shows some environmental variations.
- (iii) Production of new varieties of plants and animals through artificial selection. These show evidences that the nature having vast resources can easily produce new species through the natural selection.

## Criticism of Darwin's Natural Selection Theory

Darwin's theory was widely accepted, but Sir Richard Owen and Adam Sedgewick criticised it due to following reasons

- (i) Darwin emphasised on the **inheritance of small variations**, which are mainly non-heritable and useless for evolution.
- (ii) He could not explain the presence of vestigial organs and effect of their use and disuse.
- (iii) Darwinism failed to explain the survival of the fittest.
- (iv) Natural selection failed to explain the evolution of terrestrial animals from the aquatic organisms.
- (v) Natural selection failed to explain some adaptations such as electric organs of fish, mimicry in Karama butterfly, etc.
- (vi) Darwin was unaware about the knowledge of heredity.
- (vii) Darwinism does not account for the degeneration of certain animal organs.

### CHECK POINT 01

- 1 In which book Lamarck proposed the theory of evolution?
- 2 According to Lamarck, acquired characters are .....
- 3 Name the vestigial organs present in human.
- 4 Name the ship by which Darwin travelled?
- 5 Theory of natural selection is given by .....

## Human Evolution

Human is the wisest creature on the Earth. Some people consider human beings as a supreme creation. Biologists explain human just another animal based on its body structure and working. **Carolus Linnaeus** placed man among the monkeys and apes. **Charles Darwin** stated that man was

one more animal species whose origin and evolution could be traced just like that of any other species.

He published his idea about human ancestry in the book '*Descent of Man*' and '*Selection in Relation to Sex*'. He suggested that man, apes and monkeys have a common ancestor.

The unique qualities of human are language, advanced thoughts and culture evolved through the natural selection.

The course of human phylogeny like other mammals can be followed only from the fossil records.

Human beings belong to a single family (Hominoidae), a single genus (*Homo*), a single species (*sapiens*), a single sub-species (*sapiens*) and four races (Mongoloid, Negroid, Caucasoid and Australoid).

## Characteristics of Human

The modern man shows the following characteristic features, which acquired during the course of evolution

1. **Large brain and cranial cavity** Man has extra ordinary large brain and high intelligence. The volume of cranial cavity is more (1450 cc) in human than apes and monkeys.
2. **Upright posture** Upright posture is due to major changes in musculo-skeletal system consequently, legs became longer for balancing the body, abdominal region became short, thorax became broad and flat.
3. **Bipedal locomotion** Due to bipedal locomotion, forelimbs or hands are free to do other functions.
4. **Forelimbs** The forelimbs evolved into efficient grasping and manipulating devices for carrying things, making tools and hurling weapons.
5. **Opposable thumb** (Dexterity) During evolutionary change in human, thumb (pollex) has been brought opposite to fingers enabling the hand for better grasping power.
6. **Orthognathous face** In *Homo sapiens*, face is orthognathous with protruding canines of the lower jaw, whereas ape's face is prognathous, i.e. protruded out into a short of muzzle.
7. **Binocular vision** Human beings possess binocular and stereoscopic vision, which enables the depth perception and distance estimation.
8. **Loss of body hairs** Body hairs are present as a vestigial form.

## History of Human Evolution

The study of living and fossil primates shows that the primates (including monkey and man) has descended from a common ancestor and separated from the main stock (of a hominisation) during Oligocene period. Fossil records are the best evidence which show intermediate steps between apes and man.

The evolutionary history of man can be divided into following three steps only for the convenience of study

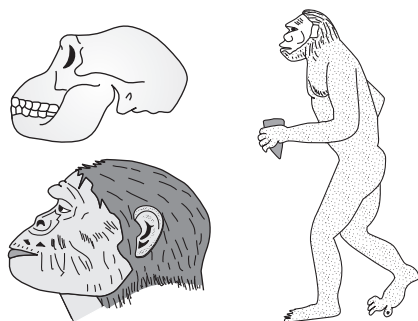
1. Prior to Ape man.
2. Ape man (including prehistoric man).
3. True man (including the living modern man).

The fossil records prior to Ape man include

- **Dryopithecus** Common ancestor of man and apes.
- **Ramapithecus** Earliest man-like primate or first hominoid.
- The various fossil records of Ape man are as follows

### *Australopithecus* (First Ape Man)

- Its height was 1.5 m and had both human and ape's characters.
- It was fully bipedal **hominid**.
- It lived from 4-1.5 million years ago in caves during Pleistocene period.
- It was of erect posture and had omnivorous diet.
- Its cranial capacity volume (brain size) was 500-700 cc, i.e. equivalent to modern gorilla.
- Brow ridges projected over the eyes and lacked chin.
- Distinct lumbar curve was present in vertebral column.



**Australopithecus**

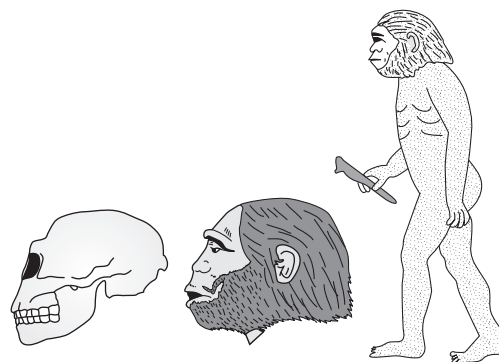
- Its thighs and hips were adapted for erect standing, walking and running.
- Its arms were somewhat less mobile than ours and pelvis was broad.

- Its ankle bones were intermediate between human and ape.
- It had protruding jaws and modern man-like teeth.
- Its face was prognathous having larger jaws and teeth than modern man.

### *Homo habilis*

(Skillful man or Tool maker)

- *Homo habilis* was about 1.2-1.5 m tall, which lived in Africa about two million years ago.
- Its cranial capacity was 700-800 cc.
- *Homo habilis* was carnivorous and they possessed small canines.
- *Homo habilis* lived in small community or groups in caves.
- Perhaps they showed sexual division of labour and communicated with visual signals and simple audible sounds.
- They were more erect than *Australopithecus* and showed bipedal locomotion.

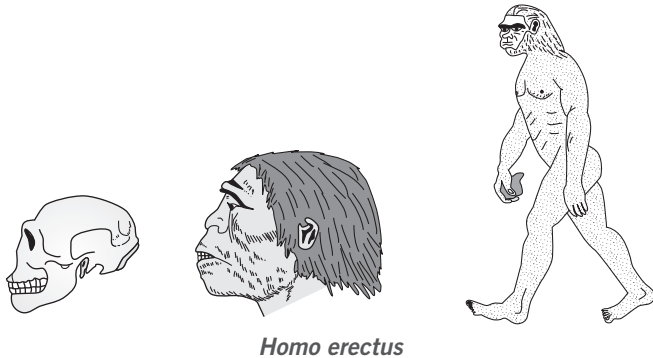


***Homo habilis***

### *Homo erectus* (Erect or Java man)

- They were the oldest known early human to have modern human-like body proportion.
- *Homo erectus* was about 1.55 - 1.75 m tall.
- Its cranial capacity was 900-1300 cc.
- They were the first human species to have fleshy nose. They had flat skull with prominent ridges over the brow.
- They had short arm and long legs. The short arms depict that the tree climbing ability was lost completely in them. The long legs depict that they are better suited for long distance migrations.
- They were the first one to walk upright and stood erect thus, named so. Also known as *Homo ergaster*.

- Their forehead was receding, jaws were still projecting and chin was absent.
- They were the first hominid to live in hunter-gatherer society.

*Homo erectus*

### *Homo sapiens neanderthalensis* (Neanderthal man)

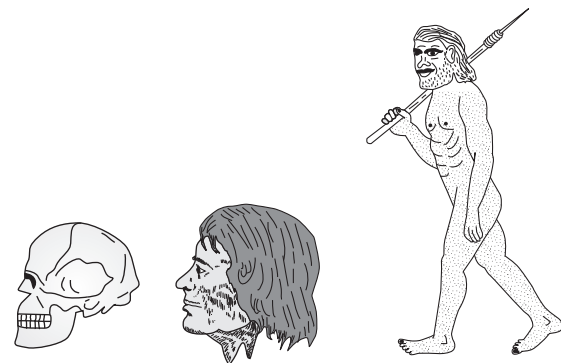
- Neanderthal man existed in the late Pleistocene period.
- Neanderthal walked upright with bipedal movement.
- The face was slightly prognathous and had low brows, receding jaws and high domed heads.
- The cranial cavity of neanderthal man was 1300-1600 cc, average 1450 cc.
- The jaw was deep with no chin and skull bones were thick.
- Culturally, these were more advanced than Java and Peking man.
- They killed the large animals by group attack and used knives to butcher.
- Neanderthal man was omnivorous and cannibal, who used fire for cooking and warmth. They used animal skin as clothing to protect themselves and adapt to the cold environment.



Neanderthal man

### *Homo sapiens fossilis* (Cro-Magnon man)

- Cro-Magnon man was almost similar to modern man with about 1.8 m height, orthognathous face, broad and arched forehead, strong jaws, elevated nose and well-developed chin as well as dentition.
- Cranial capacity was about 1650 cc, i.e. much more than modern man (1450 cc).
- They were more intelligent than modern man.
- They were intelligent, hard worker, swift footed and cave dweller hunters.
- They could run fast and lived in families.
- They used spears, bows and arrows as tools, which were made up of stones, bones or elephant tusks.
- They were omnivorous and wore skin clothes.
- Probably they succeeded from neanderthal man and distributed in Africa, Europe and Middle East.
- Cro-Magnon lived during old stone age which is also known as Palaeolithic (began more than 2 million years ago).

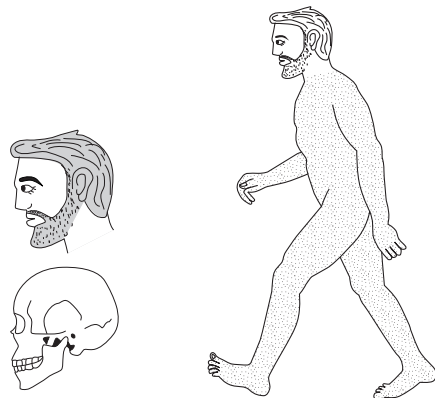


Cro-Magnon man

### *Homo sapiens sapiens* (Living Modern Man)

- Its cranial capacity is average 1450 cc, which is lesser than Cro-Magnon.
- Its limbs are straight and arms are shorter than legs.
- It shows erect posture with upright head with complex cerebral hemispheres and cerebellum.
- It is distinguished from Cro-Magnon merely by slight raising of skull cap, reduction in volume of cranial cavity (1300-1600 cc), thinning of skull bones and formation of four curves in the vertebral column.

- Human species (*sapiens*) have white or Caucaroid, Mongoloid and black or Negroid races.
- Forehead steep, reduced brow ridges, well-developed chin.



Modern man

- Note**
- it is believed that **Neanderthal** man had the concept of life and death and followed rituals. It is also believed that they buried **dead bodies**.
  - **Cro-Magnon man** made extraordinary paintings on the cave walls, which represent a reindeer, bison and wild bear.
  - **Homo habilis** is called as the first tool maker because he had developed the most primitive stone tools.

### Future Man (*Homo futuris*)

The organic evolution is a continuous process of nature, which is still continued at present and probably will remain in future too. It is believed that in future, human could be changed as a result of the factors like **gene mutation**, **gene recombination** and **natural selection**.

According to the forecasting of **HL Shapiro**, an American anthropologist, the future man (named *Homo futuris*) will possess following characteristics

- (i) Height will be higher.
- (ii) Hair will reduce and skull may become dome-shaped.
- (iii) Body and cranium will be more developed.
- (iv) The fifth finger probably may reduce.
- (v) The age will increase.

### CHECK POINT 02

- 1 Among the human ancestors, the brain size was more than 1000 cc in .....
- 2 Which man is known as the tool maker?
- 3 Which hominid is also known as *Homo ergaster*?
- 4 Write the two characteristics of erect man.
- 5 Cro-Magnon man was present in which age?
- 6 Mention the scientific name of modern man.

# SUMMARY

- The term 'Evolution' was first used by Herbert Spencer in 1852.
- Lamarck (1809) proposed a theory (Lamarckism) that states living things change by inheriting acquired characteristics, e.g. giraffes stretched their necks to reach food and their offspring inherited stretched necks.
- Lamarck's theory was the first to admit that species changed due to use and disuse of organ and tried to explain it.
- Some evidences in support of Lamarckism are that radish is a biennial crop in cold countries, but it completes its growth in a year in tropical areas. Also European peach, which is deciduous, becomes evergreen in India.
- Charles Darwin (1859) published the book Origin of Species by Means of Natural Selection or the preservation of favoured races in the struggle for life, which has been recognised as one of the most important books ever written. A very similar theory was also proposed by Alfred Wallace.
- Essentially, Darwin suggested that random variations take place in living things and that some external agent in the environment selects those individuals which are better able to survive (survival of the fittest). The method of selecting individuals is known as natural selection.
- Some evidences in favour of the theory of natural selection came from modifications seen in the beaks of finches on Galapagos Island. Also pedigree of some animals like horse, camel, etc. supports the theory of natural selection.
- Darwin was criticised by some scientists because his theory fails to explain arrival of the fittest over specialisation of organs, vestigial organs, somatic and germinal variations, etc.
- Human is the wisest creature on the earth whose origin and evolution can be traced just like that of any other species. Few books written on evolution and theories of evolution are Decent of Man by Charles Darwin, Mans Place in Nature by TH Huxley.
- History of human evolution The evolutionary history of man can be divided into three phases, i.e. prior to ape man, ape man and true man.

## Various Stages of Evolution of Human

Name	Cranial Capacity (cm <sup>3</sup> )	Food/Posture (Height)	Important features
<i>Australopithecus africans</i> (first ape-man)	450	Essentially ate fruits, fully erect, 1.5 m	Foramen magnum ventral, canines small, hunted with stone
<i>Homo habilis</i> (the first hominid tool maker)	650-800	Probably did not eat meat, fully erect	Canines small, earliest stone tools, bipedal gait, caveman led to community life
<i>Homo erectus</i> (the erect man and Java man)	800-1000	Probably ate meat 150-180 cm tall	Thick, low forehead, brow ridges, used stone and bone tools and hunted big game
<i>Homo neanderthalensis</i> (the Neanderthal man, first civilised man)	1400	Omnivorous, 1.5-1.66 m tall	Cavedweller, made flint flake tools, used hides as clothes, buried the dead, speech centres had developed, used syllabic language, prognathous face, chin absent
<i>Homo sapiens fossilis</i> (the fossil modern man or Cro-Magnon man)	1650	Omnivorous, 1.8 m	Strong jaws with teeth close together, wisdom teeth, cavedweller, paintings and carvings in caves, had art and culture, orthognathous face, broad pelvic basin, prominent chin
<i>Homo sapiens sapiens</i> (the living modern man)	1300-1600	Omnivorous, 1.5-1.8 m	Backbone with four curves; most intelligent; has art, culture, language

# EXAM PRACTICE

## Multiple Choice Questions

1. Lamarck's theory of evolution is also called as  
 (a) theory of natural selection  
 (b) inheritance of acquired characters  
 (c) survival of the fittest  
 (d) theory of special creation

Ans. (b)

2. Lamarckism fails to explain which of the following phenomenon?  
 (a) Absence of all the four limbs amongst amphibians  
 (b) Exceptionally long neck of giraffe  
 (c) An intellectual person having a dull son  
 (d) Loss of vision in cavedwelling mammals

Ans. (c)

3. Concept of inheritance of acquired characters was disapproved by the experiments of  
 (a) Oparin (b) Weismann  
 (c) Fox (d) Darwin

Ans. (b)

4. Darwin's theory of evolution fails to explain the  
 (a) role of environment  
 (b) origin and transmission of variations  
 (c) overproduction  
 (d) survival of the fittest

Ans. (b)

5. Darwin proposed the theory of origin of species by  
 (a) hybridisation (b) natural selection  
 (c) mutation (d) acquired characters

Ans. (b)

6. The common ancestor to both man and ape is  
 (a) *Australopithecus* (b) *Dryopithecus*  
 (c) *Sinanthropus* (d) *Homo erectus*

Ans. (b)

7. In the evolution of man, *Homo erectus* is considered to be evolved from  
 (a) *Dryopithecus* (b) *Ramapithecus*  
 (c) *Australopithecus* (d) Cro-Magnon

Ans. (c)

8. The false statement about Cro-Magnon man is  
 (a) his cranial cavity was less than *Homo sapiens*  
 (b) he walked erect and was swift

- (c) he was intelligent and cultured  
 (d) he started metal work, painting and farming

Ans. (a)

9. Most of the cave paintings discovered are associated with  
 (a) Cro-Magnon man (b) *Homo erectus*  
 (c) Neanderthal man (d) *Dryopithecus*

Ans. (a)

10. The major advantage of bipedal locomotion is that it  
 (a) increases speed  
 (b) reduces body weight  
 (c) releases the forelimbs for other better functions  
 (d) provides better body support

Ans. (c)

## Fill in the Blanks

11. Complete the following sentences by filling the blanks  
 (i) Weismann discarded the theory proposed by .....  
 (ii) Continuity of existence of the fittest was called ..... by Darwin.  
 (iii) Traits selected for evolution by natural selection are beneficial to .....  
 (iv) The scientific name of Java man is .....  
 (v) *Homo sapiens* arose in ..... .

- Ans. (i) Lamarck (ii) natural selection  
 (iii) species (iv) *Homo erectus*  
 (v) Africa

## True-False

12. State whether the following statements are true or false.  
 (i) Lamarckism states that acquired characters are passed to offsprings.  
 (ii) Natural selection is shown by the reproductive success of the population.  
 (iii) Darwin did not considered minute fluctuating variations as principle factors.  
 (iv) *Australopithecus* were not able to walk upright.  
 (v) Cro-Magnons lacked eyebrow ridges.

- Ans.** (i) True (ii) True  
 (iii) False. Darwin considered minute fluctuating variations as principle factors.  
 (iv) False. *Australopithecus* walked upright.  
 (v) True

## Match the Columns

- 13.** Match the following columns.

Column I		Column II	
A.	First ape-man	1.	<i>Homo erectus</i>
B.	Java man	2.	<i>Homo sapiens fossilis</i>
C.	Cro-Magnon man	3.	<i>Homo futuris</i>
D.	Future man	4.	<i>Australopithecus</i>

**Ans.** A-4, B-1, C-2, D-3

## 1 Mark Questions

- 14.** What is evolutionary biology?  
**Ans.** Evolutionary biology is the study of history of life forms on earth.
- 15.** Define the term organic evolution.  
**Ans.** Organic evolution can be defined as orderly changes in living organisms over the course of generations.
- 16.** Name the book in which Lamarck published his idea of evolution.  
**Ans.** *Philosophie Zoologique*.
- 17.** Mention the name of postulates stated by Lamarck through which an organism acquires new characters.  
**Ans.** (i) Use and disuse of organs.  
 (ii) Inheritance of acquired characters.
- 18.** Who proposed the concept of inheritance of acquired characters?  
**Ans.** The concept of inheritance of acquired characters in support of evolution was proposed by Lamarck. New traits are acquired by organisms during their lifetime and are passed on to the next generation.
- 19.** State one reason due to which Lamarck's theory was criticised.  
**Ans.** Lamarckian theory is also known as theory of inheritance of acquired characters or theory of use and disuse of organs.  
 This theory cannot explain the reason of weak muscles in the son of a wrestler.

- 20.** What was Lamarck's explanation for long neck of giraffe?

**Ans.** According to Lamarckism, long neck and high forelimbs of giraffe were well-developed due to their stretching for obtaining foliage (leaves, etc.) from the trees when ground vegetation became sparse.

- 21.** Give the biological term used for organs present in reduced form and do not perform any function.

**Ans.** Vestigial organs.

- 22.** Name a vestigial organ found in horse.

**Ans.** Splint bones in the hindlimbs are vestigial in horse.

- 23.** Choose the odd one in the following series. Wisdom tooth, nictitating membrane, vermiform appendix, vertebral column.

**Ans.** Vertebral column is the odd one. This structure is well-developed and functional in humans. Rest of the options represent vestigial organs that are non-functional.

- 24.** What is fitness according to Darwin?

**Ans.** The fitness according to Darwin refers ultimately to reproductive fitness.

- 25.** Name the scientist who also came to similar conclusion as Darwin. Where did he work?

**Ans.** Alfred Wallace. He worked in Malay Archipelago.

- 26.** Mention the two key concepts of Darwinism.

**Ans.** (i) Branching descent  
 (ii) Natural selection.

- 27.** Explain the meaning of survival of the fittest.

**Ans.** The ability to survive and to reproduce in their respective environment is termed as survival of the fittest.

- 28.** Differentiate the term on the basis of what is mention in the bracket.

Lamarckism and Darwinism (Definition).

Lamarckism	Darwinism
Proposed by Lamarck.	Proposed by Darwin.
New individuals are formed due to the inheritance of acquired characters.	New individuals are formed by the accumulation of variations.

- 29.** What are fossils?

**Ans.** Fossils are the remnants and/or impressions of the life forms that lived in the remote past.

- 30.** Given below are the sets of five terms. Rewrite the terms in a logical sequence of occurrence as who evolved first in the course of evolution.  
Skillful man, Cro-Magnon man, Erect man, Neanderthal man

**Ans.** The correct order of these evolutionary terms is Skillful man, Erect man, Neanderthal man, Cro-Magnon man.

## **b** 2 Marks Questions

- 31.** What does the inheritance of acquired characters mean? Who gave this idea?

**Ans.** Inheritance of acquired characters means organs used more extensively would enlarge and become more efficient and such changed characteristics (acquired traits) would be transmitted to the offsprings. This idea was the central theme of Lamarckism.

- 32.** Which traits are important for evolution?

**Ans.** Inherited traits are important for evolution because these traits are transferred from generation to generation. Accumulation of inherited traits of variations for several generations can give rise to new species. While retention of inherited traits of similarities for generations maintain integrity of an existing species.

- 33.** Natural selection operates when nature selects for fitness. Explain.

**Ans.** Nature selects for fitness based on the characteristics which are inherited. So, there must be a genetic basis for getting selected and to evolve; in other words, there are some organisms which are better adapted to survive in an otherwise hostile environment. Adaptive ability is inherited and it has a genetic basis; hence, fitness is the end result of the ability to adapt and get selected by nature.

- 34.** Explain Darwin's concept of natural selection.

**Ans.** According to Darwin's concept of natural selection, the organisms, which are provided with favourable variations would survive because they are fittest to face their surrounding, while the organisms, which are unfit for surrounding variations are destroyed.

- 35.** Which theory of evolution can best explain the process of organic evolution?

**Ans.** The theory of natural selection or Darwinism is an important theory for explaining the process of organic evolution.

Natural selection provides better adaptability to the organisms as it wipes out unfit or less adaptive organisms and thus, helpful for better survival.

- 36.** State the reason for the increased population of dark coloured moths coinciding with the loss of lichens (on tree barks) during industrialisation period in England.

**Ans.** During post-industrialisation period, the tree trunks got dark because of industrial smoke and soot, so the dark coloured moths were able to hide without any risk of predation, survived and increased in population.

White-winged moths did not survive due to increased predation.

- 37.** Who among the *Dryopithecus* and *Ramapithecus* was more man-like?

**Ans.** *Ramapithecus* was more man-like. They walked erect on their hindlegs, ate hard nuts and seeds like modern man and had jaws and teeth similar to humans. They arose from *Dryopithecus*, which was considered to be a common ancestor of man and apes.

*Dryopithecus* was more ape-like and had same length of arms and legs.

- 38.** Try to trace the various components of human evolution (hint : brain size and function, skeletal structure, dietary preference, etc).

**Ans.** With time, the brain size increased quite significantly. Skeletal structures has changed from ape-like, i.e. from a projecting jaw to broad forehead, a well-developed chin, semi-erect posture provided the ability to walk on their two hindlimbs.

## **c** 3 Marks Questions

- 39.** Describe Lamarck's theory of evolution.

**Ans.** Lamarck's Theory It is known as theory of inheritance of acquired characters.

According to this theory, organisms undergo certain changes to adapt themselves to the environment.

These characters acquired by an organism during its lifetime, are passed on to the progeny, e.g. the long neck of giraffe was explained by Lamarck, as an outcome of these animals having to stretch their necks constantly to eat the leaves on the upper branches of the trees.

**40.** Differentiate between inherited and acquired traits.

**Ans.** Differences between inherited and acquired traits are as follows

Inherited traits	Acquired traits
These are obtained from the parents.	These are developed during the life of an individual.
These are genetic variations.	These are somatic variations.
These develop due to crossing over phenomenon and mutations.	These develop due to use and disuse of organs and direct effect of environment.
These are passed on from one generation to the other.	These are lost with the death of the individual.

**41.** Explain how vestigial organs give an idea about evolution.

**Ans.** Those organs, which no longer have a function in our body are known as vestigial organs. These organs have reduced structurally as well as functionally. It appears that these organs were once well-developed and functional in ancestors and later on due to their less use they become reduced, e.g. vermiform appendix in man is reduced and functionless while in herbivores vermiform appendix along with caecum is used for digestion of cellulose. It gives an idea that human had herbivorous food habit and cellulose containing materials were major part of their food.

**42.** Name the ancestors of man based on the features given below

- Human-like meat eater with 900 cc brain, lived in Java.
- More human with brain size 1400 cc, lived in Central Asia, used hides and buried their dead.
- Human-like, vegetarian, with brain capacity between 650 cc and 800 cc.

**Ans.** (i) *Homo erectus*

(ii) Neanderthal man

(iii) *Homo habilis* [1 × 3]

**43.** (i) When and where did Neanderthal man live?

(ii) What was his brain capacity?

(iii) Mention the advancements he showed over *Homo erectus*.

**Ans.** (i) Neanderthal man lived in near East and Central Asia, between 100000- 40000 years before.

(ii) His brain capacity was 1400 cc.

(iii) He used hides to protect the body. He buried the dead. His brain size was more (1400 cc) than that of *Homo erectus* which was 900 cc. [1 × 3]

**44.** All human races like Africans, Asians, Europeans, Americans and other might have evolved from a common ancestor. Give a few evidences in support of this view.

**Ans.** On the basis of time dating, study of fossils and molecular phylogeny involving DNA sequences, it is clear that all humans belong to a single species, *Homo sapiens*. Two other subspecies namely, *Homo sapiens neanderthalensis* and *Homo sapiens fossilis* were also evolved, but disappeared shortly due to geological and climatic changes. We have all come from Africa. Due to vast geographical distribution and different environmental conditions prevailing at different areas, phenotypic variations can be seen, instead of being member of a single species.

### d 4/5 Marks Questions

**45.** (i) Who gave the theory of inheritance of acquired characters?

(ii) Which book he had written?

(iii) Write the main essence of his theory?

(iv) Why his theory was criticised?

**Ans.** (i) Jean Baptiste de Lamarck gave the theory of inheritance of acquired character.

(ii) '*Philosophie Zoologique*' was the book written by Lamarck.

(iii) The main essence of his theory is:

Environment keeps changing and creates new needs. Organisms acquire new habits (involving use and disuse of certain body structures) to meet these new needs of successful living. Useful organs modify and enlarge and disused organs get reduced and gradually disappear. These acquired changes are inherited and give rise to new species.

(iv) Lamarck's theory was criticised because acquired characters are not inherited. Weismann showed that even after cutting the tails of white mice continuously for 21 generations, a tail-less mouse was never born. Thus, the idea of inheritance of acquired characters was not found to be true. [1 × 4]

**46.** Compare Lamarck's and Darwin's theory.

**Ans.** Lamarck's theory says that according to environment, an organ can be used more while others can be useless. Useful organ grows and is inherited while useless organ is gradually lost, giving rise to new species devoid of that organ.

Darwin says that variations arise naturally in a population. Organism with variation best suited for

environment survives, reproduces and forms new species while other become extinct.

These two theories can be compared using giraffe's evolution.

According to Darwin, giraffes had different neck lengths. Those with longer neck were better adapted to eat leaves from trees. Thus, naturally selected and those with shorter necks died out due to starvation.

While Lamarck says, initially all giraffes had smaller necks. When leaves on lower branches of trees were all eaten up, they had to stretch their neck to eat from upper branches. Continued stretching of neck resulted into modern long neck giraffes. [4]

47. The evolutionary story of moths in England during industrialisation reveals, that 'evolution is apparently reversible'. Clarify this statement.

Ans. The peppered moth occurs in two forms, i.e. light coloured (*Biston betularia typica*) and dark coloured (*Biston betularia carbonaria*).

Before industrial revolution only light coloured moths were prevalent. Light coloured moths camouflaged well with the lichens that covered tree trunks, on the contrary dark moths were easy prey on the tree trunks and were very rare.

During the industrial revolution the population of dark coloured moth increased, while that of light coloured moth decreased. This change was due to the burning of coal in factories.

The smoke from the factories killed the lichens and the tree trunks turned black due to the deposition of soot. The black moths had an advantage against soot, therefore, escaped predation by birds while on the other hand, white moths were identified in sharp contrast and become easy prey.

With the progression of industrial revolution the coal was replaced by oil and electricity.

This resulted in reduction of soot deposits on the tree trunk. Gradually, the population of black moth decreased and that of light moth began to increase. [5]

48. (i) Name the primates that lived about 15 million years ago. List their characteristic features.  
 (ii) (a) Where was the first man-like animal found?  
 (b) Write the order in which Neanderthals, *Homo habilis* and *Homo erectus* appeared on the earth. State the brain capacity of each one of them.  
 (c) When did modern *Homo sapiens* appear on this planet?

Ans. (i) *Dryopithecus* and *Ramapithecus*

Characteristics

- (a) They were hairy.  
 (b) They walked like gorillas and chimpanzees.  
 (c) *Ramapithecus* was more man-like while *Dryopithecus* was more ape-like.  
 (ii) (a) East African grasslands.  
 (b) *Homo habilis*, *Homo erectus* and Neanderthals had brain capacities of 650-800 cc, 900 cc and 1400 cc, respectively.  
 (c) During the ice age between 75000-10000 years ago. [4]

## Diagram Based Questions

49. Explain the increase in the numbers of melanic (dark-winged) moths in the urban areas of post-industrialisation period in England.

Or

How does industrial melanism support Darwin's theory of natural selection? Explain.

Or

In England, during the post-industrialised period, the count of melanic moths increased in urban areas, but remained low in rural areas. Explain.

Or



(a)



(b)

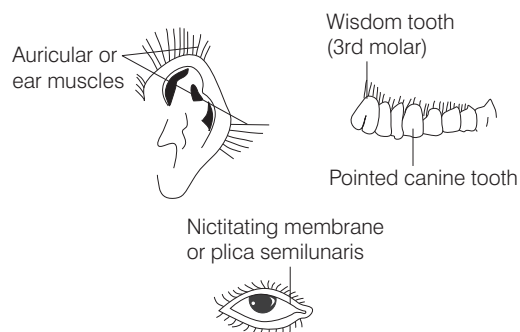
What do these pictures (a) and (b) illustrate with reference to evolution? Explain.

Ans. Industrial Melanism

- In England, before industrial revolution, there were more white-winged or dull-grey moths on the tree trunks, than the dark-winged or melanic moths.
- After industrial revolution, there were more dark-winged moths in the area.

- The explanation given for this observation was that predators will spot a moth against a contrasting background.
- During post-industrialisation period, the trunks became dark with the industrial smoke and soot.
- Under this condition, white-winged moths did not survive as predators could easily spot them, while dark-winged or melanic moths survived better.
- Before industrialisation, there used to be a thick growth of the almost white-coloured lichens on the tree trunks and in that background, the white-winged moths survived better; the dark-coloured moths were easily spotted and picked up by their predators.
- In this case, the moths which were able to camouflage and hide in the background survived and increased their population size through reproduction.

**50.** Given below are the few structures of human body.



- What do these structures called?
- Give any two characteristics of these structures.

**Ans.** (i) These structure are called vestigial organs.

- These are present in reduced or ruminant form in human body. They do not perform any function.

# CHAPTER EXERCISE

## Multiple Choice Questions

1. According to Lamarck, well-developed auricle muscles of rabbit have evolved due to  
(a) continuous use (b) internal vital force  
(c) increasing need (d) All of these
2. Darwin in his 'natural selection theory' did not believe in any role of which one of the following in organic evolution?  
(a) Parasites and predators as natural enemies  
(b) Survival of the fittest  
(c) Struggle for existence  
(d) Discontinuous variations
3. The name *Homo sapiens* can be assigned to  
(a) Java man (b) Peking man  
(c) Shivalik man (d) Cro-Magnon man
4. *Australopithecus* is also known as Southern ape, because it had  
(a) man-like characters (b) ape-like characters  
(c) Both (a) and (b) (d) monkey-like characters

Ans. 1. (d) 2. (d) 3. (d) 4. (c)

## Fill in the Blanks

5. Fill in the blanks with the correct alternative from those given in the brackets.  
(i) According to Darwin, organic evolution is due to ..... competitions.  
(ii) Natural selection operates when nature selects for .....  
(iii) Cro-Magnon lived during ..... age.

## True-False

6. State whether the following statements are true or false.  
(i) Biological evolution is alternative term for organic evolution.  
(ii) Third pair of molar is vestigial in humans.  
(iii) The volume of cranial capacity is less in human than apes.

## Match the Columns

7. Match the following columns.

Column I	Column II
A. Lamarckism	1. Industrial melanism
B. Darwinism	2. Opposable thumb
C. Dexterity	3. Long neck in giraffe

## 1 Mark Questions

8. What was the Lamarck's idea of acquisition of new characters?
9. Name any two vestigial organs in humans.
10. Give an example of branching descent.
11. What does the term binocular vision mean?

## 2 Marks Questions

12. Explain survival of the fittest proposed by Darwin.
13. Differentiate the terms 'orthognathous and prognathous' face.
14. Give any two characteristics of *Homo habilis*.

## 3/4 Marks Questions

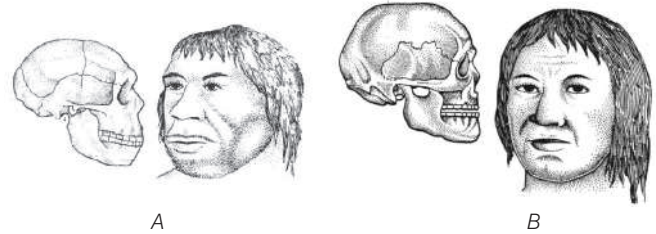
15. Natural selection is directional and variations are directionless. Comment. [3]
16. Comment on the statement that 'evolution and natural selection are end result or consequence of some other processes, but themselves are not processes.' [3]
17. Write the cranial cavity volume of different hominoids mentioned below.  
(i) Java man  
(ii) The first ape-man  
(iii) *Homo habilis*  
(iv) Primitive man  
(v) Modern man [4]

### 5 Marks Questions

- 18.** (i) Explain Darwinian theory of evolution with the help of one suitable example. State the two key concepts of the theory.  
(ii) Mention any three characteristics of Neanderthal man that lived in near East and Central Asia.
- 19.** (i) Name the first human-like hominid. Mention his food habit and brain capacity.  
(ii) Mention any three characteristics of the hominid identified in (i)
- 20.** Give a comparative account of human ancestors.

### Diagram Based Question

- 21.** Among the ancestors *A* and *B*, which can be considered more advanced?



# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 Which type of selection is observed in the moths *Biston bitularia* during industrial melanism?  
(a) Stabilising (b) Disruptive (c) Artificial (d) Directional
- 2 Variations during mutations of meiotic recombinations are  
(a) random and directionless (b) random and directional  
(c) random and small (d) random, small and directional
- 3 The most accepted line of descent is human evolution is  
(a) *Australopithecus* → *Ramapithecus* → *Homo sapiens* → *Homo habilis*  
(b) *Homo erectus* → *Homo habilis* → *Homo sapiens*  
(c) *Ramapithecus* → *Homo habilis* → *Homo erectus* → *Homo sapiens*  
(d) *Homo habilis* → *Australopithecus* → *Ramapithecus* → *Homo erectus*
- 4 Who among *Dryopithecus* and *Ramapithecus* are more man-like.
- 5 Consider the following statements regarding *Australopithecus*.  
I. It was *Homo sapiens neanderthalensis*.  
II. These were intelligent, hard worker, swift footed and cave dweller hunters.  
III. It had prognathous face and high domed heads.  
IV. It lived during old stone (Palaeolithic) age and made extraordinary painting on the cave walls.  
Choose the correct option  
(a) I and II (b) II and IV (c) III and IV (d) II and III

- 6 Match the following columns.

Column I	Column II
A. <i>Homo habilis</i>	1. The cranial cavity was 850-1200 cc.
B. Gibbon	2. The cranial cavity was 1300 cc.
C. Peking man	3. The volume of cranial cavity was 680 cc.
D. Heidelberg man	4. Most primitive and smallest genus of apes.

## Codes

	A	B	C	D
(a)	2	1	3	4
(b)	3	4	1	2
(c)	4	2	3	1
(d)	1	4	2	3

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 306.

# Pollution

## Pollution and its Types

Pollution can be defined as an undesirable change in physical, chemical or biological characteristics of environment which directly or indirectly affect human beings. It is due to addition of any unwanted substance to the environment that may adversely affect the different form of life on earth. Any substance, chemical or other factor that causes pollution is called **pollutant**.

Classification of pollutants on the basis of their existence can be done as follows

- (i) **Quantitative pollutants** Those components which become pollutant when their concentration reaches beyond a threshold value, e.g. CO, CO<sub>2</sub>, NO<sub>2</sub>, etc.
- (ii) **Non-quantitative pollutants** These do not occur in nature, but produced through human activities, e.g. DDT and other pesticides.
- (iii) Pollutants can also be **biodegradable** or **non-biodegradable** (discussed later on).

## Types of Pollution

Pollution is of following five types

1. Air pollution
2. Water pollution
3. Soil pollution
4. Noise pollution
5. Radioactive pollution

### 1. Air Pollution

The presence of any material or gas in the air in such a concentration that can be harmful for human and their environment is called **air pollution**. It occurs due to undesirable changes in the physical, chemical or biological characteristics of air. Air pollutants are of following two main types

- (i) **Particulate pollutants** These are harmful particles such as dust particles, metallic particles, smoke, particles from mining, stone drilling, wearing of rubber tyres, etc, which remain suspended in the air.
- (ii) **Gaseous pollutants** These are harmful gases such as CO<sub>2</sub>, H<sub>2</sub>S, CO, SO<sub>2</sub>, NO<sub>2</sub>, etc, that are given out from the emission of different sources.

### Chapter Objective

- Pollution and its Types
- Air Pollution
- Water Pollution
- Soil Pollution
- Noise Pollution
- Radioactive Pollution
- Greenhouse Effects
- Global Warming
- Ozone Layer Depletion

## Sources of Air Pollution

Air pollution can be caused by **natural sources** like volcanic eruptions, fumes from forest fires, dust from storms, pollens, and **man-made sources** like excessive use of automobiles, garbage, industries, brick kilns, use of leaded petrol, thermal plants, etc. Some of the man-made sources of air pollution are described as follows

- (i) **Vehicular air pollution** All the vehicles which run on petrol and diesel, liberate harmful **gaseous pollutants** mainly  $\text{CO}_2$ ,  $\text{NO}_2$ ,  $\text{SO}_2$  and CO. Besides this, rubber particles released from the wearing of rubber tyres of automobiles and some other dust particles also cause vehicular pollution.
- (ii) **Industrial air pollution** Various small scale industries (like pottery, carpet weaving units, etc.) to large scale industries (such as textiles, automobiles manufacturing units, sugar and food industries, oil refineries, etc.) expel out gaseous and **particulate pollutants** that are responsible for air pollution. The chief industrial gaseous pollutants are  $\text{CO}_2$ ,  $\text{SO}_2$ , CO and oxides of nitrogen.
- (iii) **Burning garbage** Garbage from homes and kitchen wastes include items such as vegetable and fruit peels, polythene bags, etc. These wastes are either used in making manures for agricultural purposes or burnt in enclosures. On burning garbage, harmful gases such as CO and  $\text{CO}_2$ , etc., are released which causes air pollution.
- (iv) **Brick kilns** These are fire-heated enclosures used for making bricks that are used in construction purposes. The wastes produced by these enclosures include large quantity of ash and broken, pieces of bricks, which cause air pollution.

### Smog

The smoke from vehicles, industries, fire, etc., contains oxides of nitrogen that combine with other air pollutants. This leads to the formation of smog. It results in visibility problems and if inhaled, it causes respiratory problems like coughing and asthma.

## Effects of Air Pollution

Harmful effects of air pollution depend on concentration of pollutants, duration of exposure to the pollutants and types of pollutants caused pollution.

- (i) In plants it causes fruit damage, leaf damage, chlorosis, necrosis, mottled spots on leaves, less yield of crops and causes premature death of plants, etc.

- (ii) In humans, it causes respiratory ailments like asthma, hay fever, allergic diseases, etc., cancer and genetic mutations.
- (iii) Carbon monoxide (CO) released as pollutant can combine with haemoglobin thus, preventing the supply of  $\text{O}_2$  to the cells and cause death due to asphyxiation because it leads to damage of the brain.
- (iv) Burning of fossil fuels, exhaust from the automobiles, etc., release  $\text{SO}_2$  and  $\text{NO}_2$  in the atmosphere. These gases are oxidised to sulphuric acid and nitric acid in the air. They get dissolved with the rainwater falling on the earth and forms the **acid rain**.

## Harmful Effects of Acid Rain

- Acid rain is harmful to the environment as it damages the fish and other aquatic life by increasing acidity of water bodies.
- It damages the vegetation by killing the useful soil microbial community.
- Acid in the rain reacts with the calcium of statues, sculpture and ancient monuments and damages them (e.g. damage to Taj Mahal).
- Acid rain damages the aerial parts of the plants and also acidifies the soil. It leads to the production of free radicals and decreases in photosynthesis and productivity.

## Control Measures of Air Pollution

The government of India passed the Air Prevention and Control of Pollution Act in the year 1981. It was meant for the preservation of quality air.

To control air pollution, several ways have been devised. Some of these are

- (i) Compulsory use of electrostatic precipitators, scrubbers, catalytic converters and filters in automobiles and industries.
- (ii) Establishing the industrial areas away from residential occupancy.
- (iii) Use of various unconventional sources of energy like CNG, hydropower, wind, sun, etc.
- (iv) Ban on crackers during festivals, functions, etc.
- (v) Maximum use of public transport, start car-pooling, prefer walk or cycle for short distances, etc.
- (vi) To control high level of air pollution in Delhi, the entire fleet of public transport were converted to run on CNG (Compressed Natural Gas). Also use of unleaded petrol was encouraged.

- Note**
- In CNG, methane is stored at high pressure about 20-25 MPa, usually in cylindrical or spherical shapes.
  - Hybrid vehicle technology produces vehicles which can run on dual mode like petrol and CNG. It reduces consumption of fossil fuels and thus environmental pollution.
- (vii) Engines should be switched off when traffic light signals stop. This helps in reducing vehicular noise as well as the air pollution.

### Euro/Bharat Stage : Standard for Vehicles to Reduce Air Pollution

Bharat stage or Euro norms are emission standards instituted by the government of India to regulate the air pollutants from automobiles.

The main goal of this standard is to reduce sulphur and nitrogen oxides from the automobile exhausts. Any motor vehicle running on the road has to follow emission norms in order to reduce pollution.

These standards, based on European regulations were first introduced in 2000 and have been upgraded since BS-II, BS-III and now BS-IV.

**Table Showing the Latest Mass Emission Standards in India**

Type of Vehicles	Norms	Cities of Implementation
4 Wheelers	Bharat Stage III	Throughout the country since October, 2010
4 Wheelers	Bharat Stage IV	13 Mega cities (Delhi and NCR, Mumbai, Kolkata, Chennai, Bengaluru, Surat, Kanpur, Agra, Lucknow and Sholapur) since April, 2010 and it has been enforced to entire country since April 2017.
3 Wheelers	Bharat Stage III	Throughout the country since October, 2010
2 Wheelers	Bharat Stage III	Throughout the country since October, 2010

In 2016, the Indian government announced that the country would skip the BS-V norms altogether and adopt BS-VI norms by 2020.

### CHECK POINT 01

- 1 What are pollutants?
- 2 Give few examples of gaseous pollutants causing air pollution.
- 3 Mention the harmful effect of smog.
- 4 Name the gaseous pollutants involved in asphyxiation.
- 5 Name the acids present in acid rain.
- 6 Write the expanded form of CNG.
- 7 What is the main goal of Bharat stage emission standard?

## 2. Water Pollution

Water is said to be polluted when its quality gets degraded due to the addition of various inorganic, organic, biological and radiological substances which make it unfit and hazardous to human and all aquatic organisms.

### Sources of Water Pollution

Domestic waste, sewage, soaps and detergents, run-off from agricultural fields having fertilisers and pesticides, industrial wastes, wastes from animal sheds and slaughter houses, oil spills, etc., all constitute the sources of water pollution.

Some of them are discussed here

- (i) **Sewage** The liquid waste released out from domestic activities is called sewage. It includes toilet waste, kitchen, other household wastes water. It is necessary to remove dirty part of water and release clean water into the nearby water bodies and rivers. For this purpose, many big cities have sewage treatment plants.

Small cities and rural areas do not have such facilities and they discharge sewage waste directly into a nearby water body such as rivers and lakes thereby, polluting them. This results in pollution of water at major level.

- (ii) **Household detergents** Detergents or soaps used for household purposes, like washing clothes and utensils and for bathing, release dirty water causes water pollution.

- (iii) **Industrial wastes** Water released both by small scale and large scale industries contains various types of chemical pollutants and other wastes. These industries discharge dirty water directly into the rivers, lakes, etc., and cause water pollution.

- (iv) **Oil spill** These are the accidental discharge of petroleum and their products by oil refineries, overturned oil tanks, offshore oil mining into seas, oceans and estuaries. Oil spreads out rapidly over the water surface to form a thin layer called oil stick. This cuts off the interaction between the air and water. Due to oil pollution, many aquatic life forms are killed.

- (v) **Thermal pollution** Water used in oil refineries, nuclear power plants and other thermal power plants are released into the nearby streams. The water released by industries is warmer than the normal water of streams.

Due to this temperature change, the aquatic life forms get affected.

- (vi) **Agricultural Run-off** The run-off from agricultural land is polluted with pesticides and fertilisers. It enters the water sources by seeping through the soil to groundwater or entering streams as surface run-off.

## Effects of Water Pollution

The various effects of water pollution are given below

- (i) Sewage, fertiliser and agricultural run-off contain organic materials, when discharged into water, it increases the growth of algae, which causes the depletion of oxygen. The low oxygen levels in water resulting in the death of aquatic animals.
- (ii) Industrial chemicals and agricultural pesticides that end up in aquatic environments can accumulate in fish that are later eaten by humans.  
Fish are easily poisoned with metals that are also later consumed by humans. Mercury has been found to interfere with the development of the nervous system in foetus and young children.
- (iii) **Oil spills** in the water causes animal to die when they ingest it. Oil does not dissolve in water and it forms layer on water which prevents the oxygenation of sea water, which affects the aquatic organisms.
- (iv) **Eutrophication** It is the natural ageing of lake by the nutrient enrichment of its water. Due to introduction of nutrients such as nitrogen and phosphorus, there is growth of aquatic organisms.  
Slowly and steadily as the fertility of the lake increases, organic matter remains begin to deposit in the lake. Over the centuries, the organic debris piles up, lake becomes shallower, turns marshy and eventually dries up to form land.
- (v) **Infectious diseases** Consumption of polluted water causes many diseases like typhoid, cholera, dysentery, etc., in humans.

## Control Measures of Water Pollution

To control the level of water pollution, following steps must be undertaken

- (i) Industrial waste should be processed for the removal of toxic constituents before being dumped in the water bodies.
- (ii) Proper sanitation facilities should be provided. This will reduce the pollution of water due to excretory products.

- (iii) If hot water generated by the industries is collected at common place, allowed to cool and then discharged in water bodies, it will not affect the breeding capacity of aquatic organisms.
- (iv) The Government of India passed Water (Prevention and Control of Water Pollution) Act, 1974 to safeguard the water resources from pollution and contamination.
- (v) Sewage treatment should be set-up in populated areas and septic tank in houses help in control of water pollution by sewage and waste water.

### CHECK POINT 02

- 1 Name two sources of water pollution.
- 2 What is sewage? How does it pollute natural water bodies?
- 3 Why agricultural run offs are the main cause of water pollution in villages?
- 4 How does oil spills in sea water affect the aquatic life? Give one reason.
- 5 In which year the Water Act was introduced?

## 3. Soil Pollution

Any undesirable change in the soil profile that affects its productivity is called soil pollution. It reduces the fertility of the soil and the diversity of organisms that live in it.

### Sources of Soil Pollution

These source of soil pollution are wastes generated and accumulated from different sources. These are classified as

- (i) **Biodegradable wastes** The substances which can be degraded by microbial action into harmless and non-toxic substances. Some of them are
  - Domestic and kitchen wastes like vegetable scraps, peel of fruits, grains, paper packaging, etc.
  - Agricultural wastes like animal wastes, leaves, hay, etc.
- (ii) **Non-biodegradable wastes** The substances which can not be degraded by microbial action. They persist as such for a long time and accumulate in the environment, which results in pollution examples.
  - **Urban and domestic wastes** Solid wastes produced from our homes, shops, restaurant, etc., include plastic bottles, polythene bags, bulbs, kitchen wastes, etc. These wastes are collected and disposed off by kabadiwalas and municipal workers, who dispose the wastes in nearby areas causing pollution.

- **Industrial wastes** Various industries release solid wastes in addition to gaseous air pollutants and other chemicals. The solid wastes from industries is thrown out in the form of metallic ash, chemical residues, etc., which get settled on the surface of soil, thus polluting it.
- **Biomedical wastes** Wastes produced by hospitals, clinics, laboratories, etc., are also the major causes of soil pollution. Numerous items such as syringes, needles, unused or discarded tablets, research material, wound dressings, etc., are discarded and disposed off carelessly in the municipal garbage due to which soil gets polluted.
- **Chemical fertilisers** Chemical fertilisers that are used for increasing crop yield are proved to be harmful in excess amount. They wash away from crop fields and drain into the nearby river and lake. Hence, affecting the aquatic life present in these water bodies.
- **Pesticides** Pesticides such as DDT (Dichloro Diphenyl Trichloroethane) are used to kill pests and other insects in agricultural farms and fields, also acts as major source of soil pollution. This later reaches the living beings such as humans and animals through the food grown in such soils and gets concentrated in food chains at various levels.

## Effects of Soil Pollution

There are following effects of soil pollution

- Soil pollution may lead to loss of soil fertility.
- Accumulation of pesticides in increasing concentration in the body of living beings through food chain.
- Increased concentration of DDT in birds affects calcium metabolism in them due to which their egg shells become thin and break before maturity.

### Chemical Pollutants Present in the Soil and their Effects

Chemicals	Effects
Lead and mercury	Severe brain damage
Arsenic	Skin damage
Molybdenum	Abnormality in bones, diarrhoea, gout, etc.
Chromium	Respiratory distress, lung cancer, etc.

## Control Measures of Soil Pollution

Soil pollution can be controlled by adopting the following measures

- Burning or incineration of solid wastes in a well-designed furnace.
- Sanitary landfills are the areas used for solid wastes disposal in a trench or depression and covered with layer of soil.

- The natural vegetation cover and forest land should be protected. These are threatened because of industrialisation and urbanisation.
- Agricultural pesticides and fertilisers should be used in a judicious way. Organic farming should be adapted as the new way of farming. This will decrease the dependence on chemicals like fertilisers, pesticides, etc., and help in reduction of pollution.
- Cropping techniques such as crop-rotation, contour ploughing should be followed to improve soil fertility.
- Soil pollution can be reduced by recycling the waste such as plastic bags bottles, glasswares, metal containers, etc., instead of dumping these anywhere.

## 4. Noise Pollution

Noise is an undesirable high level of sound. Noise pollution is defined as the unwanted sound, which is released into the environment and disturbs the living system. A normal person can hear 20 dB sound and feels discomfort with sound of 85dB.

## Causes of Noise Pollution

The major sources of noise pollution are as follows

- Use of loudspeakers, music systems during social gathering, festivals, political gatherings, etc.
- Industrial establishment, loud noise from machines, heavy work, create loud noise, especially if present near residential areas.
- Motor vehicles increased on road create lots of noise similarly passing of air planes, jets, etc.
- Construction work.
- Burning of crackers during celebrations.

## Effects of Noise Pollution

The general effects of noise pollution are as follows

- Sound level higher than 150 dB or more may damage eardrums and may permanently impair the hearing ability of humans.
- Psychological disorders (anxiety and stress).
- Hearing disability in humans.
- Auditory impairment, i.e. whistling and buzzing in ears cause headache.
- Lowers efficiency of work.
- Interfere in communication.
- Disturbs sleep and leads to nervous irritability.

## Control Measures of Noise Pollution

The noise pollution can be controlled by the following points

- (i) Use of sound absorbent material in buildings.
- (ii) Muffling or suppressing noise. It can be done by planting more trees.
- (iii) Creating horn-free zones around hospitals and schools.
- (iv) Sticking to the permissible sound level of crackers and loudspeakers.
- (v) Framing of laws to enforce timing after which loudspeakers cannot be played.
- (vi) Silencers can be fitted to automobiles and industrial goods.

### CHECK POINT 03

- 1 Name two sources of soil pollution.
- 2 Chemical fertilisers add nutrition to the soil. So, how do they cause soil pollution?
- 3 Name two chemical pollutants of soil.
- 4 Define biological magnification.
- 5 Whistling and buzzing in ears is caused due to
 

(a) soil pollution	(b) water pollution
(c) air pollution	(d) noise pollution

## 5. Radioactive Pollution

Contamination of air, water and soil with radioactive substances is called radioactive pollution. The radioactive elements, e.g. uranium, radium, etc. emit protons, electrons and gamma rays as radiations. This property is called **radioactivity**.

### Sources of Radioactive Pollution

The chief sources of radiation are as follows

- (i) Leakage of radioactive materials from power plants.
- (ii) Unsafe disposal methods of radioactive wastes.
- (iii) X-rays and radioactive rays.
- (iv) Spent fuel reprocessing plants.
- (v) Research laboratories.
- (vi) Natural or man-made radiations.
- (vii) Nuclear fall outs.
- (viii) Terrestrial radiations from radioisotopes present in the earth.
- (ix) Cosmic rays from space.

## Effects of Radioactive Pollution

When radiation passes through different living organisms the following disorders take place

- (i) Radiation splits the molecules of the tissues into ions and free-radicals and causes mutation by breaking DNA (Deoxyribonucleic Acid) molecules in the nucleus.
- (ii) Radiation in bone marrow may cause leukemia.
- (iii) Radiation may cause skin burns which may lead to skin cancer.
- (iv) Radiation at pelvic regions of pregnant ladies, causes damage to the foetus.
- (v) Blood component changes, nausea, vomiting, fatigue, etc.

## Control Measures of Radiation Pollution

Nuclear wastes management includes

- (i) Disposal method should be safe and harmless. It has been recommended that nuclear waste before disposal should be pre-treated and buried about 500 m deep below the earth's crust in suitably shielded containers. However, this method of disposal is also facing criticism. Disposal can be done by putting the waste in polar ice sheets or deep ocean floors.
- (ii) Preventive measures should be taken to maintain the level of radiation within permissible limits.
- (iii) Regular checking of nuclear reactors or set ups for any source of leakage.
- (iv) Care should be taken to check man-made radiation pollution at source.
- (v) Nuclear tests should be banned.
- (vi) Leakages from nuclear reactors, careless handling transport and use of radioactive fuels have to be stopped.
- (vii) The regular monitoring and quantitative analysis has to be done in risk areas.

### Swachh Bharat Abhiyan : A National Campaign for Clean India

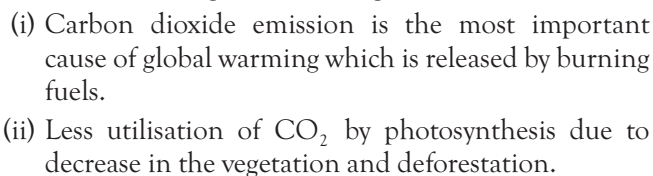
"A clean India would be the best tribute, we Indians could pay to Mahatma Gandhi on his 150 birth anniversary in 2019." This was quoted by our Prime Minister Shri Narendra Modi before launching the Swachh Bharat Abhiyan officially on 2nd October 2014. This campaign is a significant drive for undertaking cleaning of cities, towns and villages of India.

- Elimination of open defecation and construction of in house and commercial toilets.
- Cleaning the streets, roads and infrastructure of our country's towns and cities.
- Efficient management and disposal systems to be developed for solid and liquid wastes.

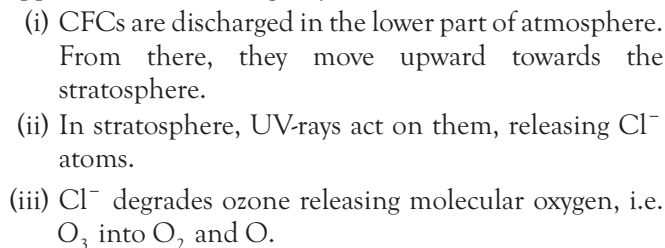
- 1 Define radioactivity.
- 2 Name two sources of radioactive pollution.
- 3 How do X-rays damage the body cells?
- 4 Name two radioactive elements which emit X-rays.
- 5 At what depth should nuclear waste be buried?

The greenhouse effect is a naturally occurring phenomenon that is responsible for heating earth's surface and atmosphere. Certain gases such as carbon dioxide ( $\text{CO}_2$ ) and methane ( $\text{CH}_4$ ) get accumulated in the atmosphere, thus prevent the escape of heat and cause warming of air. These gases are known as the **greenhouse gases**.

The rise in temperature of earth due to higher emission of greenhouse gases is called **global warming**. In greenhouse gases, 60% is carbon dioxide ( $\text{CO}_2$ ), 20% methane ( $\text{CH}_4$ ), 6% nitrous oxide ( $\text{N}_2\text{O}$ ) and 14% Chlorofluorocarbons (CFCs).



Ozone is found in the upper part of the atmosphere called **stratosphere**. It acts as a shield in absorbing harmful ultraviolet radiations coming from the sun. Ozone is a triatomic molecule ( $O_3$ ) of oxygen, formed by the action of UV-rays on molecular oxygen.



- (iv)  $\text{Cl}^-$  atoms are not consumed in the reaction. Hence, once CFCs are added to the stratosphere, they have permanent and continuous effects on ozone levels.

## Ozone Hole

Ozone depletion is particularly marked over the Antarctic region. This leads to the formation of a large area of thinned ozone layer, known as **Ozone hole**. If the ozone layer gets depleted continuously, it would not prevent the entry of UV-rays reaching the earth. UV-rays cause harmful effects like

- (i) UV-B damages DNA and causes mutation.
- (ii) Damage to the skin cells and ageing.
- (iii) Inflammation of the cornea, i.e. snow blindness due to high dose of UV-B.
- (iv) Cataract (a disease of blurred vision) and cancer.

## Control of Ozone Depletion

Ozone depletion needs to be controlled fast. The most appropriate control can be achieved by the restriction of CFCs releasing or chlorine substances.

We should also avoid the use of dangerous nitrous oxide, that is one of the harmful gases causing ozone depletion.

### CHECK POINT 05

- 1 What is the present average temperature of earth?
- 2 Name the radiations absorbed by greenhouse gases.
- 3 What proportion of  $\text{CH}_4$  and  $\text{N}_2\text{O}$  is found in greenhouse gases?
- 4 How ozone layer is formed?
- 5 Which component of CFCs is involved in degrading ozone?

## SUMMARY

- Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water and soil.
- Pollutants are chemical or biological substances that deteriorate our natural environment.
- Any undesirable change in the physical, chemical and biological characteristics of air that causes adverse effects on living things is called air pollution. It is mainly caused by combustion of fossil fuels, automobiles, etc.
- Photochemical smog was first reported in Los Angeles in 1946. It contains secondary pollutants, e.g.  $\text{O}_3$ , PAN, etc.
- Air pollution causes fruit damage, leaf damage, chlorosis, etc. in plants. Carbon monoxide combines with haemoglobin and reduces the oxygen carrying capacity of blood.
- Acid rain is caused by oxides of sulphur and nitrogen. The pH of acid rain is less than 5.65.
- Electrostatic precipitator can remove over 99% particulate matter present in the exhaust from a thermal power plant.
- Water pollution is the contamination of water bodies due to the changes in physical, chemical and biological properties of water that affect the living beings adversely. Sources of water pollution are of two types, i.e. natural sources, anthropogenic or man-made sources. Domestic sewage, industrial waste and agricultural run off are the main sources of water pollution.
- Eutrophication refers to the ageing of a lake by nutrient enrichment of its water. Nutrients rich in phosphates and nitrogen promote algal growth. Organic matter in water acts as a food source and promotes growth of planktonic algae, called algal bloom. It imparts a distinct colour to the water bodies and causes deterioration of the water quality, fish mortality, etc.
- Biomagnification is the increase in concentration of the toxic substance at successive trophic level, in the food chain. It is the indicator of water pollution.
- Thermal pollution is warming of an aquatic ecosystem to the point, where desirable organisms are adversely affected. It is caused by the water released from thermal power plants, oil refineries, etc.
- Noise pollution is caused by loud disturbing sounds dumped into the ambient atmosphere. Any value more than 80 dB causes noise pollution. The intensity of sound in normal conversation is 30-60 dB. Hatching of birds is disturbed due to noise pollution.
- Soil pollution is the alternation in soil quality caused by the removal or addition of substance. It is of two types, i.e. negative and positive soil pollution. Soil pollution can be reduced by incineration and pyrolysis.
- Radioactive pollution is physical pollution of air, water and soil due to radioactive materials. Some elements such as radium 224, uranium 235, thorium 232, etc. naturally emit radiations. Accidental leakage may also cause radioactive pollution.
- Radioactive wastes are released from radioactivity emission of  $\alpha$ -particles,  $\beta$ -particles or  $\gamma$ -rays from nucleides of their elements. Radiation causes mutations very frequently and also increases the chances of cancer.
- Ozone layer depletion is caused by the action of chlorine released from chlorofluorocarbons on ozone. Ozone hole particularly marked over Antarctica region.
- Greenhouse effect is the increase in global temperature mainly due to  $\text{CO}_2$  concentration. Greenhouse gases like  $\text{CO}_2$ ,  $\text{CH}_4$ , CFCs, etc. are produced by various human activities.
- Global warming is the gradual increase in average temperature of surface of the earth as a result of increased concentration of greenhouse gases.
- Ozone is found in the upper part of atmosphere. It is continuously formed by the action of UV rays on molecular oxygen.

# EXAM PRACTICE

## Multiple Choice Questions

1. The unfavourable alteration of environment due to human activities is termed as

(a) ecological disturbance (b) catastrophe  
(c) ecological degradation (d) pollution

Ans. (d)

2. An example of non-biodegradable waste is [2015]

(a) vegetable peels (b) sewage  
(c) livestock waste (d) DDT

Ans. (d)

3. Which one of the following is non-biodegradable? [2018]

(a) DDT (b) Vegetable peel  
(c) Cardboard (d) Bark of trees

Ans. (a)

4. Compressed Natural Gas (CNG) is

(a) propane (b) methane (c) ethane (d) butane

Ans. (b)

5. In the textbook, you came across Three Mile Island and Chernobyl disasters associated with accidental leakage of radioactive wastes. In India, we had Bhopal gas tragedy. It is associated with which of the following?

(a) CO<sub>2</sub> (b) Methyl isocyanate  
(c) CFCs (d) Methyl cyanate

Ans. (b)

6. The gradual continuous increase in average temperature of surface of the earth as a result of increase in concentration of CO<sub>2</sub> and CFCs is termed as

(a) global warming (b) greenhouse effect  
(c) ozone degradation (d) montreal protocol

Ans. (a)

7. Which one of the following is a greenhouse gas?

(a) Oxygen (b) Methane  
(c) Sulphur dioxide (d) Nitrogen [2018]

Ans. (b)

8. The primary source of chlorofluorocarbons is

(a) vehicular emissions (b) industrial effluents [2017]  
(c) domestic sewage (d) refrigeration equipments

Ans. (d)

## Fill in the Blanks

9. (A) Complete the following sentences by filling the blanks.

(i) A non-degradable pollutant is .....  
(ii) The acid rain is caused by the oxides of ..... and .....  
(iii) Drinking water coming from a polluted source causes disease like ..... and .....  
(iv) A decibel value more than ..... decibels leads to noise pollution.  
(v) ..... causes corrosion of the marble or brick surface. [2015]

Ans. (i) plastic (ii) sulphur, nitrogen  
(iii) cholera, dysentery (iv) 85  
(v) Acid rain

- (B) Complete the sentences by inserting correct word in the blanks.

(i) If there was no greenhouse effect, the average temperature of the earth's surface would be .....  
(ii) CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and CFCs are called greenhouse gases because they absorb and emit .....  
Ans. (i) -18°C (ii) heat rays

- (C) The statement given below is false. Rewrite the correct form of the statement by changing the word which is underlined.

CNG is mainly responsible for the formation of acid rain. [2015]

Ans. SO<sub>x</sub> and NO<sub>x</sub>

## True-False

10. State whether the following statements are true or false.

(i) Pollution and the pollutants can be considered as same things.  
(ii) The hot water discharged from industries hardly affects the aquatic life of that water body.

Ans. (i) **False.** Pollution and pollutants are different. Presence of pollutants causes pollution.  
(ii) **False.** The hot water discharged from industries affects the aquatic life forms due to temperature change.

## Match the Columns

11. Match the following columns.

Column I	Column II
A. Ozone	1. Bad ozone
B. Greenhouse effect	2. Rise in sea level
C. CO <sub>2</sub> , CH <sub>4</sub> and CFCs	3. Protective shield around atmosphere
D. Ozone present in troposphere	4. Global warming
	5. Greenhouse gases

**Ans.** A – 3, B – 4, C – 5, D – 1.

## a 1 Mark Questions

12. Explain the term pollutant. [2017]

**Ans.** Any substance or agent that causes pollution.

13. Given below is a set of four terms. In the set, one term is odd. Choose odd one out of the terms given and name the category to which the others belong.

Detergents, sewage, X-rays, oil spills [2018, 17]

**Ans.** Odd term – X-rays

Category – Sources of water pollution

14. Give biological reason for the following statement. Cutting of trees should be discouraged. [2017]

**Ans.** Cutting of trees should be discouraged because plants utilise atmospheric CO<sub>2</sub> during photosynthesis and release O<sub>2</sub>.

This maintains the balance of O<sub>2</sub> and CO<sub>2</sub> in environment which is helpful in reducing pollution.

15. Name the following  
The vehicular standard for controlling air pollution. [2017]

**Ans.** Bharat Stage Emission standard is the vehicular standard for controlling air pollution.

16. Give the biological/technical term for the following.  
The process causing an undesirable change in the environment. [2016]

**Ans.** Pollution

17. Name the pollutants that cannot be broken down to simple and harmless forms. [2016]

**Ans.** Non-biodegradable.

18. Give one example of water pollutant. [2014]

**Ans.** Domestic sewage is an example of water pollutant.

19. Mention any three causes of soil pollution. [2017]

**Ans.** Three main causes of soil pollution are

- Industrial wastes.
- Domestic wastes like plastic, urban and commercial wastes.
- Fertilisers and pesticides such as DDT and agricultural wastes.

20. Name the non-biodegradable pesticide. [2013]

**Ans.** DDT is an example of non-biodegradable pesticide.

21. A constituent that causes pollution. [2013]

**Ans.** A constituent that causes pollution is pesticide.

22. Identify the odd term in each set and name the **category** to which the remaining three belong.

Sewage, Newspaper, Styrofoam, Hay [2016]

**Ans.** Odd term-Styrofoam is non-biodegradable, pollutant Category-Biodegradable pollutants.

23. Give scientific reason for the following statement.  
Carbon monoxide is dangerous when inhaled. [2014]

**Ans.** Carbon monoxide has great affinity with haemoglobin of our blood. Due to this, it gets mixed with haemoglobin almost 300 times more than oxygen. Thus, cutting off the supply of oxygen.

24. Air is called as 'breath of life'. Why?

**Ans.** Air is called 'breath of life' because it contains oxygen, which is required by all living organisms for respiration.

25. Give appropriate biological/technical term for the following.

The type of waste generated in hospitals and pathological laboratories. [2017]

**Ans.** Biomedical wastes.

26. Briefly explain the term 'biomedical waste'. [2014]

**Ans.** Biomedical wastes consist of the waste produced by hospitals, i.e. wastes containing dressing amputated body parts, used surgical instruments, etc. These spread diseases if left unmanaged.

**27.** Is it true that carpets and curtains/drapes placed on the floor or wall surfaces can reduce noise level? Explain briefly.

**Ans.** Yes, it is true. This is because they act as muffling device and absorb sounds of moderate level.

**28.** What is the average temperature of earth at present?

**Ans.** 15°C.

**29.** Name any two greenhouse gases present on earth.

**Ans.** Carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>).

**30.** Give scientific reasons. Why use of CFC is banned in many countries? [2014]

**Ans.** Chlorofluorocarbons (CFCs) are banned in many countries because they are one of the major cause for ozone layer depletion.

## **b** 2 Marks Questions

**31.** Explain the cause of algal bloom in a water body. How does it affect an ecosystem?

**Ans.** Algal bloom is caused by the enrichment of nutrients in the water body, especially by the presence of phosphorus and nitrogen.

It affects the ecosystem in following ways

- (i) Deterioration of water quality.
- (ii) Death of aquatic organisms.

**32.** What are the sources of radioactive waste?

**Ans.** Sources of radioactive waste are as follows

- (i) Accidental leakage of nuclear material or radiations from nuclear power plants.
- (ii) Improper disposal of nuclear or radioactive waste.

**33.** Define ozone hole. When is the International Ozone Day observed?

**Ans.** Ozone hole is the thinning of ozone layer due to increased use of CFCs. International Ozone Day is celebrated on 16th September every year.

**34.** What will happen if all plants extinct from the earth?

**Ans.** We will not be able to survive on earth, if all plants will extinct as they are the only source of oxygen in the atmosphere.

**35.** Answer the following.

- (i) Name the greenhouse gases that cause global warming.
- (ii) Which of them caused ozone hole and how?

**Ans.** (i) CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and CFCs.

(ii) CFCs cause ozone hole. These are used in refrigerators. They travel up to stratosphere. In the stratosphere, UV-rays act on them and a chlorine atom is released. These chlorine atoms act as catalyst and degrade ozone.

[1 × 2]

**36.** State any two harmful effects of acid rain.

**Ans.** (i) Acid rain increases acidity in the soil and destroys forests and crops.

(ii) It corrodes fences, buildings, monuments, bridges and statues.

[1 × 2]

**37.** Give the biological term for

[2015]

- (i) A mixture of smoke and fog
- (ii) Greenhouse effect

**Ans.** (i) Smog

(ii) **Greenhouse effect** When the greenhouse gases trap heat in the atmosphere and they increase the temperature of earth.

This process of increase in temperature is termed as greenhouse effect.

[1 × 2]

## **c** 3 Marks Questions

**38.** Explain why smog formation occurs in cold weather.

**Ans.** The combustion of fossil fuels increases the amount of suspended particles such as unburnt carbon particles (i.e. hydrocarbons) in air.

Presence of high levels of these pollutants cause visibility to be lowered, especially in cold weather when water also condenses out of air. This is known as smog and it is a visible indication of air pollution.

**39.** Water pollution is major problem in our country. State three major factors which lead to water pollution.

**Ans.** Three major factors which lead to water pollution are

- (i) **Industrial waste** Effluent of industries contains large quantities of harmful chemicals and acids that are discharged into water bodies (rivers and lakes) and pollute them.
- (ii) **Fertilisers and pesticides** Fertilisers and pesticides are excessively used in fields to increase production. These are washed by water into water bodies and pollute them.
- (iii) **Sewage** Organic wastes contributed as domestic and commercial sewage are discharged into water bodies and decrease the quality of water.

[1 × 3]

**40.** Name any one greenhouse gas and its possible source of production on a large scale. What are the harmful effects of it?

**Ans.** The common greenhouse gases are  $\text{CO}_2$ ,  $\text{CH}_4$ , CFCs, oxide of nitrogen ( $\text{N}_2\text{O}$ ), water vapour and  $\text{O}_3$ .

**Source** The level of  $\text{CO}_2$  (greenhouse gas) is increasing due to large scale deforestation, change in land use, unlimited burning of fossil fuels and rising population.

**Harmful effect** Rise in  $\text{CO}_2$  leads to absorption of heat rays causing an increase in heat level of the atmospheres, i.e. global warming.  $\text{CO}_2$  is estimated to contribute around 60% towards greenhouse effect.

**41.** Carbon dioxide is necessary for plants. Why do we consider it as a pollutant?

**Ans.** Carbon dioxide gas is necessary for plants to perform photosynthesis. It is also a greenhouse gas. Up to certain concentration (approx. 350 ppm) in atmosphere, it is both good raw material as well as essential for keeping the earth warm. But, when concentration of  $\text{CO}_2$  rises from certain level it becomes a pollutant.

**42.** List any three human activities, which lead to release of carbon dioxide content of air.

**Ans.** The human activities, which would lead to an increase in the  $\text{CO}_2$  content of air are

- (i) **Respiration** is the natural way to release  $\text{CO}_2$  by both plants and animals. It is balanced by the release of oxygen by plants. So, it is not harmful for the environment.
- (ii) **Deforestation** increases the level of  $\text{CO}_2$  in the environment. Trees carry out photosynthesis and convert  $\text{CO}_2$  into organic compounds such as glucose, starch, etc. In their absence,  $\text{CO}_2$  cannot be utilised.
- (iii) **Combustion** of fuels leads to increase in  $\text{CO}_2$  level in the atmosphere. Fuels are burnt to carry out activities like cooking, transportation and in industrial processes. [1×3]

**43.** Refrigerants are considered to be necessary in modern living, but are said to be responsible for ozone hole detected in Antarctica. Justify.

**Ans.** Refrigerants contain Chlorofluorocarbons (CFCs), the substances that do not degrade easily and travel up to the stratosphere. In the stratosphere, UV-rays act on them and a chlorine atom is released.

These chlorine atoms act as catalyst and degrade ozone. Chlorine atoms are recycled in this reaction so, they keep on damaging ozone layer leading to creation of ozone hole as formed over Antarctica. Thus, through a necessity, refrigerants are responsible for ozone hole.

## d 4 Marks Questions

**44.** Mention the major causes of air pollution in metro cities. Write any three ways by which it can be reduced.

**Ans.** Causes of air pollution are as follows

- (i) Effluents from thermal plants, smelters and other industries.
- (ii) Emission from automobiles exhaust.
- (iii) Smoke from forest fires, volcanic eruptions, etc.
- (iv) Use of leaded petrol.

Ways to control air pollution are as follows

- (a) Reducing the use of fossil fuels.
- (b) Use of catalytic converters, electrostatic precipitators and other control devices.
- (c) Plantation of more trees.
- (d) Use of CNG in vehicles.

**45.** Write some harmful effects of air pollution.

**Ans.** Refer to text on page no. 286.

**46.** It has been recorded that the temperature of the earth's atmosphere has increased by  $0.6^\circ\text{C}$ .

- (i) What has caused this increase?
- (ii) Explain its consequences.

**Ans.** (i) The increase in average temperature of earth is due to global warming. Global warming is a result of enhanced greenhouse effect due to excessive greenhouse gases present in the atmosphere. These gases absorb the outgoing radiation from earth thereby heating the troposphere. Excessive heating of atmosphere causes global warming. [2]

- (ii) Consequences of global warming are as follows
  - (a) Melting of polar ice caps and glaciers worldwide.
  - (b) Sea level rise and submergence of coastal areas.
  - (c) Frequent floods, droughts, hurricanes.
  - (d) Ecosystem changes. [2]

**47.** (i) What are the two forms of oxygen found in atmosphere?

- (ii) State two effects of depletion of ozone layer in the atmosphere.

- Ans.** (i)  $O_2$  and  $O_3$ . [2]  
 (ii) Harmful effects of ozone layer depletion are  
 (a) Depletion of ozone layer allows the entry of harmful ultraviolet radiations to the earth. UV radiations cause skin cancer, damage to eye, etc.  
 (b) Ozone layer depletion may lead to variation in rainfall, ecological disturbances, etc. [2]

**48.** What measures as an individual would you take to reduce environmental pollution?

**Ans.** To reduce environmental pollution, I will change my habits and lifestyle so as to reduce the use of disposable materials. I will also use preferably those items, which can easily be recycled and also will minimise the use of fossil fuels.

Following steps may also be taken to reduce pollution

- (i) Prevention of noise pollution by using fire crackers/TV/loudspeakers at permissible limits.
- (ii) Reduction in air pollution from automobile exhausts by using proper speed and regular servicing and using catalyst converters in vehicles.
- (iii) No use of polythene bags.
- (iv) Tree plantation around my residential area.

## **e** 5 Marks Questions

**49.** What initiatives were taken for reducing vehicular air pollution in Delhi? Has air quality improved in Delhi?

**Ans.** Initiatives taken by government to reduce the vehicular air pollution in Delhi are as follows

- (i) Introduction of CNG (Compressed Natural Gas).  
As per directives of Supreme Court, all buses of Delhi transport were converted to run on CNG by the end of 2002. All over Delhi, CNG powered vehicle were introduced in 2006. CNG is a less polluting fuel. At present all the public transport in Delhi runs *via* CNG.
- (ii) Use of catalytic converters in vehicles.
- (iii) Use of low sulphur fuel and unleaded fuels.
- (iv) Phasing out of old vehicles.
- (v) Introduction of pollution-free norms for all vehicles.
- (vi) Implementation of Bharat Stage I, which is equivalent to Euro II norms.

All these efforts have improved the air quality of Delhi. As CNG has helped in bringing down the levels of  $CO_2$  and  $SO_2$ , but the problem of Suspended

Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM) is yet to be overcome.

**50.** Explain how water may be polluted by agricultural practices.

**Ans.** Farmers who add large amounts of fertilisers and pesticides into soil indiscriminately cause water pollution. These substances, contain high concentrations of nitrates and phosphates. They dissolve in water and are washed off into nearby rivers and streams or enter our water sources by seeping through the soil to groundwater.

The presence of large amounts of nutrients in water causes excessive growth of algae called algal bloom.

Algal bloom causes deterioration of the water quality and causes fish mortality. Some bloom forming algae are extremely toxic to human beings and animals also.

As the amount of organic matter increases, microorganisms use BOD to decompose it in the water. These consume lot of oxygen and as a result there is a sharp decline in dissolved oxygen, in the water body. This can cause death of fishes and aquatic creatures.

Thus, the accelerated eutrophication and growth of algal blooms reduces the oxygen content of water, causing pollution.

**51.** What are the various constituents of domestic sewage? Discuss the effects of sewage discharge.

**Ans.** Domestic sewage primarily contains biodegradable organic matter, which is decomposed by the microorganisms. It is released from every household on daily basis.

Domestic sewage from home and hospitals may also contain pathogens and cause diseases like typhoid, cholera, jaundice, dysentery, etc.

**Effects of sewage discharge on river**

- (i) **A sharp decline in dissolved oxygen** Low oxygen levels in the water cause death of fish and other aquatic creatures.
- (ii) **Algal bloom** This results from the presence of organic matter in water. It causes
  - (a) deterioration of the water quality.
  - (b) fish mortality.
  - (c) toxicity to humans and animals.
- (iii) **Excessive growth** of algae, e.g. water hyacinth due to the presence of organic matter in water causing an imbalance in the ecosystem dynamics of the water body.

- (iv) Biological magnification of a few toxic substances causes harmful effects in living species.
- (v) Accelerated eutrophication ageing of lakes and other water bodies.

**52.** What are the causes of noise pollution?

**Ans.** The causes of noise pollution are

- (i) Jet plane or rocket take-off.
- (ii) Use of loudspeakers, music systems.
- (iii) Electrical appliances noises, agricultural machines noises, traffic noises, industrial and factory noises.
- (iv) Burning of crackers during celebrations.
- (v) Construction work.

**53.** What are the effects of UV-rays on human beings? What causes an increase in level of UV-rays on earth?

**Ans.** UV rays cause harmful effects like

- (i) UV-B damages DNA and causes mutation.
- (ii) Damage to the skin cells.
- (iii) Ageing of the skin.
- (iv) Various types of cancers.
- (v) Inflammation of the cornea, i.e. snow blindness.
- (vi) Cataract (a disease of blurred vision).

**54.** Answer the following

- (i) Expand CFCs.
- (ii) CFCs are part of greenhouse gases. Name the other gases of this group.
- (iii) Explain the major harms caused by these gases.
- (iv) Give measures for control of ozone depletion.

**Ans** (i) Chlorofluorocarbons. [1]

(ii)  $\text{CO}_2$ ,  $\text{CH}_4$  and  $\text{N}_2\text{O}$  are the gases other than CFCs. [1]

(iii) Greenhouse gases are mainly responsible for the enhanced greenhouse effect and global warming. CFCs particularly are responsible for depletion of ozone layer and formation of ozone hole. [1]

(iv) Ozone depletion needs to be controlled fast. The most appropriate control can be achieved by the restriction of CFCs releasing or chlorine substances.

We should also avoid the use of dangerous nitrous oxide, that is one of harmful gases which causes ozone depletion. [2]

## Diagram Based Questions

**55.** Given below is the representation of a type of pollution.

Study the picture and answer the questions



- (i) Name the type of pollution shown in the picture.
- (ii) Name one source of this pollution.
- (iii) How does this pollution affect human health?
- (iv) Write one measure to reduce this pollution.
- (v) State one gaseous compound that leads to the depletion of the ozone layer and creates 'Ozone holes'. [2018]

**Ans.** (i) Air pollution

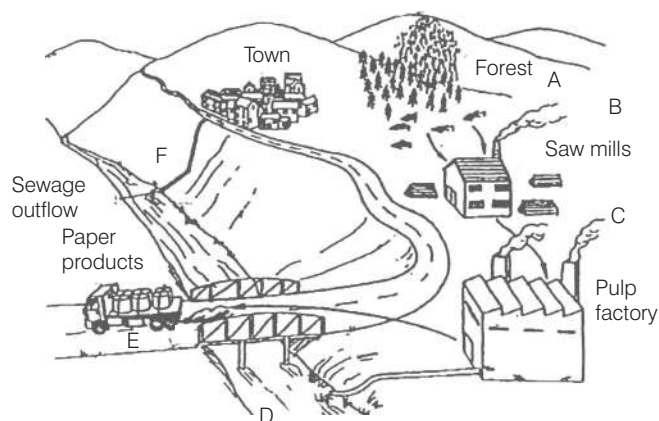
(ii) Forest fires, automobile exhaust, etc.

(iii) It causes various diseases such as asthma, cancer and can also damage the CNS.

(iv) Air pollution can be reduced by using unleaded petrol and CNG over petrol and diesel as it is environment friendly.

(v) Chlorofluorocarbons (CFCs) are gaseous compounds responsible for the depletion of ozone layer.

**56.** The figure shows some human activities which affect the environment.



- (i) Explain the harmful effects of these activities.
- (ii) Suggest ways in which the harmful effects of such activities might be overcome.

**Ans.** (i) Deforestation at (A) can lead to soil erosion and floods. The part of soil that is washed into rivers and seas reduces the clarity of water and reduces photosynthesis by water plants. Deforestation can also lead to desertification.

The saw mills (B) and pulp factory (C) cause air pollution from the smoke given off. The pulp factory also throws out waste products into the river (D) causing water pollution. At (E), the smoke given out by the lorry is a further source of air pollution. The carbon monoxide and other substances are harmful to animals in high concentrations. The sewage discharge at (F) into the river by the town causes water pollution. The bacteria in the sewage use up oxygen in the water, causing fishes and other organisms in the river to die.

- (ii) The harmful effects might be overcome by preventing the cutting down of forests, treating sewage and reducing the smoke from factories and vehicles by using less harmful fuels.

**57.** Given is a representation of a kind of pollution. Study the same and answer the questions that follows

[2017]



- (i) Name the kind of pollution.
- (ii) List any three common sources of this pollution.
- (iii) Mention three harmful effects of this pollution on human health.
- (iv) Explain the term 'Pollutant'.
- (v) Name two soil pollutants.

**Ans.** (i) The given figure is showing noise pollution.

- (ii) The three common sources of noise pollution are
  - (a) Trains
  - (b) Loudspeakers
  - (c) Jet crafts

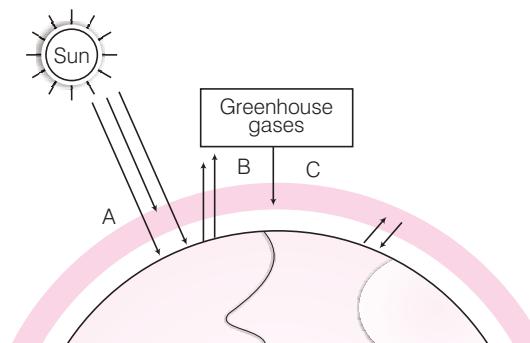
- (iii) The three harmful effects of noise pollution on human health are as follows

- (a) Nervous irritability
- (b) Damaged eardrum
- (c) Interferes with the concentration and thoughts.

- (iv) **Pollutants** are the agents that cause pollution and bring undesirable changes in the environment.

- (v) Two soil pollutants are
  - (a) Pesticides like DDT.
  - (b) Biomedical wastes like syringes, needles, etc.

**58.** The figure shows greenhouse effect. Observe it carefully and answer the questions.



- (i) What happens to A as it travels to earth?
- (ii) Describe C and its effect.

**Ans.** (i) Half of the incident radiations (A) fall on the earth surface and heat it and some portion of it is reflected back.

(ii) Greenhouse gases absorb long wave (infrared) radiation from the earth and emit it again towards the earth. The cycle continues till the earth's surface has no long wave radiation to emit.

# CHAPTER EXERCISE

## Multiple Choice Questions

- 1 Non-biodegradable pollutants are created by
  - (a) nature
  - (b) excessive use of resources
  - (c) humans
  - (d) natural disasters
- 2 Which air pollutant could cause rain to be acidic?
  - (a) Dust particles from cement factories
  - (b) Insecticides from crop sprays
  - (c) Smoke from wood fires
  - (d) Sulphur dioxide from coal-fired power stations
- 3 Ozone is present in abundance in this layer, which gets heated up as the incoming radiations are absorbed by ozone.
  - (a) Mesosphere
  - (b) Troposphere
  - (c) Stratosphere
  - (d) Thermosphere
- 4 CFCs are not recommended to be used in refrigerators because they
  - (a) increase temperature
  - (b) deplete ozone
  - (c) affect environment
  - (d) affect human body

## Answers

1. (c) 2. (d) 3. (c) 4. (b)

## Fill in the Blanks

- 5 (A) Complete the following statements by filling the blanks with correct words.
  - (i) Air pollutants are commonly ..... material, radioactive substances and ..... matter.
  - (ii) The intensity of sound is measured in ..... .
  - (iii) The effects of radioactive pollution depend on ..... of the material.
  - (iv) The best way to reduce the level of pollution and sustainable development is .... strategy.

- (B) Complete the following sentences by filling the blanks with appropriate words.

- (i) ...A... used as a refrigerant. It reacts with UV in ...B... to release chloride atoms.
- (ii) The  $\text{Cl}^-$  atoms act as a catalyst to degrade ozone and release molecular ..... .
- (iii) Bad ozone forms in ..... and is harmful. While good ozone forms in stratosphere and blocks UV radiations.

- (C) Fill in the blanks to complete the following sentences

- (i) The major source of pollution in cities are ..... .
- (ii) Ozone depletion is caused by ..... exhaust from jet emission.

## True-False

6. (A) State whether the following statements are true or false.
  - (i) Euro II norms stipulate that lead must be controlled at 350 ppm in diesel.
  - (ii) Air Prevention and Control of Pollution Act, 1981 was amended in 2005 to include noise as an air pollution.
- (B) State whether the following statements are true or false.
  - (i) The phenomenon by which certain pollutants accumulate in the body tissues in increasing concentration is called eutrophication.
  - (ii) The Montreal Protocol aims at control of carbon dioxide emission.

## Match the Columns

7. Match the following columns.

Column I	Column II
A. Agricultural pollutant	1. Uranium
B. Biodegradable pollutant	2. Vegetable waste
C. Radio active pollutant	3. Pesticides
D. Water pollutant	4. Sewage

### 1 Mark Questions

8. A group is given with four examples. Write down the category of the group and identify the odd one.  
Sulphur dioxide, carbon monoxide, oxygen, nitrogen dioxide.
9. Name the city in our country where the entire public road transport runs on CNG.

### 2 Marks Questions

10. Chemicals from added fertilisers, etc., are harmful for soil. Justify with example.
11. (i) Classify the pollutants on the basis of their ability to degrade along with examples.  
(ii) Give reason  
The use of pressure horn is prohibited in certain places.

### 3 Marks Questions

12. On which three factors, effects of air pollution depend?
13. Give reasons.  
(i) All vehicles should carry a fitness certificate.  
(ii) Warm water acts as a pollutant.  
(iii) Oil spill adversely affects the aquatic life.

### 4 Marks Questions

14. Name the following  
(i) Chief radiation pollution in Chernobyl and Three Mile Island accident.  
(ii) A radioactive substance that caused serious damage in Delhi in 2010.  
(iii) Unit of energy present in X-rays.  
(iv) Air pollutants contributed by aeroplanes.
15. (i) What is excessive warming of earth?  
(ii) What are its harmful effects?  
(iii) What are its various causes?  
(iv) How can it be reduced?

### 5 Marks Questions

16. Suggest five steps that should be taken to check air and water pollution.  
List various pollutants of air, water and soil.

17. Explain Bharat/Euro stage norm.

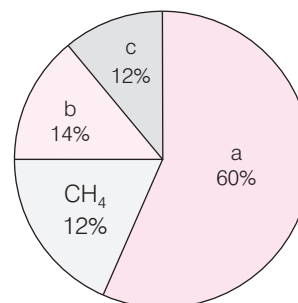
18. (i) What depletes ozone in the stratosphere? How does this affect human life?  
(ii) Write one damaging effect of ozone depletion on humans and plants, respectively.

### Diagram Based Questions

19. Observe the figure given below and answer the following questions



- (i) What is represented by the given figure?  
(ii) List any two causes of this demonstration.  
(iii) Give two effects on us according to this figure.  
(iv) Suggest atleast two control measures for the same.
20. The given diagram shows the relative contribution of different greenhouse gases to global warming. Answer the following questions



- (i) Identify 'a' and emphasise on its contribution to global warming in the last few years.  
(ii) Identify 'b' and 'c'.  
(iii) Concentration of methane (CH<sub>4</sub>) has tremendously increased since pre-industrial times. Comment.

# ARCHIVES\*

## (Last 5 Years)

Collection of Questions Asked in Last 5 Years' (2018-2014) ICSE Class 10th Examinations

### 2018

1. Choose the correct answer from each of the four options given below.
  - (i) Which one of the following is non-biodegradable?  
(a) DDT (b) Vegetable peel  
(c) Cardboard (d) Bark of trees [1]
  - (ii) Which one of the following is a greenhouse gas?  
(a) Oxygen (b) Methane  
(c) Sulphur dioxide (d) Nitrogen [1]
2. Choose the odd one out from the following terms given and name the category to which others belong.  
Detergents, X-rays, sewage, oil spills. [1]
3. Given below is representation of a type of pollution. Study the picture and answer the questions.
  - (i) Name the type of pollution shown in the picture.
  - (ii) Name one source of this pollution.
  - (iii) How does this pollution affect human health?
  - (iv) Write one measure to reduce this pollution.
  - (v) State one gaseous compound that leads to the depletion of the ozone layer and creates 'Ozone holes'. [5]



### 2017

4. The primary source of chlorofluorocarbons is  
(a) vehicular emissions (b) industrial effluents  
(c) domestic sewage (d) refrigeration equipments [1]
5. Name the vehicular standard for controlling air pollution. [1]
6. Give biological reason for the following statement  
cutting of trees should be discouraged. [1]
7. Explain the term pollutant. [1]
8. Mention any three causes of soil pollution. [1]
9. Give appropriate biological/technical term for the following [1]

The type of waste generated in hospitals and pathological laboratories.

10. Given is a representation of a kind of pollution. Study the same and answer the questions that follows [5]
  - (i) Name the kind of pollution.
  - (ii) List any three common sources of this pollution.
  - (iii) Mention three harmful effects of this pollution on human health.
  - (iv) Explain the term 'pollutant'.
  - (v) Name two soil pollutants.



### 2016

11. The pollutants that cannot be broken down to simple and harmless products. [1]
12. Identify the odd term in each set and name the category to which the remaining three belong. [1]  
Sewage, Newspaper, Styrofoam, Hay
13. Give the biological/technical term for the following [1]  
The process causing an undesirable change in the environment.

### 2015

14. The statement given below is false. Rewrite the correct form of the statement by changing the word which is underlined.  
CNG is mainly responsible for the formation of acid rain. [1]
15. Rewrite and complete the following sentence by inserting the correct word in the space indicated.  
.... causes corrosion of the marble or brick surface. [1]

### 2014

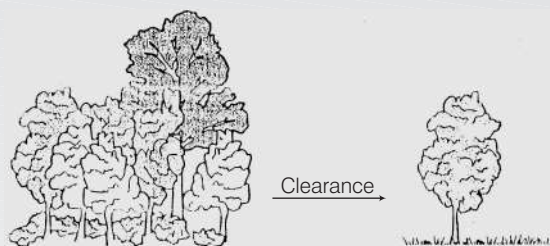
16. Give one example of water pollutant. [1]
17. Briefly explain the term 'biomedical waste'. [1]
18. Give scientific reasons.  
Why use of CFC is banned in many countries. [1]
19. Give scientific reason for the following statement.  
Carbon monoxide is dangerous when inhaled. [1]

\* Explanations/Answers to all these questions are given in the Chapter Theory and Exam Practice.

# CHALLENGERS\*

*A Set of Brain Teasing Questions for Exercise of Your Mind*

- 1 Now a days, hybrid vehicle technology has been introduced. Explain its advantages with regard to environment along with a suitable example.
- 2 Ornithologists observed a decline in the bird population in the area near a lake after the setting of an industrial unit in the same area. Explain the cause responsible for the decline observed.
- 3 Is it possible that lake can achieve at that situation that it eventually dries up to form land? If yes, then how? Please explain.
- 4 Nuisance growth of aquatic plants and bloom-forming algae in natural water is generally due to high concentrations of  
(a) carbon                      (b) sulphur                      (c) calcium                      (d) phosphorus
- 5 A village is located near a bank of river. There an industrial setup started in village near river. After the industrial setup, the health of people becomes low. Why ? Please explain.
- 6 The diagram shows a tropical forest before and after clearing for agricultural use.



Which of the effects of deforestation causes soil erosion?

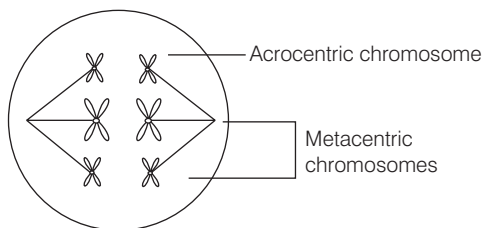
- (a) Less photosynthesis occurs
- (b) Rainfall is reduced
- (c) Roots of trees die
- (d) Salt concentration in the soil decreases

\* These questions may or may not be asked in the examination, have been given just for additional practice required for olympiads, Scholarship Exams etc. For detailed explanations refer Page No. 306.

# Explanations to Challenges

## Chapter 1. Cell Cycle, Cell Division and Structure of Chromosome

1. A cell from the same organism that is undergoing prophase of mitosis would contain a diploid number of chromosomes. A cell in this stage should contain 24 chromosomes.
2. (d)
3. X will form 2 daughter cells and Y will form 4 daughter cells.
4. The organism is dividing by mitosis. Recombination occurs in case of meiosis but not in mitosis.
5. (b)
- 6.



## Chapter 2. Genetics

1. (a)
2. (c)
3. (d)
4. 0%. All the males and females will be red-eyed.  
Pure breed female (XX) is homozygous for normal X-chromosome.  
White-eyed male ( $X^oY$ ) is hemizygous for X-chromosome with a white eye mutation.

		Sperm	
		$X^o$	Y
Egg	X	$XX^o$	XY
	x	$XX^o$	XY

Both male and female offsprings will inherit a normal X-chromosome from the female.

5. For each gene corresponding to X-linked traits, females always have two alleles since they have two X-chromosomes.  
Males only have one allele of genes related to X-linked traits, since they have only one X-chromosome.
6. No, it is not likely that son inherited the trait from his father. Colour blindness is a X-linked recessive disorder.

The son can only inherit this trait from his mother as the son's X-chromosome comes from the mother. A father passes only the Y-chromosome to his son.

## Chapter 3. Absorption by Roots

1. (b)
2. (c)
3. (c)
4. (d)
5. A plant usually fails to survive if it is conditioned to water deficiency. It results in wilting which is the shrinkage in the volume of water in plant cells.  
So, if a gardener forgets to water a potted plant for a day during summer, the plant will droop down due to wilting. Yes, it is reversible if the plant is watered before it enters into permanent wilting stage.
6. (i) On sprinkling salt on grass growing in a lawn, the soil water near the grass becomes hypertonic. Due to this, exosmosis takes place and the grass is killed.  
(ii) Transplanting of seedling to a flower bud in the evening is better than doing so in the morning because in the evening, stomata will close and thus there will be no loss of water through transpiration which may cause wilting.
7. (i) Cubes are placed in hypotonic solution so endosmosis takes place and cell becomes turgid resulting in firmness and increase in size.  
(ii) Placed in sugar solution hence become soft and decrease in size because of exosmosis.  
(iii) Osmosis. It is the flow of water molecules from the region of their higher concentration to the region of their lower concentration through a semipermeable membrane.

## Chapter 4. Transpiration in Plants

1. (b)
2. (d)
3. (a)
4. (c)
5. On a rainy day there is no transpiration because as there is high humidity, the rate of transpiration decreases.
6. The rate of transpiration by the remaining leaves increases because the root-shoot ratio will increase.
7. (i) Leaf (D) will become most limp as the transpiration occurs from both lower and upper surface of leaves.  
(ii) Leaf (C) would show least limping as no transpiration occurs from lower and upper surface of leaves.

**Chapter 5. Photosynthesis**

1. (b)      2. (d)      3. (c)      4. (c)
5. Dark reaction occurs in day and night both. It's name dark reaction is given because it does not require light. Thus, it is also known as light independent reaction.
6. Chlorophyll has various pigments like *a* and *b*. These pigments have a tendency to absorb different light or different wavelengths. Thus, this characteristic feature of various pigments of chlorophyll makes them most effective for photosynthesis.
7. Sodium bicarbonate increases the rate of photosynthesis. Thus, it is added in the water having *Hydrilla* plant in a beaker.
8. (c)

**Chapter 6. Chemical Coordination in Plants**

1. *A* – Growing region of the shoot  
*B* – Gibberellin      *C* – Branch and leaf  
*D* – Chloroplast
2. (c) Nastic movements are non-directional movements of plants with respect to direction of stimuli received.
3. (b)
4. Touch, the stimulus due to which movements occur in these plants.  
*Mimosa pudica* when touched, responds by folding of leaves. Pitcher plant opens the flap, closes when it senses touch, the movement is occurring to capture food.
5. Nastic movement does not depend upon the direction of the stimulus applied. For example, movement of leaves in *Mimosa pudica* on touching. The leaves close when touched, this happens due to sudden loss of water from the seedlings at the base of leaves. Tropic movements are directional which depend on the direction of stimulus applied. For example, movement of shoot towards the source of light. Here stimulus is light.

**Chapter 7. Circulatory System**

1. (b)      2. (c)      3. (a)      4. (d)
5. Before transfusion, blood groups of donor and recipient are matched to avoid agglutination. It may cause haemolysis or destruction of RBC and may prove fatal.
6. Renal portal system is absent in mammals due to following reasons  
 (i) The heart of mammals is four-chambered, due to which there is total separation of oxygenated and deoxygenated blood.

- (ii) Posterior portion of body gets oxygenated blood from heart. After oxidation, the blood does not contain much impurities that it should go to kidneys for filtration.

**Chapter 8. Excretory System**

1. (d)      2. (a)      3. (d)
4. The regulation of acid-base equilibrium of body depends upon reabsorption and secretion taking place in various regions of nephron.

**Chapter 9. Nervous System and Sense Organs**

1. (b)      2. Hypothalamus      3. (b)
4. (d)      5. (a)
6. A hard blow on the back can cause injury of the spinal cord. It may result in paralysis, leading to impairment in physical functioning and cognitive abilities of that person.

**Chapter 10. Endocrine System**

1. (b)
2. (d) Grave's disease is caused by the malfunctioning of thyroid gland.
3. (b)
4. Hormones are information molecules because these are secreted and transported directly into the blood. These are responsible for regulating the biological processes in the body.
5. The insufficient intake of iodine in diet causes goitre in people having swollen neck. Goitre is a disorder caused due to hyposecretion of thyroxine hormone. The synthesis of hormone at normal rate is occurred due to the adequate amount of iodine in diet.

**Chapter 11. Reproductive System**

1. (b)      2. (a)
3. (c) *Y* is testis, it secretes testosterone, male sex hormone.  
*X* is prostate gland which secretes a white alkaline fluid into the semen to neutralise acidic pH of the vagina.
4. (d) In humans, all the eggs are fertilised internally. Only one sperm can fertilise an egg.  
 Statements (III) and (IV) are correct.
5. (b) Fertilisation involves fusion of male and female gametes.  
 The male sperm first attaches to the egg, binds to it followed by penetration. The nuclei of the gametes fuse together to form zygote.

## Chapter 12. Population and Its Control

1. (c)
2. (a)
3. (c)
4. (d) Natural method includes rhythm method, which is the least reliable in the given table.
5. A normal human contains 46 chromosomes, i.e. 22 pairs of autosomes + XX or XY sex chromosomes. If an egg carrying XX fertilises an Y-carrying sperm, the sex-chromosomes of that individual will be XXY. This is an abnormality and would lead to genetic disorder. These disorders are incurable. Therefore, the female with XXY zygote was advised to undergo MTP.
6. Improved medical facilities and public health measures has lead to an increase in population of the world. Progress in the field of medical science, along with the health services made available to the countries by International health organisations.  
They have brought epidemics and diseases under control. This has reduced the mortality rate to a large extent. The public health programmes have improved the water supply and sanitary conditions. The health programmes also provide for distribution of free milk to poor children in municipal schools. All this has improved the general health of the people.
7. Population explosion leads to the depletion of natural resources and per capita income, fall in general health and many other problems. Therefore, the authors are justified in saying that a population explosion is far more dangerous than an atomic explosion.

## Chapter 13. Human Evolution

1. (d)
2. (a)
3. (c)
4. *Ramapithecus* were earliest man-like primates or first hominid.
5. (b)
6. (b)

## Chapter 14. Pollution

1. Hybrid vehicle technology produces vehicles which can run on dual mode like petrol and CNG. It reduces the consumption of fossil fuels and thus, less environmental pollution.
2. An industrial unit discharged waste water in the natural water bodies like lake, river. Hence, such contaminated water once consumed by birds, aquatic plants and animals will cause death of those organisms. This situation may lead to the declination of the population of birds, plants and organisms.
3. Yes, the natural ageing of lake occurs due to nutrient enrichment of its water. This phenomenon is known as eutrophication. The fertility of lake increases steadily and slowly due to nutrients. Thus, over the centuries, the organic debris of aquatic organisms piles up and makes lake shallower, marshy and eventually dry to form land.
4. (d)
5. Industrial setup near bank of river disposes its wastes. These wastes are accumulated in aquatic animals which are later eaten up by humans. Thus, the health of such humans becomes degraded and they may suffer from severe nervous system problems.
6. (d)

# Internal Assessment of Practical Work

## Plant Life

### Experiment 1

#### Aim

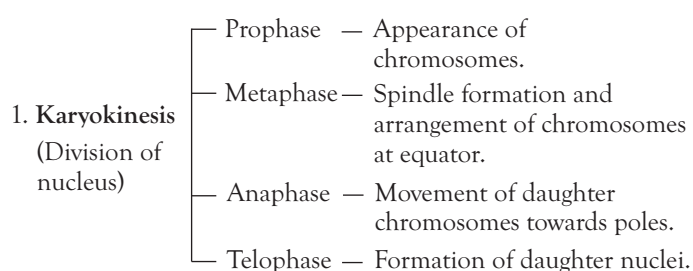
To study, observe and draw the various stages of mitosis from prepared permanent slides.

#### Materials Required

Permanent slides of various stages of mitosis, compound microscope, paper, pencil, etc.

#### Theory

Somatic growth in plants and animals takes place by the increase in the number of cells. A cell divides mitotically to form two daughter cells wherein, the number of chromosomes remains the same (i.e. unchanged) as in the mother cell. In plants, such divisions rapidly take place in meristematic tissues of root and shoot apex, where the stages of mitosis can be easily observed. Mitosis is completed in two stages.



2. Cytokinesis Division of cytoplasm to form two daughter cells.

#### Procedure

- Place the permanent slide on the stage of a compound microscope.
- Observe the slide initially under lower magnification (10X objective) to locate the dividing cells.
- Now, observe it under higher magnification (40X objective) to examine different stages of mitosis.
- Observe all the slides in the same way.

#### Observations

Under lower magnification, rectangular cells with pink nucleus are seen scattered. Most of the cells were in interphase. Under higher magnification, different stages become distinct which can be described as follows

#### Interphase

- It is a non-dividing phase of the cell cycle between two successive cell divisions.
- The cells are mostly rectangular, oval or even circular in shape.
- Nuclear envelope is distinct.
- The nucleus is homogenous, situated almost at centre and looks granular.
- Chromatin fibres appear in the form of an interconnected network within the nucleus.
- Nucleolus is also observed inside the nucleus.

#### Stages of Mitosis

##### 1. Prophase

- Nucleus is enlarged and occupies most of the cell volume. Intact nuclear outline is seen.
- Chromatin (seen as homogenous material in the nucleus at interphase) gets condensed and appears as long thread-like structures called **chromosomes**.
- Nuclear membrane starts disappearing.
- Nucleoli may or may not be visible. Nucleolus gradually disappears by the end of prophase.

##### 2. Metaphase

- Chromosomes become shorter and thicker and hence, become distinct and clearly visible under the compound microscope.
- Nuclear membrane completely disappears.
- Chromosomes orient themselves at the equator with their centromeres arranged on an equatorial

line forming **metaphase plate**. The two chromatids face the opposite poles which can be seen by changing the resolution of microscope.

- (iv) A **bipolar spindle** is made up of fine spindle fibres, appears in the cell in this phase.
- (v) In animal cells, **astral rays** appear around the centriole pairs at opposite poles. These aid in spindle formation and orientation by accumulation of microtubules.
- (vi) Series of spindle fibres attach the centromeres to the opposite poles. The points of attachment are known as **kinetochores**.
- (vii) Nucleolus is not observed during metaphase.

### 3. Anaphase

- (i) The two sister chromatids of each chromosome separate from the centromere and move towards the opposite poles.
- (ii) Chromatids separate due to splitting of the centromere. Each chromatid now represents a separate chromosome having its own centromere.
- (iii) The daughter chromosomes (separated chromatids) appear in V, J, L and I shapes, depending upon the position of centromere on the chromosomes.
- (iv) Anaphase is designated as early, mid and late, depending on the position of moving chromosomes with respect to the opposite poles.

### 4. Telophase

- (i) Chromosomes reach the opposite poles, lose their individuality and look like a mass of chromatin again.
- (ii) Nuclear membrane reappears to form the nuclei of two future daughter cells.
- (iii) Nucleolus gets reconstituted.
- (iv) Two daughter nuclei formed at the two poles of a cell, are similar to the parent nucleus both quantitatively and qualitatively.

## Cytokinesis

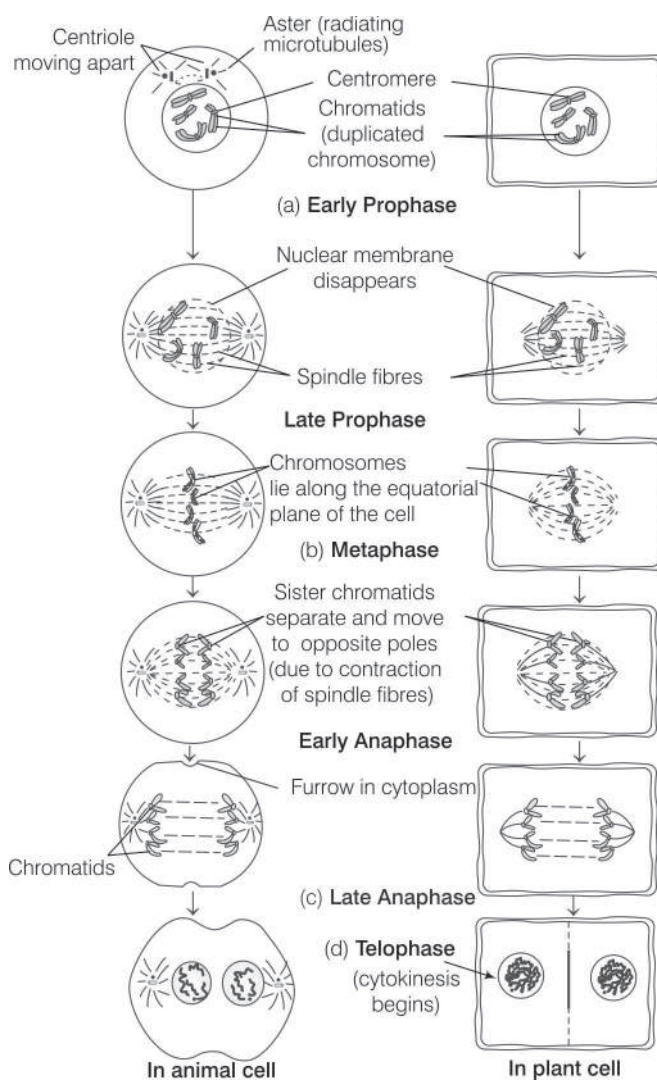
It is commonly known as division of the cytoplasm of parent cell into two daughter cells.

Cytokinesis in plant cells is different from animal cells due to the presence of a rigid cell wall.

- (i) **In plant cells** The division of cytoplasm occurs by cell plate or phragmoplast formation. The cell plate extends from the centre to the periphery and forms two daughter cells.

- (ii) **In animal cells** Cytokinesis occurs by the infolding or invagination of plasma membrane.

A furrow appears on the periphery and deepens toward the centre, finally it splits the cells into two daughter cells.



Different stages of mitosis

## Precautions

- (i) Observe all the slides carefully.
- (ii) Handle the permanent slides with care.
- (iii) First take observations under low power of objective then at higher magnification of microscope.

## Viva-Voce

1. Identify and define the cell division process which helps in regeneration.

**Ans.** Mitotic cell division results in the formation of identical daughter cells.

Thus, it helps in regeneration by forming new cells and replacing the older ones.

2. Name the chemical which inhibits cell division at metaphase stage.

**Ans.** Colchicine

3. At which stage of mitotic cell division are the chromosomes most distinctly visible?

**Ans.** Metaphase

4. Chromatids are pulled towards opposite poles at anaphase. How?

**Ans.** Through contraction of spindle fibres.

5. From where do the spindle fibres originate?

**Ans.** Spindle fibres in animal cells originate from centrioles. In plants, they develop from the cytoplasm.

6. If a cell has 6 chromosomes, what will be the number of chromosomes in daughter cells if it divides by mitosis and meiosis?

**Ans.** By mitotic division, the number of chromosomes will remain 6. By meiotic division, the number will be reduced to 3.

7. In a plant, which parts will divide by mitotic division?

**Ans.** Mitotic division occurs in the growing region like root tips and shoot tips of a plant.

8. The spindle fibres attach to the centromere at which point?

**Ans.** Spindle fibres attach to the centromere by kinetochore.

9. Nucleolus and nuclear membrane reappear in which phase?

**Ans.** Telophase

10. Division of cytoplasm differs in animal and plant cells in what ways?

**Ans.** In animal cells, cytoplasm division occurs by cell furrowing. In plant cells, cytoplasmic division occurs by cell plate method.

## Experiment 2(a)

### Aim

To demonstrate the process of diffusion in the laboratory.

### Materials Required

Beaker, water, a few tablets of potassium permanganate.

### Theory

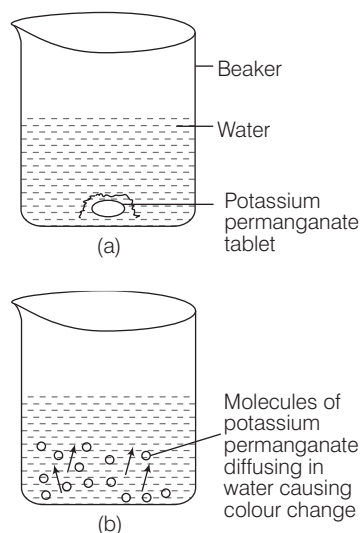
Diffusion is the process by which the molecules of a substance, i.e. solute, gas, liquid, solvent, etc., move from a region of higher concentration to a region of lower concentration.

The movement occurs when both the regions are in contact with each other.

### Procedure

- Take a beaker and fill it up with water.
- Drop a tablet of potassium permanganate in it.

- Leave the setup undisturbed for an hour and observe the changes.



Experimental setup to demonstrate the process of diffusion

## Observation

The colour of water turns pink after some time.

## Conclusion

The molecules of solid potassium permanganate diffuse in water because of its lower concentration in it.

After some time, as equilibrium is reached, the water in beaker turns homogeneously pink.

## Precautions

- (i) Clean water should be used.
- (ii) Do not swallow or smell the potassium permanganate tablet.
- (iii) Leave the setup undisturbed for some time.

## Viva-Voce

**1.** Can diffusion occurs in all types of media?

**Ans.** Yes, diffusion can occur in any medium.

**2.** Give any two factors that affect the rate of diffusion.

**Ans.** (i) Concentration gradient (ii) Temperature

**3.** Diffusion is an active process or passive transport.

**Ans.** Diffusion is passive transportation of materials from its higher concentration to lower concentration area in a medium.

**4.** List an example of diffusion from your day to day life.

**Ans.** The fragrance of an incense stick placed in one corner of a room spreads all over the room. This is because the molecules of the gas diffuse in the whole room.

**5.** Is osmosis a type of diffusion process?

**Ans.** Yes, it is the movement of water molecules from the region of higher concentration to a lower concentration through a semipermeable membrane. It is the special type of diffusion process.

**6.** Diffusion is a mode of transportation of water in plants. Why is there a need of water in plants?

**Ans.** Plants require water to carry out various processes of photosynthesis.

The water also helps in the transport of various other materials throughout the plant.

**7.** Diffusion is considered as a very important phenomenon in plants. Comment.

**Ans.** Apart from transport of gases, diffusion is the only means of transport of gases in plants.

## Experiment 2(b)

### Aim

To demonstrate osmosis by an experimental setup in laboratory.

### Materials Required

A stand, thistle funnel, water, sugar solution (sucrose), a semipermeable membrane (animal bladder or an egg membrane) and a beaker.

### Theory

Osmosis can be defined as the net movement of water molecules or solvent molecules through a differentially permeable or semipermeable membrane from the region of low solute concentration to the region of high solute concentration till a state of equilibrium is reached.

Osmosis depends on the **permeability** of the separating membrane. Permeability is the ability of a membrane to allow the passage of gases, liquids and liquid dissolved substances through it.

The membrane that allows passage of all types of substances through it is called **permeable membrane**, while the membrane that allows passage of only certain molecules or ions through it is called **semipermeable membrane**.

### Types of Osmosis

Osmosis is of two types

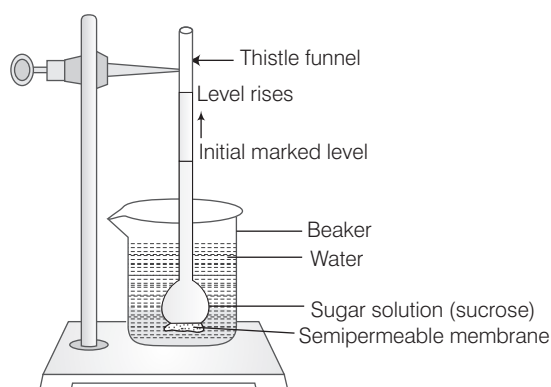
- (i) **Endosmosis** When the cell is placed in a hypotonic solution (i.e. osmotic potential is lower than cell sap), the solvent or water moves inside the cell.

During endosmosis, the cells swell up due to the entry of water and become turgid.

- (ii) **Exosmosis** When the cell is placed in a hypertonic solution (i.e. osmotic potential is higher than cell sap), the outward flow of water or solvent takes place. During exosmosis, the cells tend to shrink and become **flaccid**.

## Procedure

- (i) Take a thistle funnel and tie its mouth with a semipermeable membrane.



Experimental setup to demonstrate process of osmosis

- (ii) Fix the thistle funnel to a stand in the inverted form.  
 (iii) A beaker is taken and filled with water and kept at the base of the stand.  
 (iv) Insert the thistle funnel into the beaker.  
 (v) Pour sugar solution into the stem of inverted thistle funnel.  
 (vi) Mark the level of sugar solution and leave the apparatus undisturbed for a few hours.

## Observation

The level of the sucrose solution will rise in the funnel stem.

## Conclusion

The water moves into the stem of thistle funnel through the semipermeable membrane. It will continue to move until an equilibrium state is achieved.

## Precautions

- (i) The semipermeable membrane used in experimental setup should be intact.  
 (ii) Note the initial level of sugar solution carefully.

## Viva-Voce

1. Define osmosis.

**Ans.** It is the movement of water molecule from its higher concentration to lower concentration through semipermeable membrane.

2. How is osmosis different from diffusion?

**Ans.** Osmosis involves movement of water across a semipermeable membrane. It occurs only in liquid medium.

3. Osmosis is a special kind of diffusion, in which water diffuses across the cell membrane. List the factors on which the rate and direction of osmosis depend upon.

**Ans.** (i) Pressure  
 (ii) Concentration gradient

4. Enumerate the importance of osmosis in plants.

**Ans.** (i) It helps in maintaining turgidity of the cells.  
 (ii) It affects absorption of water by the roots.

5. What is meant by permeability?

**Ans.** Permeability is the ability of a membrane to allow the passage of gases, liquids and liquid dissolved substances through it.

6. Give difference between hypotonic and hypertonic solutions.

**Ans.** The solution whose osmotic potential is lower than that of the cell sap is called **hypotonic solution**, while the solution whose osmotic potential is higher than that of the cell sap is called **hypertonic solution**.

7. What do you mean by osmotic pressure?

**Ans.** It is the pressure which has to be applied to prevent the flow of pure water into concentrated solution under ideal osmotic condition.

8. Define the following terms

(i) Exosmosis                      (ii) Endosmosis

**Ans.** (i) **Exosmosis** The outward movement of water from the cell when kept in a hypertonic solution is called exosmosis.  
 (ii) **Endosmosis** The inward movement of water inside the cell when kept in a hypotonic solution is called endosmosis.

## Experiment 2(c)

### Aim

To study the process of osmosis by potato osmoscope or osmometer.

### Materials Required

A fresh big potato, peeler or scooper, 10-20% sugar solution (or conc. salt solution), petridish, blade, beaker, water and pins or needles marked with ink (waterproof).

### Theory

The living cells contain an osmotically active cell sap, which is surrounded by semipermeable membrane called **tonoplast** over the **vacuole** and plasma membrane over the protoplast.

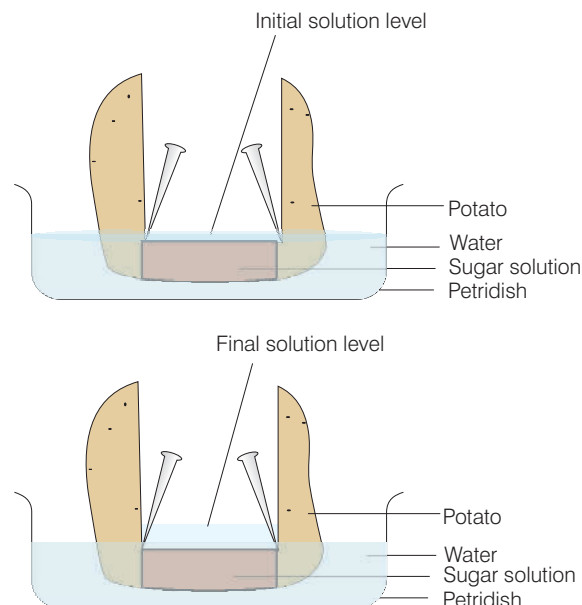
Thus, living cells show osmosis when placed in water or solutions having concentration lower than cell sap.

**Reverse osmosis** is the expulsion of pure water from solution through a semipermeable membrane under the influence of external pressure, higher than the osmotic pressure of solution.

### Procedure

- Cut the potato into two equal halves with blade. Peel off the outer skin of potato and shape the two halves into squares to give it a flat and even base.
- Make a square or circular-shaped cavity in the centre of the potato by scooping the soft parenchyma with the help of a peeler or scooper. The cavity prepared by scooping should have minimum thickness at the bottom.
- Place the potato on its flat cut end in a petridish, half-filled with water in such a way that 2/3rd of the potato is dipped in water.
- Fill half the cavity of the potato with 10-20% sugar solution and mark the level of sugar solution inside the cavity with the help of a pin or dissecting needle. This prepared apparatus works as an osmoscope or osmometer.
- Leave this osmometer undisturbed for about 2-3 hours.
- Observe the level of sugar solution.

- Repeat this experiment using water in potato cavity and sugar solution in petridish.



Demonstration of osmosis by potato osmometer or osmoscope

### Observation

The level of sugar solution in the potato cavity (which acted as an osmometer or osmoscope) rises after some time due to the entry of water from the beaker into as a result of endosmosis.

### Conclusion

A water potential gradient is established between sucrose solution in the potato cavity and the external water.

The cell membrane enclosing the cells of potato acts as a selectively permeable membrane for the movement of water and osmosis takes place successfully.

### Precautions

- The potato cavity should be deep enough to keep only a thin layer of tissues at the base.
- The potato block should be flat at the lower end to keep it stable in the petridish.
- Sugar solution should be highly concentrated, as compared to the cell sap of potato cells for osmosis to take place.

## Viva-Voce

1. Why do we use potato for making an osmometer or osmoscope?

**Ans.** Potato is an easily available living material and can be handled easily, therefore it is used as an osmometer or osmoscope.

2. Why is the potato peeled off while making it as an osmometer?

**Ans.** The skin of potato is thick and makes it impermeable for water to move across it. Therefore, it must be peeled off before making it as an osmometer.

3. What will happen if we use boiled potato for making an osmometer?

**Ans.** If we use boiled potato for making an osmometer, the living cells of potato will be killed by boiling and osmosis cannot be demonstrated.

4. Can we use salt solution instead of sugar solution to demonstrate the process of osmosis?

**Ans.** Yes, salt solution can also be used instead of sugar solution but it must be concentrated.

5. Why only living cells can act as an osmometer?

**Ans.** Since, living cells contain an osmotically active cell sap and are surrounded by semipermeable membrane, they can be used to act as osmometer. Dead cells do not have active cell sap.

## Experiment 2(d)

### Aim

To demonstrate that roots of a plant absorb water.

### Materials Required

Two test tubes, water, oil, a young small herbaceous plant with intact roots.

### Theory

Plants absorb water through their roots. The root hairs contain cell sap which has higher concentration of salts compared with outside water.

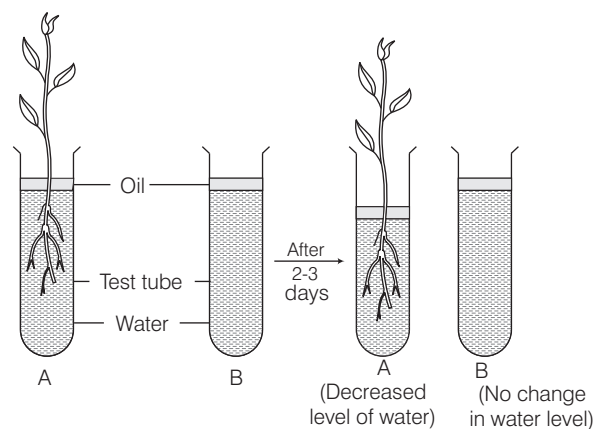
The difference between these two media triggers osmosis and the water present outside the cell starts diffusing into the root hairs.

The upward movement of water is facilitated by the root pressure developed in xylem tissues.

### Procedure

- (i) Take two clean test tubes and fill them with water. Label them as A and B.
- (ii) In test tube A, the young plant with intact roots is inserted carefully.
- (iii) Add a few drops of oil in test tube A to prevent the loss of water by evaporation.
- (iv) Prepare a similar setup in test tube B but without the plant.
- (v) Mark the level of water in both the tubes.

- (vi) Leave the setup undisturbed for few hours or a day.



Experimental setup to demonstrate that plant roots absorb water

### Observation

The level of the water in test tube A declines from the marked level. In test tube B, no change is observed.

### Conclusion

The decrease in the level of water in test tube A occurs because the water is being absorbed by the roots of the plant.

### Precautions

- (i) A healthy and fresh plant should be selected.
- (ii) Mark the level of water in both the tubes for accurate observations.

## Viva-Voce

1. Identify the process which causes loss of water from plants.

**Ans.** Transpiration removes water in the form of vapour from aerial parts of plant.

2. Which part of leaf aids the transpiration process?

**Ans.** Stomata

3. What is the purpose behind adding oil in the test tubes?

**Ans.** Oil cuts off the exchange between the surfaces and inhibits evaporation of water.

4. Identify the part of plants that absorbs water.

**Ans.** The root hairs present in roots absorb water from the soil.

5. Name the tissue responsible for upward movement of water.

**Ans.** Xylem

## Experiment 3(a)

### Aim

To demonstrate the process of transpiration using a bell jar.

For complete experiment refer to page no. 66 and 67 in chapter 4.

## Experiment 3(b)

### Aim

To demonstrate the unequal transpiration in a dorsiventral leaf using cobalt chloride paper.

### Materials Required

A potted plant, cobalt chloride ( $\text{CoCl}_2$ ) solution, glass slides, rubber bands, hot plate, blotting sheet, clip, vaseline and a desiccator.

### Theory

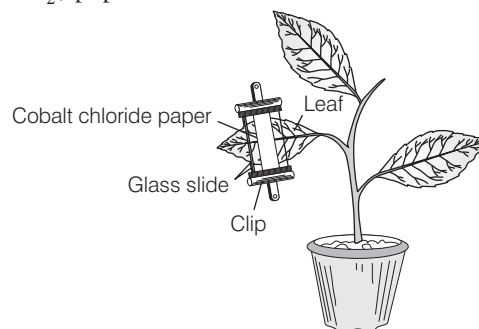
Transpiration is the loss of water in the form of vapour from the aerial parts of a plant. Transpiration mainly occurs through the minute pores on the surface of leaves called stomata. It occurs mostly during daytime when temperature is comparatively high and stomata are open.

About 85% of transpiration takes place through stomata and is called **stomatal transpiration**. The number of stomata present on the two surfaces of the leaves differ in most of the plants. Some amount of water is also lost through cuticles and this type of transpiration is called **cuticular transpiration**.

The rate of transpiration from the two surfaces of a leaf can be studied by comparing the loss of water vapour from the two surfaces of the leaf. Transpiration can be easily demonstrated by cobalt chloride paper test. Cobalt chloride is blue coloured in anhydrous (dry) form but turns pink, when it comes in contact with water. This property of cobalt chloride is used to demonstrate that water is lost during transpiration.

### Procedure

- In 100 mL of water, dissolve 5 g of cobalt chloride to prepare a 5% solution of cobalt chloride.
- Take a filter paper and cut thin uniform strips and dip these strips in  $\text{CoCl}_2$  solution.
- Now, dry the filter paper strip on hot plate or oven but take care that strips should not get burned or charred. These anhydrous cobalt chloride coated strips will appear blue in colour.
- Store these cobalt chloride coated strips in a desiccator.
- Select a leaf of a potted plant and blot the leaf dry from both the sides with the help of blotting sheets.
- Keep one dry cobalt chloride paper strip on the upper surface of leaf and stick it with the help of rubber band.
- Likewise, stick another strip of cobalt chloride ( $\text{CoCl}_2$ ) paper on the lower surface of leaf.



Demonstration of the rate of transpiration (loss of water) by cobalt chloride method

- (viii) Hold the leaf with the help of two slides and clips. Apply vaseline around the slide's edges to make it airtight.
- (ix) Now, place the potted plant in sunlight.
- (x) Keep observing after every 2 minutes till the strips turn blue to pink.

## Observation

It is observed that the strip fixed to the lower surface of leaf changes its colour blue to pink, i.e. from earlier as compared to the strip attached to the upper surface.

## Conclusion

It can be concluded from the given experiment that more stomata are present on the lower surface of leaf than the

upper surface. The strip's colour has changed from pink to blue because of the water vapours released from the leaf surface due to transpiration. Since, more stomata are present on the lower surface, the colour change occurs quickly in the strip attached to lower surface.

## Precautions

- (i) The strips dipped in cobalt chloride should be dried completely.
- (ii) Do not handle the dried strips with wet hands or place on wet surface.
- (iii) Cover the strips completely with the glass slides. The rubber band should be fixed tightly to hold the strips.

## Viva-Voce

1. What is transpiration?

**Ans.** The phenomenon of loss of water in the form of vapours from aerial parts of leaf.

2. State the part of leaf through which maximum transpiration occurs.

**Ans.** Stomata

3. From which surface of leaf do you think that the rate of transpiration is less and why?

**Ans.** The rate of transpiration is reduced in the upper surface of leaf. This is so because the number of stomata is less on the upper surface of leaf as compared to the lower surface.

4. Name the factors that can affect the rate of transpiration.

**Ans.** Factors affecting transpiration rate are

- (i) humidity                      (ii) light
- (iii) temperature              (iv) wind

5. What is the purpose of transpiration process in plants?

**Ans.** Transpiration helps in keeping the plant cool and in absorption of water by the roots through transpirational pull.

6. Why do we use the paper strips dipped in  $\text{CoCl}_2$  solution in this experiment?

**Ans.** The strips dipped in  $\text{CoCl}_2$  changes colour, i.e. it is blue when dry and turns pink when wet.

## Experiment 3(c)

### Aim

To demonstrate the uptake of water and the rate of transpiration using Ganong's potometer.

### Materials Required

A twig from a plant like Coleus, Ganong's potometer, water, beaker, a colouring dye (eosin).

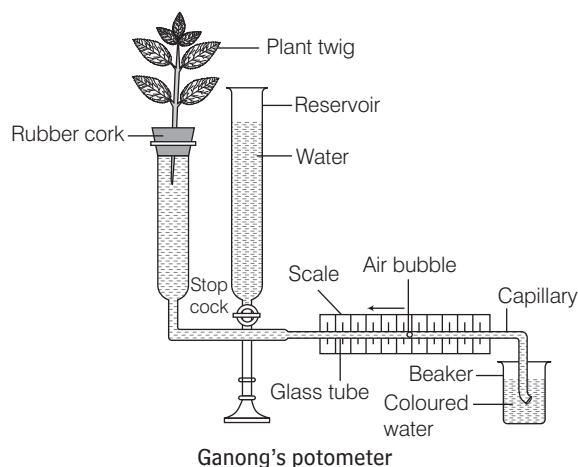
### Theory

Transpiration is the loss of water from aerial parts of plants like leaves, shoot, etc. It occurs at an increasing rate during the daytime. However, at night this rate is checked by closing of stomata. The transpirational pull is a force that pulls up the absorbed water and minerals to the top of trees. This pull is strong enough to resist the gravitational force and allows narrow xylem channels to uptake the water.

### Procedure

- (i) Select a twig from a plant and cut it out with a sharp knife.
- (ii) Fix the shoot at the upper end of the graduated capillary tube of the apparatus through a rubber cork.
- (iii) Fill the graduated capillary tube with the water.
- (iv) One end of the tube is made to dip in the beaker filled with coloured water (pink, if eosin is used).
- (v) An air bubble is allowed to enter the horizontal capillary tube by lifting the bent capillary tube above the coloured water containing beaker.
- (vi) The reservoir in the apparatus helps to bring air bubble to its original position. This can be done by releasing some more water into the capillary tube by opening the stop cork.
- (vii) Observe the apparatus without any disturbance.

- (viii) The capillary tube is graduated and will give an idea about the volume of water lost at the end of the experimental observation.



## Observation

When the process of transpiration starts in the twig, the bubble will move forward or the coloured water rises in the tube. This happens because of the suction force generated by transpiration which pulls the coloured water up from the beaker.

## Conclusion

Transpiration is occurring from the leaves of a twig which results in absorption of water by the roots. The absorbed water then moves up to the leaves *via* the stem.

## Precautions

- (i) The apparatus should be filled with water.
- (ii) Make sure no air spaces are present.
- (iii) Introduce the bubble carefully into the apparatus.

## Viva-Voce

1. What is the purpose of using coloured water in this experiment setup?

**Ans.** The coloured water can be easily seen moving through the apparatus.

2. How is the transpiration rate checked at night?

**Ans.** At night, the stomatal opening closes which checks the rate of water loss.

3. Name any anti-transpirants you know.

**Ans.** ABA and wax.

4. Desert plants have modified themselves in certain ways to check the rate of transpiration to avoid water loss. List some of these modifications.

**Ans.** (i) Thick cuticle  
(ii) Sunken stomata  
(iii) Reduction of leaves to spines

5. What is the limitation of using Ganong's potometer?

**Ans.** The placing of bubble in the capillary tube is difficult, thus making apparatus less effective.

## Experiment 4(a)

### Aim

To experimentally show that light is necessary for photosynthesis.

### Materials Required

A healthy potted green plant, black paper strips, glass slides, alcohol, beaker, water bath, burner or spirit lamp, tripod stand, rubber band, iodine, petridish, paper clips.

### Theory

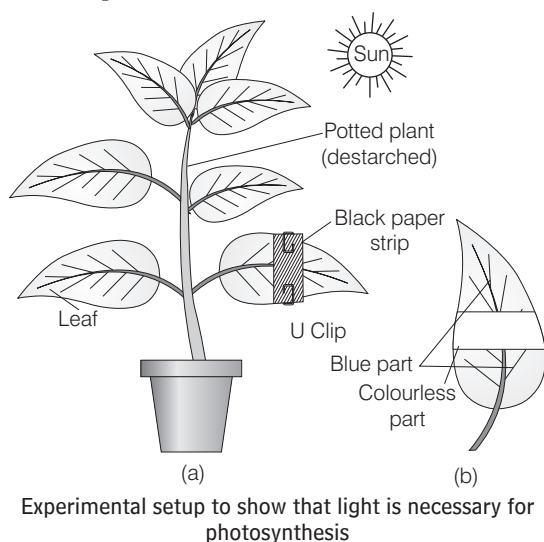
Plants prepare their food by the process of photosynthesis. This process utilises the light,  $\text{CO}_2$  and water along with chlorophyll pigment. Light from the sun provides energy

for this process. Light is converted into chemical energy by the photosynthetic pigments of the plant.

### Procedure

- (i) A healthy green plant is selected for the experiment.
- (ii) The potted plant is kept in a dark place for 1-2 days. This leads to destarching of the leaves of plant.
- (iii) After destarching the leaves, cover few leaves by uniform strips of black paper in the middle.
- (iv) The paper strips can be attached using paper clips or by glass slides bound together with rubber bands.
- (v) The plant is placed in sunlight for few hours or a day.

- (vi) After the stipulated time, remove the experimental leaf and remove the black paper strips.
- (vii) The experimental leaf is boiled in beaker containing alcohol kept in a water bath, maintained at about 60°C.
- (viii) The leaf is boiled until it becomes colourless. The leaf is taken out and washed with water. Put it in a clean petridish.
- (ix) Add a few drops of iodine solution to petridish and observe the changes occurring in exposed and covered part of the leaf.



## Observations

1. The portion of the leaf kept covered with black strips of paper does not turn blue-black on the addition of iodine.
2. The colour of uncovered portion of leaf changes into blue-black in presence of iodine.

## Conclusion

In the covered portion of leaf, photosynthesis did not occur. Starch, the end product of photosynthetic reaction was absent in this portion.

Iodine gives blue-black colour only in the presence of starch. Since, there was no starch in the covered portion of leaf, no colour change was observed unlike in the exposed portion of leaf.

## Precautions

- (i) The plant should be properly destarched.
- (ii) Black paper strips should be carefully clipped so that no sunlight reaches the leaf surface.
- (iii) Boiling in alcohol should be done in a water bath. Alcohol is inflammable, it will catch fire if boiled directly.
- (iv) Leaf should be washed after boiling in alcohol.

## Viva-Voce

1. Define photosynthesis.

**Ans.** The process by which green plants make food using sunlight, CO<sub>2</sub> and water in the presence of chlorophyll pigment.

2. Identify the cellular organelle which performs photosynthesis.

**Ans.** Chloroplast

3. Black paper strips of paper should be carefully fixed on leaf. Why?

**Ans.** Black paper inhibits the light from reaching the leaf surface. It should be fixed properly on leaf to block the path of light.

4. What is the role of light energy in the photosynthesis?

**Ans.** Light energy is converted into chemical energy during photosynthesis.

5. Name the first product of photosynthesis.

**Ans.** Glucose is the first product of photosynthesis.

## Experiment 4(b)

### Aim

To show that carbon dioxide is essential for photosynthesis.

### Materials Required

A green plant, potassium hydroxide (KOH), glass bottle, split cork, iodine, alcohol, spirit lamp, tripod stand, test tube, a water bath, petridish.

## Theory

Carbon dioxide is one of the raw materials required for photosynthesis. It is taken up by the plants from the atmosphere.

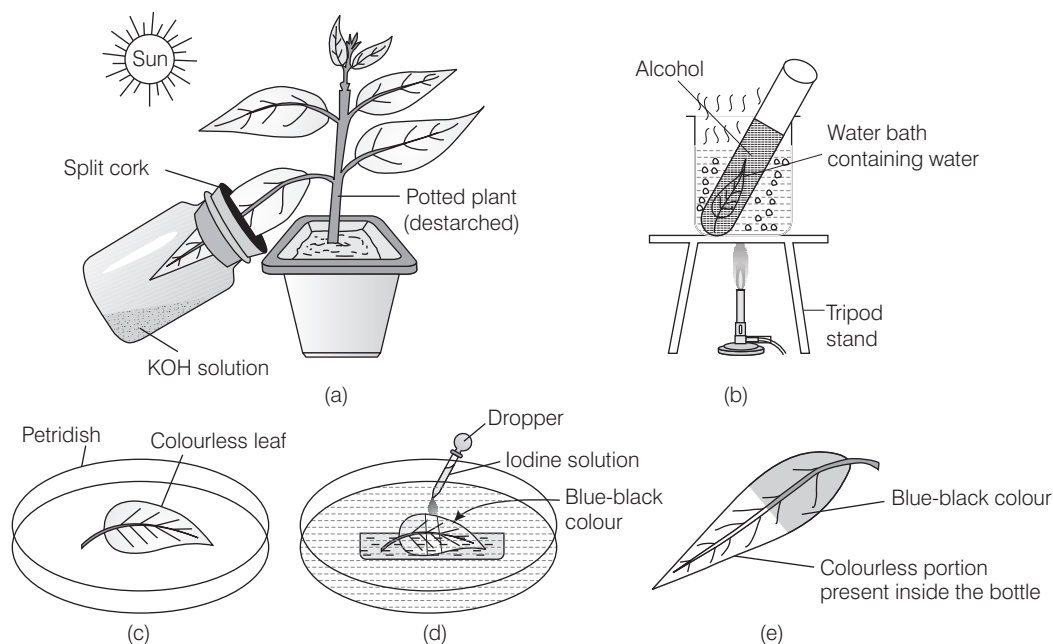
## Procedure

- (i) Place the healthy green plant chosen for experiment in a dark place for 24 hours to destarch it.

**Note** Destarching is important in all these experiments because if starch is already present in the leaves it will give positive test with iodine and experiment will not yield accurate result.

- (ii) Take a wide mouthed corked bottle and add potassium hydroxide (KOH) in it. The cork of the bottle is split in the middle.

- (iii) One of the leaves is inserted about half of its length through the split cork into the bottle.
- (iv) Place the whole apparatus in light for about 8 hours.
- (v) Remove the leaf from the bottle after 8 hours and test it for the presence of starch.
- (vi) The leaf is boiled in an alcohol contained in a test tube which is kept in a water bath. The leaf is boiled till it is completely decolourised.
- (vii) Remove the leaf from alcohol solution, wash it with water and place it in a clean petridish.
- (viii) Add a few drops of iodine on the leaf.
- (ix) Record your observations.



Experimental setup to prove that carbon dioxide is necessary for photosynthesis

## Observation

Portion of the leaf inside the bottle and within cork gives negative test for starch but the part of leaf outside the bottle gives a positive test for starch.

## Conclusion

The part of leaf inside the bottle did not get  $\text{CO}_2$  as it was absorbed by KOH present inside the glass bottle.

Hence, it cannot prepare food (starch in plants). So, when tested for starch, this part of leaf gives a negative test.

## Precautions

- (i) Completely destarch the plant.
- (ii) Use freshly prepared KOH solution.
- (iii) The glass bottle should be airtight.

## Viva-Voce

1. Plants synthesise food by photosynthesis in which form?

**Ans.** Starch

2. It is necessary to completely destarch a plant before the experiment. Why?

**Ans.** Destarching is done to make sure that the starch present in plant is completely used up.

3. What is the role of KOH in this experiment?

**Ans.** KOH absorbs the  $\text{CO}_2$  present in the bottle.

4. Give any one significance of photosynthesis.

**Ans.** Photosynthesis indirectly supplies the food to all the heterotrophs through plants.

5. What will happen when  $\text{CO}_2$  availability to plant is less?

**Ans.** The rate of photosynthesis will decline.

## Experiment 4(c)

### Aim

To show that chlorophyll is necessary for photosynthesis.

### Materials Required

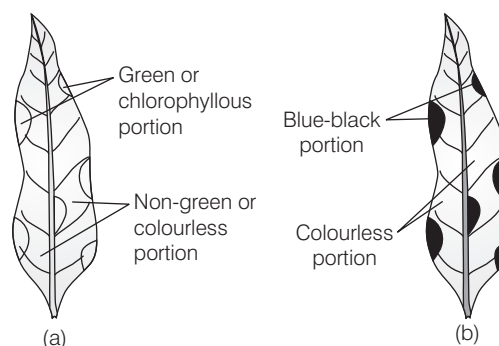
A potted plant with variegated leaves (*Coleus*/*Croton*), iodine solution, alcohol, petridish, tripod stand, burner, beaker, water bath.

### Theory

Chlorophyll is the green coloured pigment present in leaves. It converts the light energy of the sun to the chemical energy during photosynthesis.

### Procedure

- Take a healthy potted plant with variegated leaves (having different colour zones, i.e. green and non-green areas).
- First, destarch the leaves by keeping them in the dark room for about 2-3 days.  
Then restarch them by keeping the plant in the sun.
- After few hours, pluck one leaf. Draw the outline of green and non-green areas of leaf on the paper and mark the green and non-green parts.
- Now, test the leaf for starch with iodine solution.



Experiment to show that chlorophyll is essential for photosynthesis  
(a) Variegated leaf before experiment,  
(b) Variegated leaf after treatment with iodine solution

### Observation

The areas of leaf which were green will turn into blue-black colour.

### Conclusion

The green plants of the leaves have chlorophyll so they carry out photosynthesis and thus, make starch. Starch give blue-black colour with iodine. Therefore, this experiment proves that photosynthesis can take place only in the presence of chlorophyll.

### Precautions

- Destarch the plant completely.
- Draw the outline of leaves carefully.

## Viva-Voce

1. If we keep a potted plant in dark for a very long time, what is likely to happen?

**Ans.** Leaves will likely to become pale due to the decomposition of chlorophyll and plant may die later on.

2. What steps will be taken to decolourise the leaf in this experiment?

**Ans.** The leaf should be boiled in alcohol solution, kept in a water bath until it is colourless.

3. How is variegated leaf different from a normal leaf?

**Ans.** Variegated leaf has different colour zones, i.e. green and non-green zones.

4. Why is chlorophyll necessary for photosynthesis?

**Ans.** Chlorophyll pigment traps solar energy and converts it into chemical energy by the process of photosynthesis.

5. Write a balanced chemical equation for photosynthesis in plants.

**Ans.**  $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$

## Experiment 4(d)

### Aim

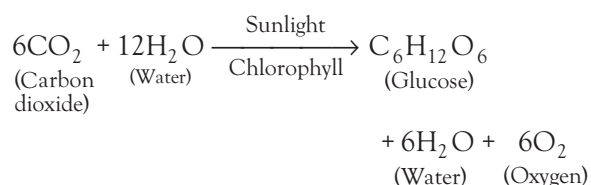
To show that oxygen is evolved during photosynthesis.

### Materials Required

An aquatic plant stem/twig (e.g. *Hydrilla*), water, beaker, glass funnel, splinter, matchbox, test tubes, sodium bicarbonate.

### Theory

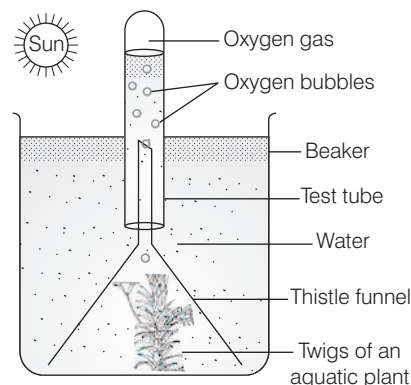
The process of photosynthesis is used by plants to prepare their food. It requires the presence of light,  $\text{CO}_2$  and water and releases oxygen in the process. The overall equation of this reaction is



In plants, photosynthesis takes place in organelles called chloroplast.

### Procedure

- Place any aquatic plant twig in a glass funnel.
- Place the glass funnel in inverted position in a beaker containing water.
- Add a pinch of sodium bicarbonate to the water in the beaker to produce carbon dioxide in the setup.
- Now take a test tube full of water and invert it over the stem of the funnel. Allow the setup to stand in the sunlight for about few hours.



Demonstration of the Liberation of oxygen in photosynthesis by an aquatic plant

### Observation

After a few hours, you will observe the presence of bubbles in the inverted test tube, which will get collected in the form of gas in the test tube.

The test tube will completely lose its water contents. A glowing splinter is introduced in the test tube, it will burst into flames. This demonstrates that oxygen ( $\text{O}_2$ ) is liberated as a byproduct in photosynthesis.

### Precautions

- Ensure that the aquatic plant stem (e.g. *Hydrilla*) is completely submerged in water.
- Remove the empty test tube carefully by placing your thumb at its mouth to prevent escape of gas.
- Maintain distance while inserting the splinter into the test tube.

## Viva-Voce

1. In this experiment, why sodium bicarbonate is added to the water in beaker?

**Ans.** Sodium bicarbonate produces  $\text{CO}_2$ , i.e. a necessary raw material for photosynthesis.

2. When a glowing splinter is placed at the mouth of test tube, it bursts into flame. Why?

**Ans.** The splinter bursts into flame because oxygen is present in the tube which supports burning.

3. Why is aquatic plant used in this experiment?

**Ans.** An aquatic plant can perform photosynthesis in water.

4. The oxygen released from photosynthetic reactions comes from splitting of water or  $\text{CO}_2$ ?

**Ans.** The oxygen released comes from splitting up of water molecules.

## Animal Life

### Experiment 1 (a)

#### Aim

To study the structure of human urinary system using chart or model.

#### Materials Required

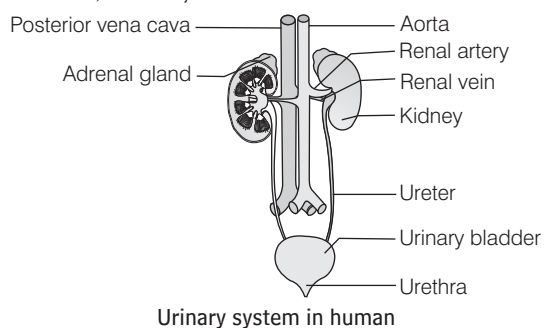
A model or chart of the human urinary system.

#### Procedure

- Observe the model or chart given by the teacher carefully. Note down the salient features of the system.
- Carefully observe the labelling and location of various parts.
- Draw a well-labelled diagram of urinary system in your notebook along with comments about the system.

#### Observations

Urinary system in humans consists of a pair of kidneys, a pair of ureters, urinary bladder and urethra.



#### Kidneys

These are two bean-shaped structures, located on either sides of the backbone in the abdominal cavity. Kidneys are located below the diaphragm on the left and right sides and protected by the last two ribs.

Right kidney is slightly lower than left kidney because liver takes much space of right side and pushes it down.

#### External Structure of Kidney

Each kidney is about 10cm long, 6cm wide and 3.5cm thick. The outer surface of kidney is convex and the inner surface is concave.

At the inner concave surface, a notch-type structure called **hilum** is present, through which the supply of blood occurs, i.e. renal artery and renal vein, pass in and out of the kidneys along with ureter and nerve supply of the kidney.

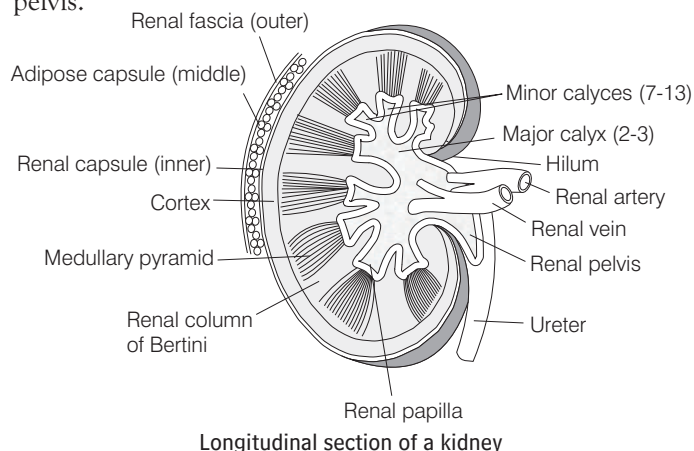
The kidney is bounded externally by a thin sheet of white fibrous tissue called **renal capsule**.

#### Internal Structure of Kidney

Internally, each kidney is made up of two main regions, i.e. **outer cortex** and **inner medulla**. The cortex is the outer darker region which is dotted in appearance. The **nephrons** are highly coiled in this region.

The medulla is composed of finely stripped substance being arranged in several conical projections called **renal** or **medullary pyramids**.

Apex of each renal pyramid projects inwards towards the pelvis.



Each kidney is composed of enormous number of microscopic tubules called **nephrons** or **renal tubules**, or **uriniferous tubules**, which are the functional units of the kidney.

## Ureters

These are the paired tubular structures arising from the pelvis of each kidney. The upper half of the ureter is located in the abdomen and lower half is located in the pelvic area. The tube has thick walls comprised of a fibrous, a muscular and mucus coat, which are able to contract. The urine produced in the kidneys constantly flows through these ureters and collects into the urinary bladder. The valves present in the ureters prevent the backflow of urine during the contraction of bladder.

## Urinary Bladder

It is a thin-walled and pear-shaped sac which is meant to store the urine temporarily.

Urine enters the bladder *via* ureters and exits *via* urethra. It is located in the lower abdominal area of body near the pelvic bones.

## Urethra

It is a membranous tube through which urine emptied from bladder is conducted to the exterior.

The **urethral sphincters** keep the urethra closed and open it only at the time of urination.

Its main function is to excrete waste product out of the body.

## Functioning of the Human Urinary System

- (i) The nephrons present in kidney act like filters. The blood carrying waste reaches the kidney and is filtered through the nephrons.
- (ii) The useful substances are reabsorbed while the wastes are retained to be passed out of the body.
- (iii) The blood without the waste is then returned back to circulation.

## Precautions

- (i) Handle the model with care.
- (ii) Make precise observations.

## Viva-Voce

**1.** Where are the kidneys present?

**Ans.** They are present in the abdominal cavity on either sides of the vertebral column.

**2.** What is the shape and weight of a kidney?

**Ans.** It is bean-shaped and it weighs about 120-170 g.

**3.** Name the components of the human urinary system.

**Ans.** A pair of kidney, a pair of ureter, a urinary bladder and a urethra.

**4.** What is the process of urine formation called?

**Ans.** Uropoiesis

**5.** Name the structural and functional unit of kidneys.

**Ans.** Nephron

**6.** What is the excretory product from the kidney of reptiles?

**Ans.** Uric acid

**7.** Name the two components of nephron that together form Malpighian body or renal corpuscle.

**Ans.** Glomerulus and Bowman's capsule.

**8.** Which blood vessel will carry the filtered blood away from the kidneys?

**Ans.** The renal vein.

**9.** Give the name of the reservoir of urine in the body.

**Ans.** Urinary bladder.

**10.** What is the role of ureters?

**Ans.** These are ducts which carry the urine from the kidneys towards the urinary bladder.

**11.** What are the two parts of a kidney?

**Ans.** It has an outer cortex and an inner medulla.

## Experiment 1 (b)

### Aim

To study the internal structure of human heart using chart or model.

### Materials Required

A model or chart of the human heart.

### Procedure

- Observe the model and chart given by the teacher carefully. Note down the important features.
- Carefully observe the labelling and location of parts of heart.
- Draw a well-labelled diagram of heart in your notebook along with comments.

### Observations

Heart is the main pumping organ found in the thoracic cavity in human beings, i.e. between the two lungs and above the diaphragm. It is independent from the control of both nervous system and hormonal system.

It is made-up of cardiac muscles having unique features like automatic contraction and they do not get fatigued whole life.

### External Structure

It is about the size of our close fist and is protected by a double membranous covering known as **pericardium**. The space between the two pericardial membranes is filled with **pericardial fluid**, which protects the heart from any mechanical injury and shocks and also helps in reducing friction.

Human heart is comprised of four main chambers, i.e. two relatively small upper chambers called **auricles** (sing. atria) and two larger lower chambers called **ventricles** (sing. ventricle). The right atrium is slightly larger than the left atrium. Both these atria are meant to receive blood from different body parts.

### Internal Structure

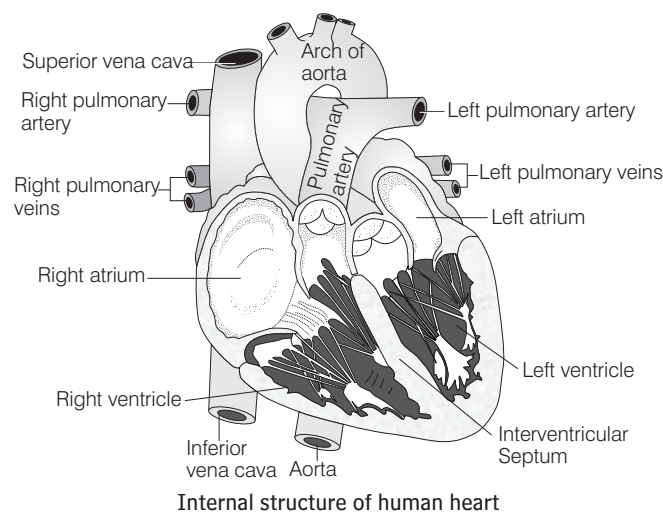
Internally, the chambers of heart, i.e. two auricles (atria) and two ventricles are separated by different septa and valves. The chambers of heart are discussed below

- Auricles (Atria)** These are the upper two thin-walled and smaller chambers. They serve to receive the blood, therefore are called **receiving chambers** (right atrium and left atrium). Both the right and the left atria are

separated by a thin, muscular wall known as **interatrial septum**.

(i) **Right atrium** This right chamber deals with only **impure** (deoxygenated) blood. It receives impure blood from various parts of the body, through two major veins, i.e. superior and inferior vena cana. It also receives blood from the walls of the heart itself (through a coronary sinus).

(ii) **Left atrium** This chamber is meant to deal with only **pure** (oxygenated) blood. It receives pure blood from lungs through two **pulmonary veins** (i.e. one from the each lung).



- Ventricles** These are lower two chambers of the heart, that pump the blood away from the heart. These function as **pumping chambers**. Both the right and the left ventricles are separated by the **inter-ventricular septum**. The atrium and the ventricle of the same side are also separated by another septum, a thick fibrous tissue called **Atrio-Ventricular septum** (i.e. AV septum).
  - Right ventricle** It receives impure blood from right atrium and pumps blood into **pulmonary artery**, which further takes this blood to lungs for purification.
  - Left ventricle** It receives pure (oxygenated) blood from left atrium and pumps its pure blood to **aorta** (largest artery in the pathway), which in turn takes this blood to whole body and organs.

## Functioning of the Human Heart

- (i) The heart beats 72 times per minute. The beating of heart corresponds to the contraction and relaxation of the chamber of heart.
- (ii) Blood circulation is the result of the rhythmic movement of the heart.
- (iii) Heartbeat originates at the SA node.
- (iv) A complete separation of the oxygenated and deoxygenated blood is observed in human heart.
- (v) Vena cava brings the deoxygenated blood to the heart and pours it into right auricle. From here, the blood

goes into the right ventricle. The blood then passes to lungs for oxygenation *via* pulmonary arteries.

- (vi) The oxygenated blood is brought by pulmonary veins to left auricle. From here, it goes to left ventricle and gets distributed in the body *via* aorta.

This blood circulation system of human heart is called **double circulation**.

## Precautions

- (i) Observation should be made carefully.
- (ii) Handle the model of heart with care.

## Viva-Voce

1. Specify the location of heart in human beings.

**Ans.** In the chest cavity between the lungs.

2. What type of circulation system is found in humans?

**Ans.** Closed circulatory system. In this, the blood flows through a closed network of vessels.

3. The initiation and maintenance of the rhythmic activity of heart is function of which part of heart?

**Ans.** Sino-atrial node. It is also known as the pacemaker of heart.

4. The walls of ventricles are found to be thicker than those of auricles. Why?

**Ans.** The ventricles pump the oxygenated blood with great pressure to long distance from the heart.

5. Why are valves present in heart and veins?

**Ans.** Valves are present in heart and veins to ensure that blood does not flow backward in their respective source chambers.

6. Name the protective covering of the heart.

**Ans.** Pericardium is the protective covering of heart.

7. State the exact location of the tricuspid valve.

**Ans.** Tricuspid valve is found between the right auricle and right ventricle.

8. All veins carry deoxygenated blood. Do you agree?

**Ans.** No, pulmonary vein is an exception because it carries oxygenated blood from lungs to left atrium.

9. Differentiate between the bicuspid valve and tricuspid valve (function).

**Ans.** The difference between bicuspid valve and tricuspid valve are as follows

Bicuspid valve	Tricuspid valve
It guards the opening when blood rushes from left auricle into left ventricle.	It guards the opening when blood rushes from right atrium to right ventricle.

10. Write the functions of two upper chambers of human heart.

**Ans.** The functions of two upper chambers, i.e. left atrium and right atrium of human heart are given below

- (i) Left atrium receives oxygenated blood from pulmonary vein.
- (ii) Right atrium receives deoxygenated blood from vena cava.

11. State the correct location of pulmonary semilunar valve.

**Ans.** Pulmonary semilunar valve is located at the base of the pulmonary trunk.

## Experiment 1 (c)

### Aim

To study the structure of human brain using chart or model.

### Materials Required

A model or chart of the human brain.

### Theory

Brain along with the spinal cord constitutes the Central Nervous System (CNS). It is the integrating and command centre of the nervous system.

The brain is the central information processing unit in our body. It controls many activities, few of them are

- (i) The voluntary and involuntary movements.
- (ii) Maintenance of body balance.
- (iii) Thermoregulation, hunger and thirst.
- (iv) Regulation of vision, speech, memory, intelligence, etc.

### Procedure

- (i) Observe the model and chart of brain carefully and note down its features.
- (ii) Draw a well-labelled diagram of brain along with comments in your notebook.

### Observations

#### Brain

The brain is the central information processing organ of our body and acts as the 'command and control system' of all body activities. The brain is the anteriormost part of the central nervous system. It is located in the cranium (cranial cavity) of the skull. It weighs about 1.4 kgs. It is made up of approximately 86 billion neurons.

#### Protective Covering of the Brain

Inside the skull, the brain is protected by meninges. The meninges are continuous with the spinal cord and consists of three layers as follows

- (i) **Duramater** Tough fibrous outermost covering.
- (ii) **Arachnoid mater** Middle, very thin and delicate layer.
- (iii) **Piamater** Innermost very thin, tough and highly vascular.

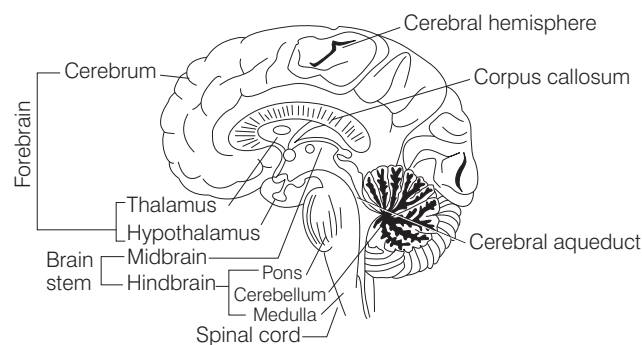


Diagram showing sagittal section of the human brain

### Parts of Brain

Human brain is divisible into three main parts

#### (i) Forebrain

It is the largest part of the brain. It is divided into olfactory lobe, cerebrum and diencephalon. All of these are discussed below

- (a) **Olfactory lobe** These are paired lobes and functionally related with sense of smell.
- (b) **Cerebrum** It is the largest, most complex and most developed part of the human brain. Hence, it is considered as **seat of intelligence**.

It is divided into two main parts (halves) known as **cerebral hemispheres**. Each cerebral hemisphere is hollow from interior and has two regions, i.e. **outer cortex** and **inner medulla**.

The outer (cortex) portion is greyish in colour containing all the cell bodies of the neuron. It is also known as **grey matter**. The large grooves formed by the layers of grey matter are called **gyri** and the small folds in it are called **sulci**.

The inner (medulla) portion is composed of **white matter**, which mainly consists of axons of the neurons. The two cerebral hemispheres are interconnected by a sheet of fibres known as **corpus callosum**. It is meant to transfer information from one cerebral hemisphere to the another.

Cerebrum enables us to think, invent, plan, memorise, reason, logic, etc. It mainly controls all the voluntary actions. It also contains subconscious mind where past experiences are stored.

- (c) **Diencephalon** It consists of two major parts **thalamus** (a major coordinating centre for sensory and motor signalling) and **hypothalamus** (mainly controls body temperature, urge for eating, drinking, anger, pleasure and actions of pituitary gland).

## (ii) Midbrain

It is located in between the **thalamus/ hypothalamus** (of forebrain) and **pons** (of hindbrain). It is the small tubular part (about 2cm long) of brain, which helps to relay information for vision and hearing.

The **medulla oblongata**, the **pons** and the **midbrain** form **brain stem**.

## (iii) Hindbrain

It further consists of following three main parts

- (a) **Cerebellum** It is situated at the base, under the cerebrum of forebrain. It is also known as **Little brain**.

It is composed of outer cortex and inner medulla consisting of grey and white matter, respectively. It has no convolutions but has numerous furrows. It coordinates the muscular activity and maintains the balance of the body.

- (b) **Pons** It is located below the cerebellum and is responsible for carrying impulses from cerebellum to cerebrum. It also helps in regulation of breathing movements.

- (c) **Medulla oblongata** It is the lowermost portion of the hindbrain situated at the base of the skull. It continues behind as the spinal cord.

It's main function is to control the activities of internal organs like respiration, gastric secretions, beating of heart, peristaltic movements, etc.

## Precautions

- Observe the models and charts carefully.
- Handle the models with care.

## Viva-Voce

- Give the name of the central information processing organ of our body.

**Ans.** Brain

- Identify the main parts of the brain.

**Ans.** Cerebrum, cerebellum and medulla oblongata.

- Which is the largest and most complex part of the brain?

**Ans.** Cerebrum

- Any injury occurring to the medulla most often results in death. Comment.

**Ans.** The medulla oblongata controls vital activities like beating of heart, respiration, etc.

- Name the structural and functional unit of the brain.

**Ans.** Neuron (nerve cell).

- Name the part of the brain associated with memory.

**Ans.** Cerebrum is the part of brain associated with the memory.

- State the exact location of corpus callosum.

**Ans.** It is found between the two lobes of cerebrum called cerebral hemispheres.

- Give the exact location and function of the meninges.

**Ans.** Meninges are located as the covering of brain and spinal cord. Its function is to provide protection to the brain and spinal cord.

- What is grey matter?

**Ans.** It is the outer portion of the cerebrum which contains cell bodies of neuron.

- What is corpus callosum?

**Ans.** It is a band of fibres which joins the two cerebral hemispheres.

- What covers the heart?

**Ans.** There is a membrane called the pericardium which covers the heart.

## Experiment 2

### Aim

To identify different types of blood cells under a microscope.

### Materials Required

Permanent slides of blood smear, microscope, a chart showing the type of blood cells.

### Theory

Blood is a fluid connective tissue comprising of plasma and other cellular elements.

The other cellular elements are blood corpuscles of different types which form about 45% of the blood.

### Procedure

- Take the permanent slide and wipe it with a dry tissue.
- Fix the slide on the stage under the low power objective lens of microscope. Make your observations.
- Change the power of objective lens to higher magnification and record your observation.
- Draw a well-labelled diagram in your notebook with few characteristics.

### Observations

The following types of blood cells can be observed in the blood smear

**Blood** is a fluid connective tissue, found circulating inside the body. The blood is bright red in colour, when taken from an artery (contains oxygenated blood) and its colour is dark

red when taken from a vein (contains deoxygenated blood). Its pH is 7.3-7.5, i.e. slightly alkaline in nature. The amount of blood present in an average adult human is 4-6 litres.

The blood corpuscles are the cellular elements of the blood constituting about 45% of the blood. These include erythrocytes (RBCs), leucocytes (WBCs) and thrombocytes (platelets).

- Erythrocytes (RBCs)** They are the most abundant type of cells found in the blood. RBCs are biconcave disc-like structures. Sometimes, due to an abnormality (mutation), RBCs become fragile and sickle-shaped. This condition is called **sickle-cell anaemia**. Erythrocytes are extremely small in size (of about 7  $\mu\text{m}$ ), due to which they move easily through the capillaries in the body. Humans have 4-6 million/ $\text{m}^3$  RBC in blood.

The average lifespan of a mature RBC is only 120 days, after which it gets destroyed in the spleen (graveyard of RBCs).

**Function** The major function of RBCs is to transport respiratory gases to the tissues.

- Leucocytes (WBCs)** These are the most active and motile constituents of blood. They differ from RBCs as they are nucleated (have nucleus) and lack the coloured pigment haemoglobin.

WBCs are irregular in shape and are generally short-lived, i.e. only 12-14 days. They comprise 5000-9000  $\text{mm}^3$  of human blood.

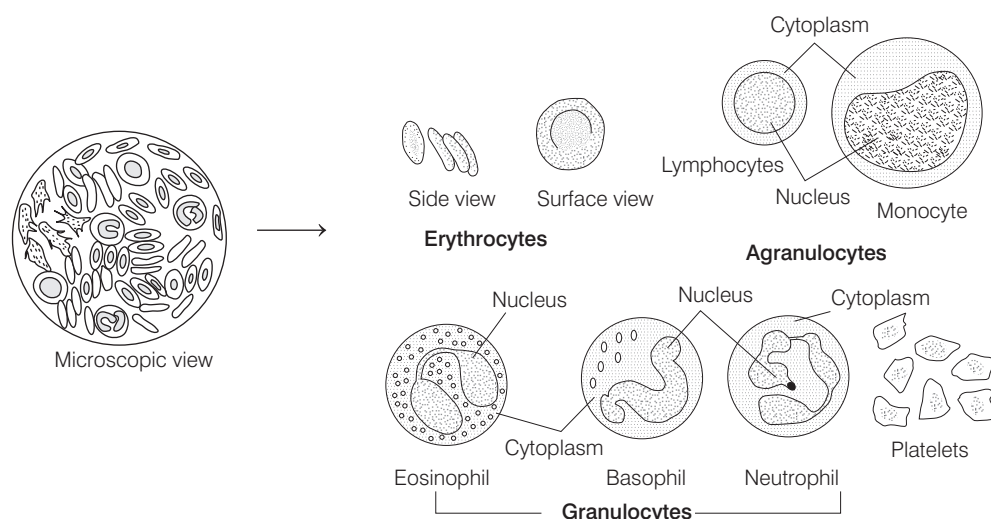
Different Types of White Blood Cells (Leucocytes) after Staining

Two major categories of WBCs	Cell type	Distinguishing features	Functions
Granular	Neutrophils (62%)	Nucleus with 3-4 lobes. Granules stain with neutral dyes.	Engulf bacteria. (phagocytosis)
	Eosinophils (2.3%) count increases during allergic reactions	Nucleus with 2 lobes. Granules stain dark red with eosin (acid dye).	Engulf bacteria. Secrete antitoxins, that are associated with allergy.
	Basophils (0.4%)	Nucleus large indistinctly lobed. Granules stain with basic dyes, i.e. methylene blue.	Release chemicals (such as histamine) for inflammation which dilate blood vessels.
Agranular	Lymphocytes (30%)	Smallest type of WBC. Single large nucleus.	Produce antibodies
	Monocytes (5.3%)	Large kidney-shaped nucleus. Transform into macrophages at the site of infection.	Ingest germ

**Functions** The major function of leucocytes is to act in defence mechanism for body. They have the ability of phagocytosis or engulfing the foreign particles, e.g. neutrophils. Some types of WBCs help in reducing inflammation caused by injury or trauma (e.g. monocytes, neutrophils). WBCs also produce antibodies that provide immunity and help in killing foreign particles, e.g. lymphocytes.

- (iii) **Thrombocytes** (Blood Platelets) They are minute, oval or round and enucleated structures found floating in the blood. They are  $20000-400000/\text{mm}^3$  in blood. Their lifespan is about 3-5 days after which they get destroyed in the spleen along with RBCs.

**Function** Their main function is to help in clotting or coagulation of blood.



## Precautions

- (i) Handle the slide carefully.
- (ii) Wipe the surface of slide softly with dry tissue.
- (iii) First, observation should be made in low power followed by high power objective.

## Viva-Voce

1. Define blood.

**Ans.** Blood is a fluid connective tissue present in our body and is responsible for circulation.

2. Identify the components found in blood.

**Ans.** Plasma and formed elements (i.e. RBC, WBC and platelets).

3. What should be the normal leucocyte count in humans?

**Ans.**  $5000-9000/\text{mm}^3$  of blood.

4. Which blood cells boost the immune system of our body?

**Ans.** White blood cells.

5. Give any two functions of blood.

**Ans.** (i) Helps in transportation of respiratory gases.  
(ii) Maintains pH, water and ionic balance of the body.

6. A reduction in platelet count is observed in an individual during blood test. What possible problem will he suffer from?

**Ans.** A reduction in platelet count leads to clotting disorder which will cause excessive blood loss at the time of an injury.

7. All the allergic responses in our body are attributed to which cells?

**Ans.** Eosinophils

8. Mention the function of RBCs in our body.

**Ans.** RBCs help in oxygen transport with the help of respiratory pigment, i.e. haemoglobin.

9. What will happen if the RBC count declines from the normal level?

**Ans.** The condition occurring due to fall in RBC number is called anaemia.

10. Do RBCs have a nucleus?

**Ans.** No, they do not have a nucleus.

## Experiment 3

### Aim

To study the structure of human eye and ear using model and charts.

### Materials Required

Models of the human eye and ear or charts of the same.

### Theory

The human eye and ear both form the sensory organs in our body. They enable us to detect the changes in the environment and send appropriate signals to the CNS. Here, all the inputs are processed and analysed.

### Procedure

- (i) Observe the model shown by the teacher from all sides with care.
- (ii) Observe and identify all the parts of both the organs.
- (iii) Draw the diagram of the human eye and ear with correct labelling. Take help from the charts shown.

### Observations

#### The Human Eye

The human eye is one of the most valuable and sensitive sense organs in the human body. It enables us to see the wonderful world and colour around us. It consists of a **lens**, which is made up of living tissues.

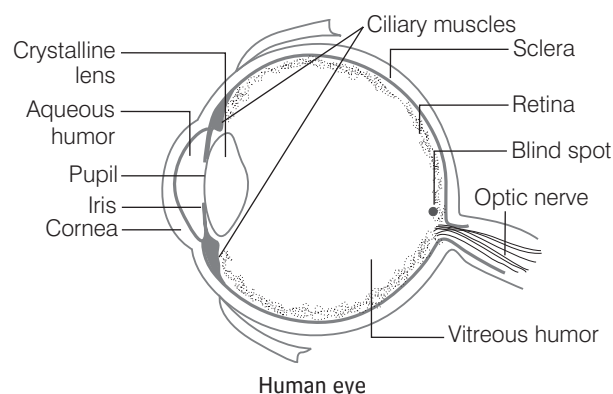
#### Structure of Human Eye

A human eye has the following main parts

1. **Cornea** It is the transparent spherical membrane covering the front of the eye. Light enters the eye through this membrane.  
Most of the refraction of light rays entering the eye occurs at the outer surface of the cornea.
2. **Crystalline lens** The eye lens is a convex lens made of a transparent, soft and flexible material like a jelly made of proteins.
3. **Iris** It is a dark muscular diaphragm between the **cornea** and the **lens**. It controls the size of the **pupil**. It is the colour of the iris that we call colour of the eye.
4. **Pupil** It is a small hole between the **iris** through which light enters the eye. In dim light, it opens up

completely due to expansion of iris muscles, but in bright light it becomes very small due to contraction of iris muscles.

5. **Ciliary muscles** They hold the lens in position and help in modifying the curvature of the lens.
6. **Retina** It is the light-sensitive surface of eye on which the image is formed. It contains light-sensitive cells, i.e., **rods** and **cones**. Rod cells respond to the intensity of light and cones respond to the illumination. Their number is around 125 million. Number of rod cells is greater than number of cone cells. These cells generate signals which are transmitted to the brain through optic nerves.



7. **Optic nerve** It transmits visual information from the **retina** to the **brain**.
8. **Sclera** It is an opaque, fibrous, protective and an outer layer of an eye containing **collagen** and **elastic fibre**. It is also known as **white of the eye**.
9. **Blind spot** It is the point at which the optic nerve leaves the eye. It contains no rods and cones, so an image formed at this point is not sent to the brain.
10. **Aqueous humor** Behind the cornea, we have a space filled with a transparent liquid called the aqueous humor and behind this, there is a crystalline lens which helps to refract light to be focussed on retina and maintains intraocular pressure.
11. **Vitreous humor** The space between eye lens and retina is filled with another liquid called vitreous humor.

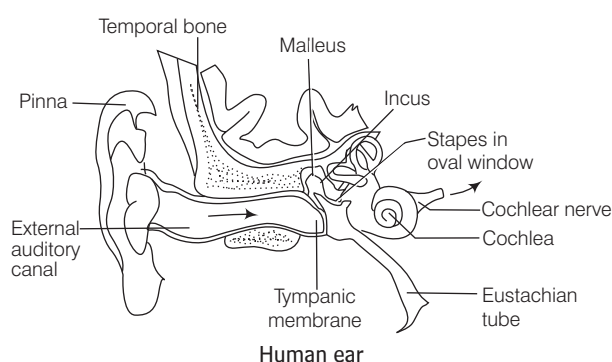
#### Working of the Eye

The light rays reflected from the object enter the eye through the cornea and are converged by the lens.

An inverted image forms on the retina. Photoreceptor cells are activated, nerve impulses are generated and get transmitted to the cerebrum *via* optic nerve. This leads to the formation of an upright image on retina.

## The Human Ear

Human ear is concerned with two functions, sensory functions such as hearing and maintenance of body balance.



This organ receives sound waves during hearing. The ear analyses these sound waves for examining the pitch, intensity, quality and direction of these waves.

## Structure of Ear

Each ear is divided into three main divisions as follows

1. **Outer (External) ear** This portion of ear mainly consists of **pinna** and **auditory canal** leading to the eardrum.
2. **Middle ear** This portion of the ear contains three ossicles or bones called **malleus** (hammer), **incus** (anvil) and **stapes** (stirrup), which are attached to each other in chain-like fashion. One end of hammer is attached to the eardrum (**tympanic membrane**) and the other free end is attached to the oval window of inner ear.

It opens into the **eustachian tube**, which connects with the pharynx and maintains the pressure on each sides of the eardrum. An infection in throat may also lead to ear infections due to this connection.

3. **Inner ear** This portion of ear consists of a **labyrinth**, i.e. fluid-filled chambers within the temporal bone of the skull. The fluid within the chambers of membranous labyrinth is called **endolymph**. The membranous labyrinth is divided into two main parts

- (i) **Cochlea** It is a coiled portion of the labyrinth and has around two and half turns. Its inner winding cavity is divided into three parallel canals separated by membranes. Out of these, the middle canal contains areas, which has auditory sense cells called **organ of Corti**.

An extracellular fluid called '**perilymph**' is found within the cochlea containing hair cells.

The impulses from the cochlea of the ear are transmitted to the brain through **auditory nerve**.

- (ii) **Semicircular canals** These are the set of three semicircular, interconnected tubes located inside each ear. Each canal widens to form ampulla. The ampulla contains sense cells, which provide dynamic equilibrium to body. Each canal is filled with the fluid called **endolymph** and contains motion sensor cells within the fluid.

## Working of the Ear

**Pinna** (of outer ear) collects the sound waves from the surroundings. These waves pass through the ear canal (auditory canal) and fall on the eardrum (tympanum) or **tympanic membrane**.

The **eardrum** starts vibrating back and forth rapidly.

These vibrations are amplified several times by the three bones in the middle ear and then passed to the liquid (endolymph) in the cochlea.

Due to this, the liquid in the cochlea begins to vibrate and the pressure variations are turned into electrical signals by the cochlea.

These electrical signals are carried by auditory nerve to the brain and the brain interprets them as sound and we get the sensation of hearing.

## Viva-Voce

1. Name the covering that maintains the shape of the eyeball.

**Ans.** Sclera

2. Identify the type of vision in human eye.

**Ans.** Binocular vision.

3. Name the light sensitive layer present in the eye.

**Ans.** Retina

4. List any two defects of vision.

**Ans.** Cataract and myopia.

5. An individual's eyesight was lost in an accident without any damage to eye. What could be the reason for loss of sight?

**Ans.** The region concerned with sight in cerebrum could have damaged.

6. Name the part of body which helps in maintenance of body balance.

**Ans.** Ears

7. What is the role of eustachian tube in ears?

**Ans.** It equalises the air pressure on both sides of the eardrum.

8. How can sudden loud noise affect the ears?

**Ans.** Loud noise can cause damage to the eardrum causing loss of sound.

9. Identify the nerve carrying impulse from cochlea to cerebrum.

**Ans.** Auditory nerve.

10. What is the role of waxy substance present in our ears?

**Ans.** The waxy substance, i.e. earwax traps dust particles and other foreign substances entering the ear.

## Experiment 4

### Aim

To identify and locate endocrine glands (adrenal, pancreas, thyroid, pituitary) using model or chart.

### Materials Required

A model or chart of the human endocrine system.

### Theory

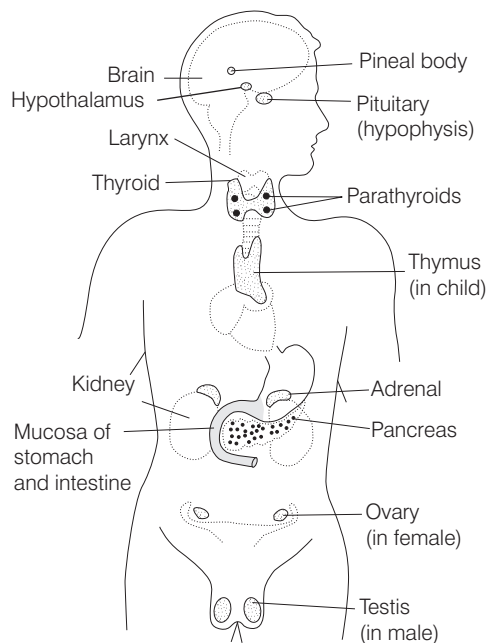
The endocrine system is a special kind of coordination and integration system provided to all the cells for continuous cellular functioning.

Endocrine glands are ductless glands. This system employs hormones that are released directly into the blood from various glands present in our body.

### Procedure

(i) Study the model and charts carefully to see the location and structure of endocrine glands.

(ii) Draw labelled diagram with specific comments on endocrine glands studied in your notebook.



Human endocrine system

## Observations

### 1. Pituitary Gland

- (i) The smallest endocrine gland found attached to the base of the midbrain.
- (ii) It is also called master gland as it controls the secretion from other endocrine glands in the body.

### 2. Adrenal Glands

- (i) These are paired glands located just above the anterior part of each kidney.
- (ii) Adrenal glands are conical yellowish bodies formed by two type of tissues
  - (a) Cortex
  - (b) Medulla
- (iii) Adrenal gland secretions are considered as emergency hormones.

### 3. Pancreas

- (i) It is a composite gland that acts both as the exocrine and endocrine glands.
- (ii) It lies just below the stomach, in the loop of duodenum.
- (iii) An irregular-shaped elongated gland. It secretes insulin and glucagon. These hormones regulate the level of sugar in the blood.

### 4. Thyroid Gland

- (i) Largest endocrine gland, it is a bilobed, butterfly-shaped gland.
- (ii) Thyroid gland is located below the larynx surrounding its front.
- (iii) It secretes thyroxine hormone which regulates the rate of growth and metabolism in our body.

## Precautions

- (i) Handle the model with care.
- (ii) Observe the structure of each gland carefully.

## Viva-Voce

#### 1. Define endocrine glands.

**Ans.** The ductless glands which pour their secretions directly into the blood.

#### 2. What is the advantage of endocrine system over neural system?

**Ans.** Endocrine system provides networking to each cell for continuous cellular functioning. Nerve cells do not reach every cell of the body.

#### 3. Pituitary gland is called as the master gland. Why?

**Ans.** It controls the secretion of hormones from other glands.

#### 4. A person heard a gun shot nearby. Which gland will be secreting hormones during this condition?

**Ans.** The anxiety and fear of the person result in the secretion of hormones from adrenal gland.

#### 5. What happens whenever there is under or over secretion of hormones in the body?

**Ans.** Certain abnormalities arise specifically associated with hyper or hyposecretion of hormone.

#### 6. Name a composite gland present in our body.

**Ans.** Pancreas

#### 7. Name the condition occurring due to hyposecretion of insulin.

**Ans.** Diabetes mellitus.

#### 8. Thyroid is considered as an important hormone in our body. Why?

**Ans.** The hormone released by thyroid affects the growth and metabolism in a person.

#### 9. Some people are gifted with good height while others are short. Give reason.

**Ans.** The growth hormone released by pituitary gland affects the growth of a person. Hyposecretion results in stunted growth while hypersecretion leads to gigantism.



**SAMPLE  
QUESTION PAPERS (1-5)**

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**ICSE EXAMINATION PAPER 2019**

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**LATEST ICSE SPECIMEN PAPER**



# SAMPLE QUESTION PAPER 1

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

## BIOLOGY (FULLY SOLVED)

### General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

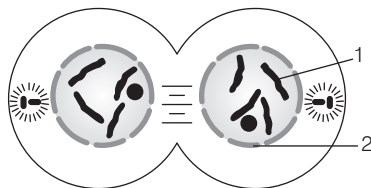
### Section-I

[40 Marks]

1. (a) Name the following
  - (i) The longest phase of the cell cycle.
  - (ii) The father of genetics.
  - (iii) High energy product of photosynthesis.
  - (iv) Instrument used for measuring blood pressure.
  - (v) Small ovoid paired glands opening into the urethra. [5]
- (b) Fill in the blanks
  - (i) Fertilisation is the ..... of egg nucleus and sperm nucleus.
  - (ii) The pulmonary artery arises from the right ventricle and carries.....blood to the lungs.
  - (iii) Deafness is caused due to the rupturing of ..... .
  - (iv) Animals secreting ammonia as waste are called ..... .
  - (v) Watson and Crick discovered the ..... helical structure of the molecule of DNA. [5]
- (c) Choose the correct alternative from the choices given below each statement so as to complete its meaning.
  - (i) A cell is plasmolysed when it is placed in
    - (a) isotonic solution
    - (b) hypotonic solution
    - (c) hypertonic solution
    - (d) water
  - (ii) Which one of the following glands has both endocrine and exocrine functions?
    - (a) Pituitary gland (b)Pancreas
    - (c) Thyroid gland (d) Adrenal gland
  - (iii) Growth of plants in response to force of gravity is called
    - (a) phototropism (b) geotropism
    - (c) thigmotropism (d) chemotropism
  - (iv) Which part of the heart pumps the blood with greatest force?
    - (a) Right auricle (b) Left auricle
    - (c) Right ventricle (d) Left ventricle
  - (v) The hormone which increases water reabsorption in the kidney is [5]
    - (a) oxytocin (b) ADH
    - (c) serotonin (d) ACTH
- (d) Mention where in the living organisms are the following structures located and state their main function.
  - (i) Absciscic acid
  - (ii) Vermiform appendix
  - (iii) Testis
  - (iv) Neurons
  - (v) Stomata [5]
- (e) State whether the following statements are true or false. If false, rewrite the correct statement by changing the first or last word only.
  - (i) Penicillin obtained from *Penicillium notatum* is an antibiotic.
  - (ii) Chromosomes are highly condensed during metaphase.
  - (iii) RBCs are of several kinds.
  - (iv) Urine is excreted out from the body through the ureter.

FULLY SOLVED

- (v) External appearance of an organism is called genotype. [5]
- (f) Study the diagram given below which represents a stage during the mitotic cell division and answer the questions that follows

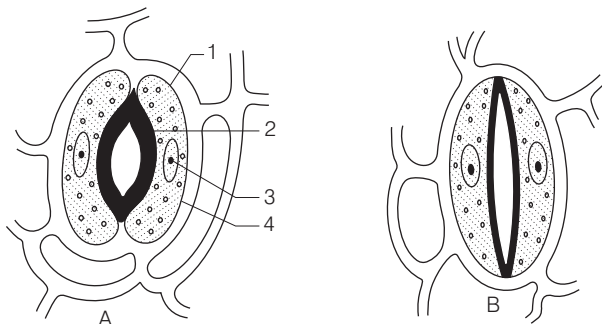


- Identify the stage giving suitable reasons.
  - Name the parts numbered 1 and 2.
  - What is the technical term for the division of nucleus?
  - Mention the stage comes before the stage shown in the diagram.
  - Which is the cell division that results in half the number of chromosomes in daughter cells? [5]
- (g) Give a biological/scientific term for the following statements
- The fusion of male gamete with the egg.
  - Pigment present in the urine.
  - Visual disorder resulting due to lack of vitamin-A.
  - Main organ responsible for the circulation of blood.
  - A process by which plants get rid of the excess water. [5]
- (h) State one main function of the following
- Vasa efferentia
  - Swachh Bharat Abhiyan
  - Cerebrum
  - Auxins
  - Eyelids [5]

## Section-II

[40 Marks]

2. (a) Given below are the diagram of certain structures in plants in certain conditions.



- Name the structure shown here.
  - Label the parts numbered 1-4 in A.
  - Mention the most apparent difference between A and B.
  - Which process is regulated by these diagrams?
  - How does sunlight affect the process mentioned in (iv)? [5]
- (b) Define the following terms
- Reflex action
  - Photosynthesis
  - Meiosis
  - Natality
  - Pollutant [5]
3. (a) Mention the difference between the following pairs on the basis of what is given in the brackets
- Stomatal transpiration and cuticular transpiration (percentage loss of water).
  - Antibody and antibiotic (source).
  - Hormones and enzymes (properties).
  - Stomata and lenticels (position).
  - Insulin and glucagon (mode of action) [5]
- (b) With respect to human eye, answer the following questions
- How is the image formed on the retina?
  - How is the amount of light entering the eye controlled?
  - What type of lens is used for the correction of 'Long-sight' defect?
  - With the help of a ray diagram show the defect of the eye and then its correction after the use of lens. [5]

4. (a) Answer the following briefly

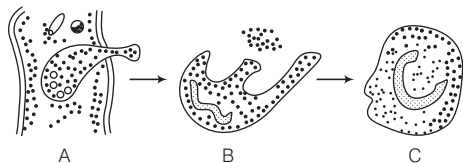
- Explain with the help of a chart what will be the colour of a child's hair if father has got dominant gene for black hair and mother has recessive gene for brown hair?
  - Explain the following terms
    - Laws of inheritance
    - Identical twins
  - Define the term heredity. [5]
- (b) (i) Draw a simplified diagram showing the structure of human testis and the passage of sperms from seminiferous tubules to the urethra. Label the three basic parts of the testis.
- Where in the male reproductive system most of the sperms are stored?
  - What are Cowper's glands? [5]

5. (a) Complete the following table by filling in the numbered blanks with an appropriate term/statement

Gland	Hormone produced	Function
Thyroid	1	2
3	4	Dilates pupil of eyes
5	Insulin	6
7	ADH	8
9	10	Conversion of glycogen to glucose

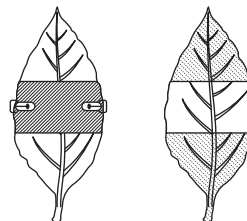
[5]

- (b) (i) Give the biological names of Cro-Magnon and modern man.  
 (ii) All life on earth would come to an end if there were no green plants. Explain briefly.  
 (iii) What is the importance of fermentation?  
 (iv) What are otoliths? [5]
6. (a) Look at the figures A, B and C carefully and answer the questions which follows



- (i) Which kind of blood vessel is shown in A? Write any two characteristics of such blood vessels.  
 (ii) Name the two kinds of blood cells shown in A.  
 (iii) Describe step by step, what is happening in the three figures. What is the advantage of this activity to our body? [5]

- (b) The figure given below shows an experiment of photosynthesis



- (i) What is the aim of this experiment?  
 (ii) What do you conclude from this experiment?  
 (iii) What is the role of light in photosynthesis? [5]

7. (a) (i) Name the raw materials required for photosynthesis.  
 (ii) What are the byproducts of photosynthesis?  
 (iii) How do green plants obtain water for photosynthesis?  
 (iv) Name the pigment that imparts green colour to plant.  
 (v) Name the yellowish pigment developed by plants in the absence of light. [5]
- (b) The diagram below represents a very important part of a structure found in the kidney.
- (i) Name the part to which it belongs.  
 (ii) What do the arrows indicate?  
 (iii) Label the parts marked 1-5.  
 (iv) How do the kidneys assist in maintenance of water balance in the human body?  
 (v) On hot summer days, you do not seem to produce as much urine as you would produce otherwise. Explain why? [5]

## ANSWERS

### Section-I

1. (a) (i) Interphase (ii) GJ Mendel  
 (iii) Glucose (iv) Sphygmomanometer  
 (v) Cowper's glands.
- (b) (i) fusion  
 (ii) deoxygenated  
 (iii) eardrum  
 (iv) ammonotelic animals  
 (v) double

- (c) (i) (c) (ii) (b)  
 (iii) (b) (iv) (d)  
 (v) (b)
- (d) (i) Abscissic acid is produced in terminal buds of plants. They help in abscission of plant leaves.  
 (ii) Vermiform appendix is located at the junction of large and small intestine. It is a vestigial organ and do not perform any function in human body.  
 (iii) Testis is found in the scrotum of males, it produces sperms and the hormone testosterone.

- (iv) Neurons are found in brain. These conduct nerve impulses.
- (v) Stomata On the surface of leaf, water escapes through it in the form of water vapour during transpiration.
- (e) (i) True  
(ii) True  
(iii) False. WBCs are of several kinds.  
(iv) False. Urine is excreted out from the body through urethra.  
(v) False. External appearance of an organism is called phenotype.
- (f) (i) The stage shown in the figure is telophase due to the following reasons
- Nuclear membrane and nucleolus have reappeared.
  - Spindle fibres are disappearing.
  - Furrows have been formed for the division of cytoplasm.
  - Sister chromatids reach opposite poles.
  - The two sets of daughter chromosomes have reached the opposite poles.
- (ii) 1- Chromatin fibres  
2- Nuclear membrane
- (iii) The division of nucleus is called karyokinesis.
- (iv) The stage comes before this stage that is shown in the diagram is anaphase.
- (v) Meiosis is the cell division that results in half the number of chromosomes in daughter cells.
- (g) (i) Fertilisation  
(ii) Urochrome  
(iii) Night blindness  
(iv) Heart  
(v) Transpiration
- (h) (i) Vasa efferentia These are the tubules found in male reproductive system which help in conveying spermatozoa to epididymis.
- (ii) Swachh Bharat Abhiyan was launched to keep city clean, to eliminate open defecation and to carry out waste management at mass level.
- (iii) Cerebrum controls the voluntary activities. It is the seat of intelligence and memory.
- (iv) Auxin is plant hormone that stimulates plant cells to elongate by inhibiting the growth of lateral buds.
- (v) Eyelids protect the eyes from excessive light and foreign particles.

## Section-II

2. (a) (i) Guard cells with stomata (stomatal apparatus).  
(ii) 1. Guard cells    2. Inner wall of guard cells  
3. Nucleus    4. Outer wall of guard cells  
(iii) In A, the stoma is open while in B, the stoma is closed.  
(iv) The process of transpiration is regulated by the structure A (stoma).  
(v) Increase in sunlight increases the rate of transpiration upto a point. After that a decrease in transpiration occurs to prevent wilting of plant.
- (b) (i) Reflex action is a rapid, quick autonomous response to a stimulus by an organ or system of organs which does not involve brain for its initiation. Reflex actions are unconditioned, inborn and a natural part of our life.  
(ii) Photosynthesis is a process by which green plants manufacture glucose or starch in the presence of sunlight, carbon dioxide (from air) and water (absorbed from soil).  
(iii) Meiosis is a type of reductional cell division that gives rise to four reproductive cells (gametes), each with half the chromosome number of the parent cell.  
(iv) Natality or birth rate is the total number of live births per 1000 individuals of a population per year.  
(v) The agents that cause pollution and bring undesirable change in the environment are known as pollutants.

3. (a)

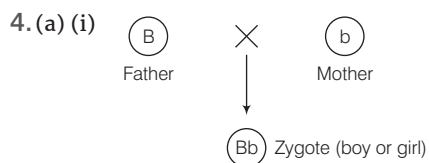
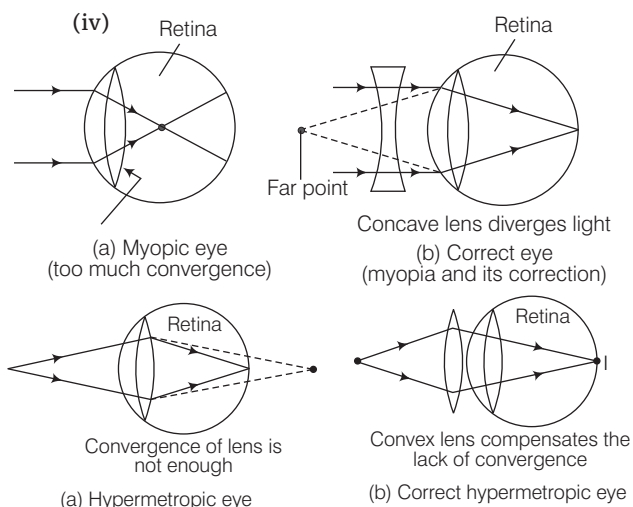
(i)	Stomatal transpiration	Cuticular transpiration
	It accounts for nearly 97% of the total loss of water from plants.	It accounts for only 3% of the total loss of water from plants.
(ii)	Antibodies	Antibiotics
	These are produced by some white blood corpuscles.	These are produced by microorganisms and certain species of fungus.
(iii)	Hormones	Enzyme
	They may be protein, amine or steroid.	All enzymes are proteins.
	Produced by ductless or endocrine glands.	Produced by glands with ducts or exocrine glands.

(iv)	<b>Stomata</b>	<b>Lenticels</b>
	Stomata are minute openings formed in the epidermal layer of green leaves.	Lenticels are aerating pores formed in the bark.
(v)	<b>Insulin</b>	<b>Glucagon</b>
	Stimulates deposition of extra glucose in liver and muscles.	Stimulates liver to convert glycogen into glucose.

(b) (i) Light from the source when reaches the eye, it gets converged by the lens and an inverted image is formed on the retina.

(ii) The amount of light entering the eye can be controlled by dilating or constricting the pupil.

(iii) A convex lens is used to correct long-sightedness.



'B' is the dominant gene for black hair while 'b' is the recessive gene for brown hair. The child will have black hair, as gene for black hair is dominant over the gene for brown hair.

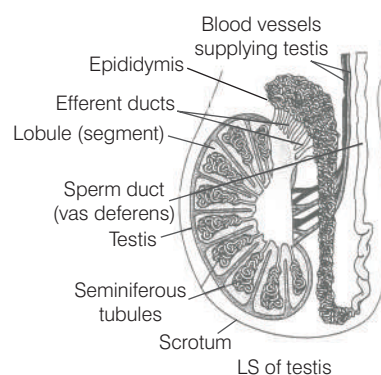
(ii) I. Laws of inheritance These laws state that separate traits are passed independently from one another from parents to offspring. Gregor Johann Mendel postulated three laws of inheritance. These are

1. Law of dominance
2. Law of segregation
3. Law of independent assortment

II. Identical twins Sometimes two embryos are formed when a developing zygote gets divided. They develop independently in the mother's uterus. Being from the same ovum and the same sperm, they inherit same genes and are genotypically identical and develop into identical babies always of the same sex.

(iii) Transmission of characters or traits from one generation to other is called heredity.

(b) (i) Structure of human testis



Passage of sperms Seminiferous tubules → Efferent ducts → Epididymis → Vas deferens → Urethra.

(ii) Epididymis.

(iii) Cowper's glands are paired glands whose ducts open into the urethra. These glands secrete mucus and an alkaline fluid into urethra for lubrication of penis.

5. (a)

Gland	Hormone produced	Function
Thyroid	Thyroxine	Regulates basal metabolism.
Adrenal medulla	Adrenaline	Dilates pupil of eyes.
Pancreas (β-cells)	Insulin	Lowers blood sugar level.
Posterior pituitary	ADH	Increases reabsorption of water from kidney tubules.
Pancreas (α-cells)	Glucagon	Conversion of glycogen to glucose.

(b) (i) The biological name of Cro-Magnon is *Homo sapiens fossilis* and that of modern man is *Homo sapiens sapiens*.

(ii) Green plants by the process of photosynthesis provide food and oxygen to all living organisms which are essential for the existence of life.

Hence, all life on the earth would come to an end if there were no green plants.

- (iii) The process of fermentation is of great economic importance. The ripening of cheese, the curing of tea leaves and tanning of leather are some of the important fermentative processes which are brought about by different bacteria.
- (iv) In the inner ear, number of crystals of calcium carbonate are present. They are called otoliths.
6. (a) (i) Blood capillary is shown in the given diagram. Its characteristics are
- It is a narrow tube.
  - Its wall consists of single layer of epithelial cells (endothelium) and has no muscles.
- (ii) Red blood cell and white blood cell.
- (iii) I. In 'A', WBC is squeezing through the wall of the capillary into the tissue.  
 II. In 'B', WBC (neutrophil) is engulfing bacteria.  
 III. In 'C', neutrophil has engulfed bacteria.  
 This activity is helpful to protect our body from microorganisms.
- (b) (i) To demonstrate that sunlight is necessary for photosynthesis.  
 (ii) Light is necessary for photosynthesis.

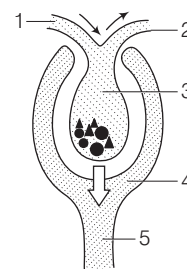
(iii) Light supplies energy in the form of photons to split water during the light reaction.

7. (a) (i) Carbon dioxide and water.  
 (ii) Water vapour and oxygen.  
 (iii) Green plants absorb water from the soil with the help of root system.  
 (iv) Chlorophyll.  
 (v) Etiolin.

(b) (i) This part belongs to nephron or uriniferous tubule.

(ii) The arrows indicate the direction of flow of glomerular filtrate.

- (iii) 1. Afferent arteriole  
 2. Efferent arteriole  
 3. Glomerulus  
 4. Bowman's capsule  
 5. Proximal convoluted tubule



- (iv) The kidneys expel extra water in the form of urine and reabsorb water to maintain water balance in the body.
- (v) On hot summer days water is also lost in the form of sweat. Hence, we do not seem to produce as much urine as would be produced otherwise.

# SAMPLE QUESTION PAPER 2

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

## BIOLOGY (FULLY SOLVED)

### General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

### Section-I

[40 Marks]

1. (a) Name the following.

- (i) The pressure which facilitates entry of water into root hairs.
- (ii) Loss of water in form of vapour through stomata.
- (iii) Site of photosynthesis.
- (iv) Part of the human eye which controls the amount of light entering into it.
- (v) The growth movement of shoots of a plant in response to light. [5]

(b) Given below are certain functional activities of specific structures in the body of living organism. Name the structure responsible for them.

- (i) Act as bearer of heredity units.
- (ii) Nutrition and oxygen from the mother's blood diffuse into the blood of foetus.
- (iii) The soluble protein present in blood plasma responsible for clotting.
- (iv) The tube which carries water away from the kidney.
- (v) Opening of the leaf through which transpiration occurs. [5]

(c) Complete the following table by filling in the blanks number 1 to 5.

Glands	Hormones	Functions	Diseases
Pituitary	Growth hormone	1	Gigantism (Hyper), Dwarfism (Hypo)
2	Thyroxine	3	Cretinism, Exophthalmic goitre
Pancreas	4	Glycogenesis	Diabetes mellitus
Adrenal	5	Carbohydrate and protein metabolism	Addison's disease

[5]

(d) Give one point of difference between the following pairs on the basis of what is given in brackets

- (i) Cobalt chloride paper (process where it is used).
- (ii) Thorn of Bougainvillea and tendrils of Cucurbita (type of organs).
- (iii) Exocrine and endocrine glands (secretion transport).
- (iv) Plasma and lymph (blood corpuscles).
- (v) Primary and secondary pollutant (form in which they persist). [5]

FULLY SOLVED

- (e) Match the items in Column I with those which are most appropriate in Column II. Rewrite the matching pairs

Column I	Column II
A. Blind spot	1. Absciscic acid
B. Nissl's granules	2. Kidney
C. Bowman's capsule	3. Neuron
D. Stomata	4. Retina
E. Bud dormancy	5. Leaf surface

[5]

- (f) Given below are five groups of terms. In each group, arrange and rewrite the terms in the correct order so as to be in a logical sequence. An example has been solved for inference,

**e.g.** Zygote, trophoblast, blastocyst, egg, morula.

Egg → zygote → morula → trophoblast → blastocyst

- Axon, node of Ranvier, dendrites, cell body, axon endings.
  - Homo habilis, Cro-Magnon man, Australopithecus, Homo erectus, Neanderthal man.
  - Fertilisation, ovulation, gestation, childbirth, implantation.
  - Metaphase, prophase, telophase, anaphase, interphase.
  - DCT, loop of Henle, Bowman's capsule, PCT, glomerulus.
- (g) Given below are the name of certain structures, write down the special functional activity of each.
- Ribosome .....
  - Cochlea .....
  - Hydathodes .....
  - Chloroplast .....
  - Meninges .....

[5]

- (h) Fill in the blanks by choosing appropriate term from the box given below

Ribosomes, Thrombocytes, Ethylene, Natalty, Sclerotic layer, Hypotonic, Vascular bundles, Homologous organs, Sulphur dioxide, Hypertonic, Auxin.

- The structures that conduct water throughout a plant are called .....
- The other name of blood platelets is .....
- Parthenocarpy can be induced by applying ...
- The white portion on the front of the eye is .....
- Number of live births per 1000 people of population per year is .....

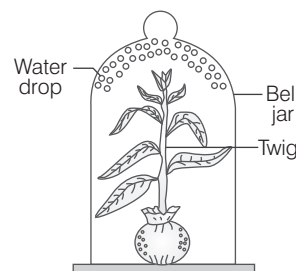
[5]

## Section-II

[40 Marks]

2. (a) Given below is an experimental setup to study a particular process.

- Identify the process being studied.
- Explain the process named in (i) above.
- Why is the pot showing water drops after some time?
- Mention one advantage of this process to the plants.
- According to you, what can be the suitable control for this experiment?



- Draw a well-labelled diagram of human sperm.
- What is the function of acrosome?
- What is the function of mitochondria of sperm in the process of reproduction?

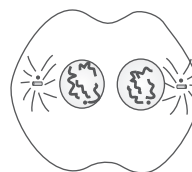
3. (a) Account for the following

- Counting pulses is the counting of heartbeat.
- Most often only one embryo is formed at a time although there are two ovaries in woman.
- Injury to the medulla oblongata results in death.
- Abnormally large number of WBCs in the blood is usually an indication of some infection in body.
- Plants growing in fertilised soil are often found to wilt if the soil is not adequately watered.

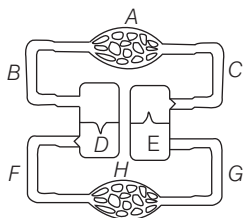
[5]

- Why is meiosis referred to as reduction division?
- What is interphase?
- Mention three significant changes that occur in a cell during interphase.
- The below figure is that of a certain stage of mitosis. Identify the stage.

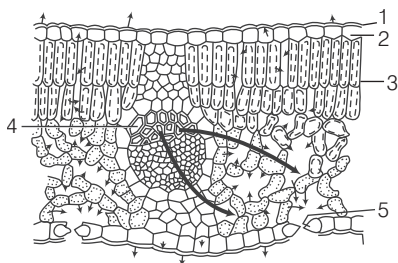
[5]



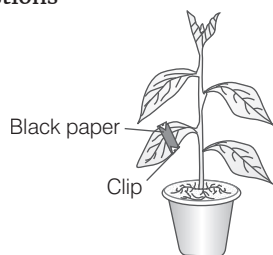
4. (a) (i) Draw a labelled diagram of human eye with the two labellings.  
 (ii) What is presbyopia?  
 (iii) Write about one more defect of eye. [5]
- (b) Given below is a simple diagram of the circulation of blood in a mammal showing the main blood vessels, the heart, lungs and body tissues. Observe it carefully and answer the questions that follows



- (i) Name the blood vessels or organs marked as A to H.  
 (ii) What do you mean by the term double circulation of blood in mammals?  
 (iii) What is diastole? [5]
5. (a) The figure represents the vertical section of a leaf.



- (i) Name the parts 1 to 5.  
 (ii) How many veins have been shown in the section?  
 (iii) State the functions of part 4 and 5. [5]
- (b) The diagram given below represents an experiment conducted to prove the importance of a factor in photosynthesis. Study the diagram and answer the following questions



- (i) Which factor is studied in this experiment?  
 (ii) The plant was kept in a dark room before conducting the experiment. Give reason.

- (iii) Why was the experimental leaf kept in  
 1. boiling water      2. methylated spirit?  
 (iv) Which solution is used to test for the presence of starch in a leaf?  
 (v) What observation of the experimental leaf takes place at the end of the starch test?  
 (vi) Write a balanced chemical equation to represent photosynthesis. [5]

6. (a) Give the biological/technical term for the following  
 (i) Excess of glucose in blood.  
 (ii) Cell division that does not involve nuclear changes.  
 (iii) Transmission of characters from one generation to another.  
 (iv) The plant hormones which inhibit growth.  
 (v) Regulates the amount of water excreted in urine.  
 (vi) Genetic make up of an individual.  
 (vii) The place for dark reaction of photosynthesis.  
 (viii) Theory of inheritance of acquired characteristics.  
 (ix) Carries impulses towards the brain and spinal cord.  
 (x) Number of deaths in a specified period of time. [5]

(b) Define the following terms

- (i) Rh factor      (ii) Diapedesis  
 (iii) Diaphragm      (iv) Excretion  
 (v) Bipedalism [5]

7. (a) A homozygous tall plant (T) bearing red coloured (R) flowers is crossed with a homozygous dwarf (t) plant bearing white (r) flowers.  
 (i) Give the genotype and phenotype of the plants of  $F_1$ -generation.  
 (ii) Mention the possible combinations of the gametes that can be obtained from the  $F_1$  hybrid plant.  
 (iii) State the Mendel's law of Independent Assortment.  
 (iv) Mention the phenotypes of the offsprings obtained in  $F_2$ -generation.  
 (v) What is the phenotypic ratio obtained in  $F_2$ -generation? [5]

(b) Briefly explain the following terms.

- (i) Reflex action  
 (ii) Power of accommodation  
 (iii) Photophosphorylation  
 (iv) Hormone  
 (v) Synapse [5]

## ANSWERS

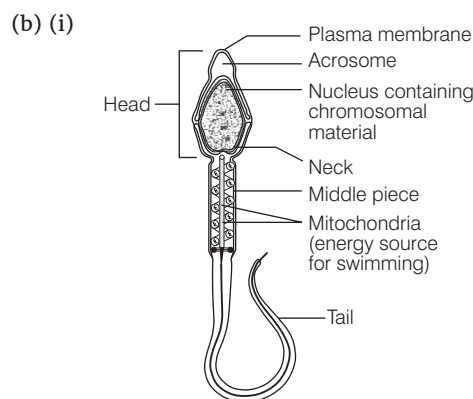
### Section-I

1. (a) (i) Root pressure  
(ii) Transpiration  
(iii) Leaves  
(iv) Pupil of the iris  
(v) Positive phototropism
- (b) (i) Chromosomes  
(ii) Placenta  
(iii) Fibrinogen  
(iv) Ureter  
(v) Stomata
- (c) 1. Growth of the body.  
2. Thyroid.  
3. Regulate Basal Metabolic Rate (BMR).  
4. Insulin.  
5. Glucocorticoids.
- (d) (i) Cobalt chloride paper It is used in the process of transpiration.  
(ii) Both are homologous organs, i.e. they share common ancestry and structure but differ in functions.  
(iii) Exocrine gland Secretion transported by the way of ducts.  
Endocrine gland Secretion transported by the way of blood.  
(iv) Plasma contains RBCs as well as WBCs.  
Lymph contains only WBCs (lymphocytes).  
(v) Primary pollutants persist in the original form in which they are discharged.  
Secondary pollutants are formed by the reaction of primary pollutants.
- (e)
- |    | Column I         |    | Column II     |
|----|------------------|----|---------------|
| A. | Blind spot       | 4. | Retina        |
| B. | Nissl's granules | 3. | Neuron        |
| C. | Bowman's capsule | 2. | Kidney        |
| D. | Stomata          | 5. | Leaf surface  |
| E. | Bud dormancy     | 1. | Abscisic acid |
- (f) (i) Dendrites → cell body → axon → node of Ranvier → axon endings.  
(ii) Australopithecus, Homo habilis, Homo erectus, Neanderthal man, Cro-Magnon man.  
(iii) Ovulation → fertilisation → implantation → gestation → childbirth.

- (iv) Interphase → prophase → metaphase → anaphase → telophase.  
(v) Glomerulus → Bowman's capsule → PCT → Loop of Henle → DCT.
- (g) (i) Synthesis of proteins  
(ii) Hearing  
(iii) Guttation  
(iv) Photosynthesis  
(v) Protection of brain
- (h) (i) Vascular bundles  
(ii) Thrombocytes  
(iii) Auxin  
(iv) Sclerotic layer  
(v) Natality

### Section-II

2. (a) (i) The process being studied is transpiration.  
(ii) Transpiration is the loss of water in the form of vapours from the aerial parts of a plant (specially leaves) into the atmosphere.  
(iii) The pot is showing water drops due to evaporation of water.  
(iv) Transpiration produces a cooling effect for the plant.  
(v) The control is to keep the same experimental setup away from sunlight in a comparatively cool place.

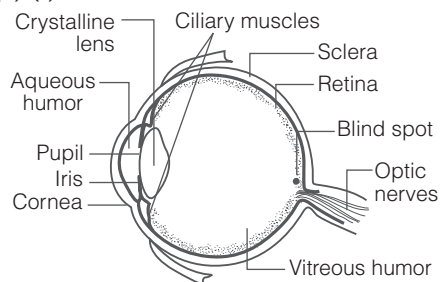


Structure of sperm

- (ii) Acrosome contains enzymes that help the sperm to penetrate the ovum or egg during fertilisation.  
(iii) The mitochondria provide energy required by the sperms for their active movement to reach the ovum and facilitate fertilisation.
3. (a) (i) The movement of blood with pressure causes jerky movement or pulse. It occurs when heart pumps blood with pressure. Thus, counting of pulse is indirectly counting of heartbeat.

- (ii) Each ovary releases one ovum under the influence of hormones in every alternate month. Only one sperm is able to fertilise the egg and therefore at a time, only one embryo develops.
- (iii) Medulla oblongata controls heartbeat, respiration, etc. Injury to it leads to sudden stop of these processes which results in death.
- (iv) When germs enter into the body, a large number of WBCs are formed to protect the body from infection.
- (v) Due to the concentration of water molecules being less outside, exosmosis takes place resulting in the wilting of the plants.
- (b) (i) Meiosis has two phases—Meiosis-I and Meiosis-II. In the first meiotic division, the reduction in chromosome number takes place, thus two haploid cells results in this division. As chromosome number is reduced in this stage, it is also called reduction division.
- (ii) The period following the completion of cell division when the nucleus is not dividing is called interphase.
- (iii) Interphase stage is considered as the preparatory stage for cell division. Main changes occurring in this stage include
- Synthesis of DNA
  - Synthesis of RNA and protein
  - Cell growth
- (iv) The stage is telophase.

4. (a) (i)



- (ii) Presbyopia is a condition of eye affecting older people which leads to the difficulty in focussing on near objects. Its because of the loss of flexibility of the lens.
- (iii) In cataract, the lens becomes opaque either due to ageing or some disease. Sometimes cornea may become opaque leading to this condition.
- (b) (i) A. Lungs capillaries  
B. Pulmonary artery  
C. Pulmonary vein  
D. Right ventricle  
E. Left ventricle  
F. Vena cava  
G. Aorta  
H. Body tissues capillaries

- (ii) Double circulation is a circulation in which blood before going to the general circulation around the body, enters the heart twice first as deoxygenated blood and then as oxygenated blood.

The oxygenated blood goes to the general circulation.

- (iii) Relaxation phase of auricle and ventricle is known as diastole.

5. (a) (i) 1. Cuticle

2. Upper epidermis

3. Palisade tissue/Chloroplast

4. Xylem

5. Stoma

- (ii) One vein has been shown.

- (iii) Xylem helps in the conduction of water.

Stoma through which exchange of gases takes place.

- (b) (i) The factor being studied in this experiment is the presence of starch.

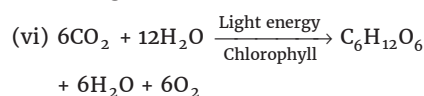
- (ii) The plant was kept in a dark room to destarch the plant before conducting the experiment.

- (iii) 1. The leaf is kept in boiling water to destroy the enzymes to kill the cells so that further chemical changes cannot take place within the cell.

2. The leaf is kept in methylated spirit to dissolve out the chlorophyll from the leaf.

- (iv) Iodine solution is used to test the presence of starch in the leaf.

- (v) The experimental leaf will change to blue-black colour when iodine is added to it except the part which is covered with black paper. The part covered with black paper will not show any colour change.



6. (a) (i) Diabetes mellitus

- (ii) Amitosis

- (iii) Heredity

- (iv) Ethylene and Abscissic acid

- (v) Vasopressin

- (vi) Genotype

- (vii) Stroma of chloroplast

- (viii) Lamarck

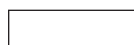
- (ix) Afferent neuron

- (x) Mortality

- (b) (i) Rh factor It was first discovered in Rhesus monkey. Hence, it is called Rh factor. The blood groups are also classified on the basis of presence ( $\text{Rh}^+$ ) or absence ( $\text{Rh}^-$ ) of Rh factor.

- (ii) **Diapedesis** The migration of leucocytes through the walls of blood capillaries into the surrounding tissue is called diapedesis.
- (iii) **Diaphragm** It is a muscular partition which separates thoracic cavity from the abdominal cavity.
- (iv) **Excretion** It is the elimination of waste materials from the body.
- (v) **Bipedalism** A form of terrestrial locomotion (walking, running, etc.) in humans where an organism moves using its two rear limbs or legs.

7. (a)
- |   |        |  |
|---|--------|--|
| Tall and red<br>coloured flower<br>(TTRR) | x<br>↓ | Dwarf and white<br>coloured flower<br>(ttrr) |
|---|--------|--|



- (i) Genotype - TtRr, Phenotype - Tall and red coloured flower.
- (ii)  $\textcircled{\text{TR}} \textcircled{\text{tR}} \textcircled{\text{Tr}} \textcircled{\text{tr}}$
- (iii) **Law of independent assortment** (Third law)  
Based on the observation in dihybrid crosses Mendel proposed third law of inheritance.  
According to this law, when two pairs of contrasting characters are combined in a hybrid, segregation of the members of one pair of

character into the gamete is independent to the members of the another pair of character at the time of gamete formation.

- (iv) a. Tall and red flower  
b. Dwarf and red flower  
c. Tall and white flower  
d. Dwarf and white flower
- (v) 9 : 3 : 3 : 1
- (b) (i) **Reflex action** It is an involuntary action of any organ or part of the body in response to a particular stimulus without involvement of central nervous system.
- (ii) **Power of accommodation** The adjustment of the eye to enable it to focus at various distances is called power of accommodation.
- (iii) **Photophosphorylation** It is the formation of ATP from ADP and inorganic phosphate in the presence of light. It occurs in light reaction of photosynthesis.
- (iv) **Hormones** These are chemical messengers which are directly released into blood and control different vital reactions of the body at a very low concentration.
- (v) **Synapse** It is the junction point of the two adjacent neurons, between axon ending of one neuron with dendrite of other.

# SAMPLE QUESTION PAPER 3

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

## BIOLOGY (UNSOLVED)

### General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

### Section-I

[40 Marks]

1. (a) Fill in the blanks with an appropriate term
- (i) The growth of an organism is achieved by ..... division.
  - (ii) The yellowish fluid which remains after blood has clotted is called ..... .
  - (iii) Delay in senescence in plants is achieved by ..... .
  - (iv) Potometer is an instrument for measuring ..... .
  - (v) Largest region of the brain is ..... . [5]
- (b) Choose the correct option for each of the following
- (i) The chamber of heart that contains pure blood is  
(a) right auricle (b) left auricle  
(c) right ventricle (d) left ventricle
  - (ii) Ear ossicles consist of  
(a) hammer, anvil, stirrup  
(b) three semicircular canals  
(c) scala vestibuli, scala media, scala tympani  
(d) Bowman's capsule and uriniferous tubules
  - (iii) Islets of Langerhans are  
(a) ductless glands in pancreas  
(b) modified lymph glands  
(c) specialised areas in pituitary  
(d) small tubules in kidneys

- (iv) The 'Dark Reaction' in photosynthesis is called so because it  
(a) can occur more rapidly at night  
(b) does not require light energy  
(c) cannot occur during daytime  
(d) can occur only in shade
  - (v) The most significant trend in the evolution of modern man different from his ancestors is  
(a) shortening of jaws  
(b) increased cranial capacity  
(c) upright posture  
(d) binocular vision [5]
- (c) Choose the odd one from each of the following sets, giving the reason for your choice
- (i) Phototropism, Geotropism, Hydrotropism, Thigmotropism
  - (ii) Adrenal, Liver, Thyroid, Pituitary
  - (iii) Coughing, Sneezing, Eating, Blinking
  - (iv) Corpus luteum, Corpus callosum, Pons, Cerebellum
  - (v) Wings of insects and birds, Vertebrate hearts, Potato and sweet potato, Eyes of Octopus [5]
- (d) Give the full forms of the following
- (i) NAA (ii) ABA
  - (iii) DDT (iv) ADH
  - (v) NADP [5]

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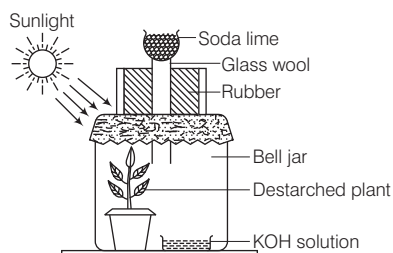
(e) Identify the following statements as true or false. If false, rewrite the correct statement by changing the first word only.

- (i) Hypermyopia is caused due to the rupture of tympanum.
- (ii) Homologous organs are anatomically different structures which perform similar function.
- (iii) WBC contains oxyhaemoglobin.
- (iv) One function of hormones is to induce adaptation to external stimuli.
- (v) Eardrum receives sound vibration from pinna through auditory canal and transfers them to ear ossicles. [5]

(f) Give the terms for the following

- (i) State of plant cell when it can absorb no more water.
- (ii) Part of the human eye which controls the amount of light entering into it.
- (iii) Growth of pollen tube towards ovule during fertilisation.
- (iv) Particular type of protein present in DNA.
- (v) Bilobed gland situated in front of the neck below the larynx. [5]

(g) Given below is an experimental setup



- (i) What is the aim of the experiment?
  - (ii) Why is KOH solution kept inside the bell jar?
  - (iii) What is the use of soda lime?
  - (iv) What would be the next and final step in this experiment?
  - (v) What would be the result of the final step? [5]
- (h) Mention one difference in each of the following pairs on the basis of what is indicated in brackets after each
- (i) The blind spot and the yellow spot (image).
  - (ii) The stroma and the grana (type of reaction).
  - (iii) Lymphocyte and platelets (function).
  - (iv) Genotype and phenotype (definition)
  - (v) Dendron and cyton (origin). [5]

## Section-II

[40 Marks]

2. (a) Given below in the box are a set of 12 biological terms, which can be matched into 6 pairs. Of the six pairs, one has been solved for you as an example. Write out the remaining 5 matching pairs (i) to (v).

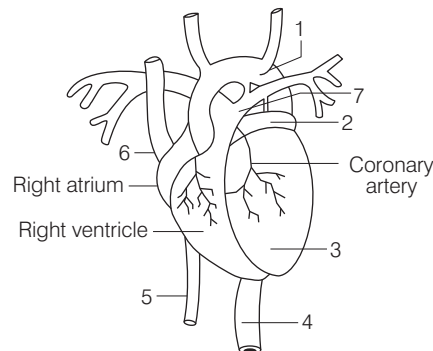
Endemic goitre, Neurohypophysis, Hypersecretion of GSH, Posterior lobe of pituitary gland, Myxoedema, Addison's disease, Pancreas, Deficiency of dietary iodine, Black freckles, Gigantism, Undersecretion of thyroid hormones, Islets of Langerhans.

Example : Endemic goitre — Deficiency of dietary iodine. [5]

(b) Answer the following

- (i) State any two harmful effects of noise pollution on human health.
- (ii) Classify the following physiological functions given below for plant hormones cytokinin and gibberellins.
  1. Flowering in plants like Wolffia.
  2. Induce parthenocarpy.
  3. Promotes organ formation (shoots) in tissue culture.
  4. Counteracts apical dominance.
- (iii) Write any two major reasons for the population explosion in India.
- (iv) Explain the reason for the medical practice of administering thyroxine to young children who show symptoms of cretinism. [5]

3. (a) Following diagram shows the external features of the heart

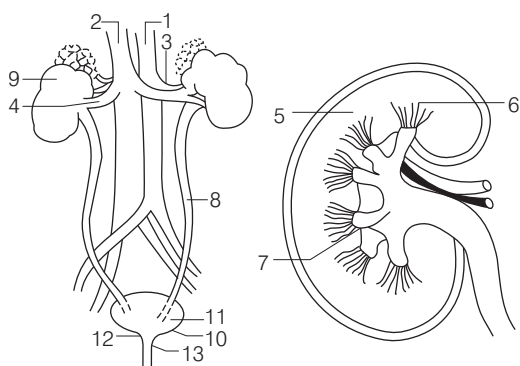


- (i) Label the parts '1' to '7'.
- (ii) What happens if the coronary artery gets an internal clot?
- (iii) What type of blood does '5' carry?
- (iv) Mention one structural difference between '5' and '4'. [5]

(b) Give reasons

- (i) Wilted lettuce leaves if kept in cold water become crisp.
- (ii) A tiger owes its existence to chlorophyll.
- (iii) It is advisable not to sleep under a tree at night.
- (iv) On sprinkling common salt on grass growing in a lawn, the grass is killed.
- (v) Tendrils of pea plant curl around a solid object on contact.

4. Observe the figure carefully [5]



(a) The given diagram shows excretory system longitudinal section of the kidneys of mammals.

- (i) Name the parts 1 to 13.
- (ii) Which parts in the above diagram perform the following functions
  1. Produce urine
  2. Store urine
  3. Carry urine to the urinary bladder.
- (iii) Name the blood vessel that carries urea from the liver to the urinary bladder.
- (iv) Give the differences between the composition of blood in renal artery and renal vein.
- (v) Name the substance formed in excess in the urine of a diabetic patient. [5]

(b) Answer briefly

- (i) What is the importance of iodine in our body?
- (ii) Which hormone brings about changes in emergency situation?
- (iii) What is the difference between nervous and chemical coordination?
- (iv) What are hormones?
- (v) What is the full form of ACTH? [5]

5. (a) Answer the following questions

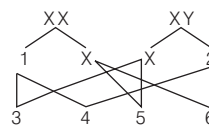
- (i) What is photosynthesis?
- (ii) Give balanced equation for photosynthesis.
- (iii) In what form is the glucose stored in the plants?
- (iv) Name the two phases of photosynthesis.
- (v) Mention the function of palisade parenchyma in a leaf. [5]

(b) (i) Draw a diagram of the human sperm and label it.

(ii) Define artificial insemination.

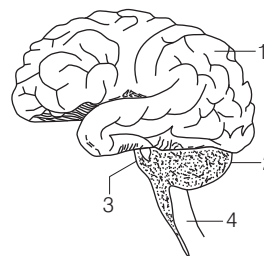
(iii) What do you understand by the term capacitation? [5]

6. (a) The given figure shows sex-determination in humans.



- (i) What is the sex of individuals represented by 3, 4, 5 and 6?
- (ii) Who is responsible for the sex male or female of offspring? Why?
- (iii) What is the scientific term used for sex-chromosomes?
- (iv) What is the term used for chromosomes other than sex chromosomes? Give their number in human. [5]

(b) Given below is the diagram of the human brain.



- (i) Label the parts numbered 1 to 4.
- (ii) Mention the difference in the arrangement of the nerve cells in the part marked 1 and 4.
- (iii) Name the fluid that surrounds the brain. State its function.
- (iv) What are mixed nerves? [5]

## 7. (a) Answer the following

(i) Give the name of the pigments present in

1. Urine                      2. Cones of eye
3. Blood                    4. Leaves

(ii) Write these phases of menstrual cycle in a proper sequence

Follicular phase, Luteal phase, Menstrual phase, Ovulatory phase

(iii) If you are planning an experiment to show the effect of light on photosynthesis

1. Which light will you select—green light or white light? Give reason.
2. Why would you select a destarched plant for this experiment on photosynthesis?

[5]

(b) The diagram below shows a schematic representation of the start of a certain phenomenon in cell division.

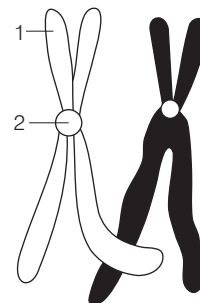
(i) Name the phenomenon.

(ii) Name the type of cell division in which this phenomenon occurs.

(iii) Label the parts 1 and 2. What is the most significant aspect of this type of cell division?

(iv) Explain briefly the phenomenon by using the following terms Homologous chromosomes, crossing over.

[5]



# SAMPLE QUESTION PAPER 4

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

## BIOLOGY (UNSOLVED)

### General Instructions

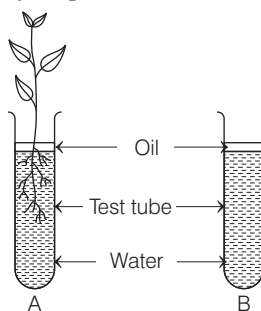
1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

### Section-I

[40 Marks]

1. (a) Name the following
  - (i) Gas that reduces the  $O_2$  carrying capacity of blood.
  - (ii) Blood vessels which enter and leave the kidney.
  - (iii) Common ancestors of man and ape.
  - (iv) Structures present on the leaves through which transpiration occurs.
  - (v) Plant hormone that helps in the ripening of fruits. [5]
- (b) State true or false for the following statements. Correct the false statement by changing the first or the last word only.
  - (i) Prophase is the resting stage in mitosis.
  - (ii) All the cells of the plant undergo photosynthesis.
  - (iii) Both exocrine and endocrine functions are carried out by the hypothalamus.
  - (iv) Human red blood cells contain numerous mitochondria.
  - (v) Cerebellum controls all the voluntary actions of the body. [5]
- (c) Give the biological (technical) term for the following
  - (i) Movement of leucocytes out of capillary walls at the site of injury.
  - (ii) Fibres which hold the lens of the eye in position.
  - (iii) The mucous membrane lining the uterus.
  - (iv) The rise of water from the root to the leaf of a plant.
  - (v) Functional unit of kidney. [5]
- (d) Given below are sets of five terms. Rewrite the terms in the correct order so as to be in logical sequence.
  - (i) Metaphase, prophase, telophase, interphase, anaphase.
  - (ii) Childbirth, gestation, implantation, ovulation, fertilisation.
  - (iii) Tympanum, ear ossicles, cochlea, auditory canal, pinna.
  - (iv) Protoplasm system, cell, tissue, organ.
  - (v) Arterioles, vein, artery, capillaries, venules. [5]
- (e) The figure represents the setup at the start of a certain experiment to demonstrate an activity of plants.
  - (i) Mention the aim of the experiment.
  - (ii) Why has oil been put in each test tube?

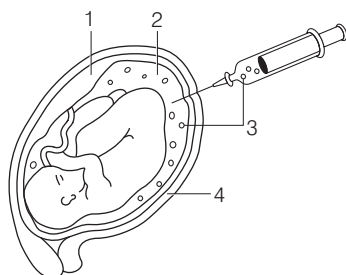
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- (iii) What will be the observation in the two test tubes after about 2–3 days?
- (iv) Give reason to explain any change observed as answered in (iii) above.
- (v) Describe the significance of test tube B (without the plant) taken in the experiment. [5]
- (f) Given below are five sets with four terms each. In each set one term is odd. Choose the odd one out of the following terms given and name the category to which the others belong.
- Sneezing, coughing, blinking, typing
  - ADH, TSH, NADPH, ACTH
  - Detergents, sewage, X-rays, oil spills
  - Stoma, stroma, lamellae, quantasome
  - Basophil, neutrophil, eosinophil, lymphocyte. [5]
- (g) Give function of each of the following
- Sertoli cells
  - Ethylene hormone
  - Semicircular canals
  - Glomerulus
  - Carbon cycle [5]
- (h) Make the given statements complete, by choosing the correct alternative out of those given within brackets
- Injury of which part results in our memory weakening (medulla, cerebrum, cerebellum, hypothalamus).
  - Female sterilisation operation is called (vasectomy, tubectomy, castration).
  - Name the mineral which plays a role in blood clotting ( $\text{Ca}^{2+}$ ,  $\text{Na}^+$ ,  $\text{Fe}^{2+}$ ).
  - The chromosomal arrangement of a male child is ( $44 + \text{XX}$ ,  $44 + \text{XY}$ ,  $42 + \text{XXXY}$ ).
  - Respiratory openings found on the stems of woody plants are (lenticels, stomata, trachea). [5]

## Section - II

[40 Marks]

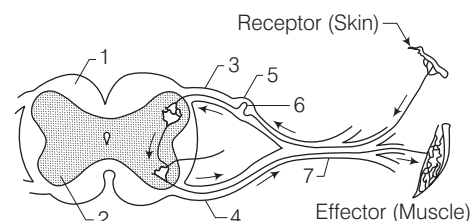
2. (a) Observe the figure and answer the questions that follows



The figure given here represents a technique

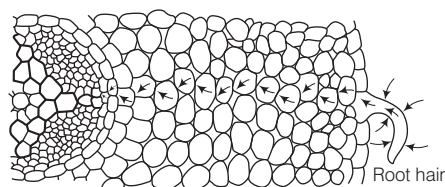
- Name the technique.
  - Name the fluid being taken out through the syringe.
  - How is this process helpful?
  - How is it misused?
  - Name parts 1–4. [5]
- (b) (i) Draw a labelled diagram of chromosomes at anaphase stage of cell cycle.
- (ii) Name the hormones produced by the following glands and give one function of each.
- Thyroid
  - Pancreas
  - Adrenal medulla. [5]

3. (a) Following diagram represents the spinal cord of a mammal seen in a transverse section together with the nerves.



- Name the parts 1–8.
  - What do the arrows indicate? What is the pathway indicated termed?
  - What type of nerve is shown in the diagram? [5]
- (b) Answer the following
- List the steps taken to remove chlorophyll from a leaf.
  - Describe an experiment to prove that carbon dioxide is necessary for the process of photosynthesis.
  - With the help of schematic diagram explain how sex is determined in human being?
  - What is genetic engineering? Write its importance. [5]

4. (a) Following is the diagrammatic representation of the movement of certain substances inside the root of a plant.

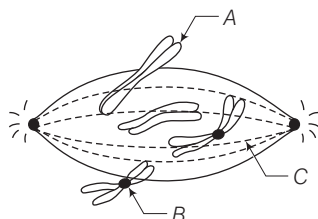


- (i) List the function of root hairs?
- (ii) In what region of root, these hairs are mainly present?
- (iii) Define root pressure.
- (iv) Are root hairs a part of the cell?
- (v) Give the function of xylem vessels? [5]

- (b) Give one point of difference between the following on the basis of what is given in the brackets.

- (i) Chromosomes and DNA (structure).
- (ii) Bleeding and guttation (nature or form of water loss).
- (iii) Cerebrum and cerebellum (function).
- (iv) Geotropism and chemotropism (stimulus received).
- (v) Ureotelic and Uricotelic (nature of nitrogenous waste). [5]

5. (a) Following figure shows a certain stage in cell division in a cell with 4 chromosomes.

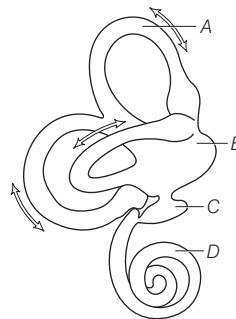


- (i) Name the parts labelled A and B.
  - (ii) Name the part C. Give its function.
  - (iii) Name the type of division with a logical reason.
  - (iv) Name the stages occurring before and after the stage shown in the diagram.
  - (v) Name the type of spindle shown in the diagram. [5]
- (b) Complete the following table by filling in the blanks from A-J with appropriate terms.

Gland	Secretion	Function/Effect on body
Thyroid	A	B
C	Vasopressin	D
E	F	Promotes glucose utilisation by the body cells.
Lacrimal gland	G	H
Adrenal medulla	I	J

[5]

6. (a) Given diagram shows the inner ear.



- (i) Label the parts A, B, C and D.
  - (ii) Which part of the ear is responsible for transmitting impulses to the brain?
  - (iii) Which above labelled part is responsible for
    1. Static equilibrium
    2. Dynamic equilibrium
  - (iv) Name the audio receptor cells responsible to pick up vibrations.
  - (v) The inner ear contains a fluid. Name the fluid. [5]
- (b) (i) Mention three reasons for high birth rate in India.
- (ii) What are the steps taken by the government of India to control population.
- (iii) Enumerate any two problems faced due to population explosion. [5]

7. (a) (i) The evolutionary story of moths in England during industrialisation reveals, that evolution is apparently reversible. Clarify this statement.
- (ii) If the industries have been removed to other area, how would that have impacted moth population?
- (iii) Name the scientists associated with the following theories.

1. Theory of use and disuse of organs.
2. Natural selection [5]

- (b) Give scientific reasons for the following statements

- (i) Use of CFC is banned in many countries.
- (ii) Shoots of a plant always grow towards light source.
- (iii) Balsam plants wilt during mid-day even if the soil is well-watered.
- (iv) Carbon monoxide is highly dangerous when inhaled.
- (v) Unleaded petrol is used in vehicles. [5]

# SAMPLE QUESTION PAPER 5

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

## BIOLOGY (UNSOLVED)

### General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

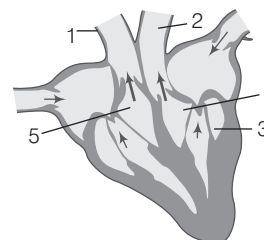
### Section-I

[40 Marks]

1. (a) Name the following
- (i) Specific part of chromosome determining hereditary characteristics.
  - (ii) The canal through which the testes descend into the scrotum just before the birth in a human male.
  - (iii) Hormone responsible for bending of shoot towards light.
  - (iv) The light induced reaction which leads to splitting of water.
  - (v) The condition which results in the abnormal long bones, long lower jaw bone due to hypersecretion of pituitary hormone. [5]
- (b) Give the biological/technical term for each of the following
- (i) The pairing of homologous chromosomes.
  - (ii) Genetic makeup of an organism.
  - (iii) Swelling in throat due to the underactivity of thyroid.
  - (iv) Foetal membrane that provides oxygen and nutrients to growing body.
  - (v) Ozone depleting substances used in refrigerators and spray cans. [5]
- (c) Choose the odd one out in each of the following and give reason
- (i) Urea, carbolic acid, creatinine, uric acid
  - (ii) Diffusion, exosmosis, plasmolysis, endosmosis
  - (iii) Auxin, acid, cytokinin gibberellins
  - (iv) Vagina, vulva, seminal vesicle, uterus

- (v) Myopia, hypermetropia, xerophthalmia, astigmatism. [5]

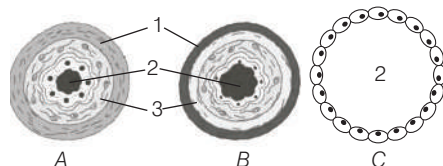
- (d) The diagram given below represents the human heart in one phase of its functions. Study the diagram carefully and answer the questions that follows



- (i) Name the phase.
  - (ii) Which part of the heart is contracting in this phase? Give a reason to support your answer.
  - (iii) Name the parts labelled 1 to 4.
  - (iv) Which type of blood flows through 2?
  - (v) State the function of the part numbered 5.
  - (vi) Name the membrane that covers the heart. [5]
- (e) Given below are incomplete explanations of certain biological processes/terms when a key word has been left out. Rewrite the complete explanation by inserting the key word in the space indicated by 'Λ'.
- (i) Left ventricle is 'Λ' chamber of the left side of the heart.
  - (ii) The frontal lobe is the centre of speech, 'Λ' and thinking.
  - (iii) The 'Λ' man with brain capacity 1400 cc lives near East and Central Asia.

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- (iv) Acrosome is a cap-like structure seen around the head of the human 'A'.
- (v) 'A' are openings located on the stems of woody plant. [5]
- (f) The diagrams given below are cross sections of blood vessels

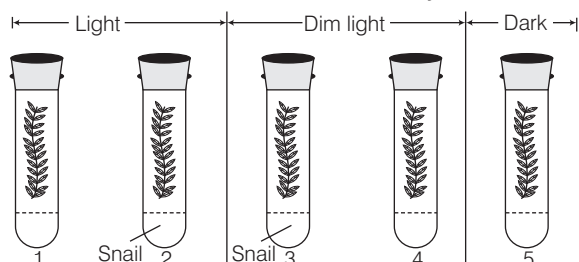


- (i) Identify the blood vessels A, B and C.
- (ii) Name the parts labelled 1 to 3.
- (iii) Name the type of blood that flows through A.
- (iv) Mention one structural difference between A and B.
- (v) In which of the above vessels does exchange of gases actually take place? [5]
- (g) The first pair in the following lists indicates the kind of relationship that exists between both the items. Rewrite and complete the second pair on a similar basis.
- (i) Ear : Hearing : : Tongue : .....
- (ii) 650-800 cc : Homo habilis : : 900 cc : .....
- (iii) Female : Tubectomy : : Male : .....
- (iv) Right auricle : Superior and inferior vena cava : : Left auricle : .....
- (v) Auxin : Stem elongation : : Cytokinin : ..... [5]
- (h) Answer the following briefly
- (i) Three reasons for sharp rise in human population in India.
- (ii) Explain the terms
1. Population density
  2. Demography

## Section-II

[40 Marks]

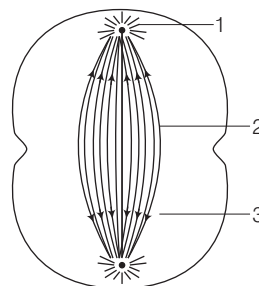
2. (a) Pond weed was placed in five water-filled tubes and the experimental setup was allowed to remain as shown in the diagram below for 24 hours. In which tube would you find



- (i) the greatest increase in dry weight of the pond weed?
- (ii) the plant with least starch?
- (iii) the plant with maximum oxygen?
- (iv) the plant with least carbon dioxide?
- (v) the plant to survive for the longest length of time? Why? [5]

- (b) (i) Draw a labelled diagram of human excretory system (with 3 labels).
- (ii) State the function of ureter.
- (iii) Which endocrine gland is present on kidneys?
- (iv) Why is insulin not given orally but is injected into the body?
- (v) What technical term is used for the cells of the pancreas that produce endocrine hormones?
- (vi) Where is the pancreas located? [5]

3. (a) The diagram represents a stage during cell division. Study it and answer the questions that follows

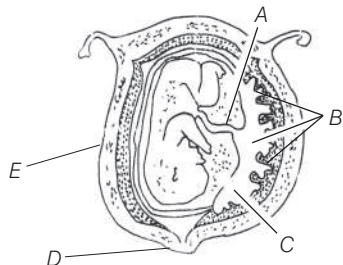


- (i) Name the parts labelled 1, 2 and 3.
- (ii) Identify the above stage and explain what happens in it.
- (iii) Mention the site in the body where this type of cell division occurs.
- (iv) Name the stage prior to this stage and draw a diagram to represent the same. [5]
- (b) During a street fight between two individuals, mention the effects on the following organs, in the table given below.

Organ	Sympathetic	Parasympathetic system
Heart		
Pupil of the eye		
Blood vessels		
Breathing		
Lungs		

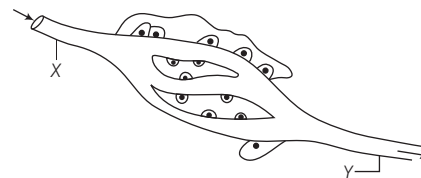
[5]

4. (a) The diagram given below shows a developing human foetus in the womb. Study it and answer the questions that follows



- Name the parts 'A' to 'E'.
  - What term is given to the period of development of the foetus in the womb?
  - How many days does the foetus normally take to be fully developed?
  - Write two functions of the part labelled 'B' (other than its endocrine function).
  - Name a hormone produced by the part labelled 'B'. [5]
- (b) Define the following
- Tropism in plants
  - Artificial insemination
  - The Law of Dominance
  - Seminal vesicle
  - Thigmotropism [5]
5. (a) Draw a diagram of the side view of human brain and label parts that perform the following functions/descriptions
- It lies below and behind the cerebrum and made up of three parts.
  - It is a cross-wise broad band of fibres which connects medulla oblongata, cerebellum and cerebrum.
  - It is the lowermost and hind part of the brain which continues below into spinal cord.
  - It is a small thick-walled area which lies hidden below the cerebrum.
  - It is the largest part of the brain which constitutes more than 80% and possesses 6-7 billion neurons.
  - It takes part in relaying sensory impulses and regulation of smooth muscle activity. [5]

- (b) The diagram below shows some capillaries in close contact with a group of cells.



- Name the blood vessels X and Y.
  - State the changes taking place in the blood as it passes from X to Y through a group of cells.
  - Name the liquid present between the cells and the capillaries.
  - State one structural difference between X and Y. [5]
6. (a) Complete the following table by filling in the blanks 1 to 10 with the appropriate terms
- | Disease     | Cause                              | Corrected                        |
|-------------|------------------------------------|----------------------------------|
| 1           | Failure of producing visual purple | 2                                |
| Astigmatism | 3                                  | 4                                |
| 5           | 6                                  | Surgical replacement of the lens |
| 7           | HIV                                | 8                                |
| Scurvy      | 9                                  | 10                               |
- [5]
- (b) (i) Draw the diagram of plant with
- part showing positive geotropism
  - part showing negative geotropism.
- (ii) Draw an experimental setup for showing positive phototropism in plants.
- (iii) Tropism is called stimulus dependent growth. Give reason. [5]
7. (a) Briefly explain the following terms
- Monohybrid cross
  - Biomedical waste
  - Innate immunity
  - Diapedesis
  - Vestigial organs [5]
- (b) (i) Draw a labelled diagram of neuron with three labellings
- (ii) Which part of the brain is largest and which one is second largest?
- (iii) State the function of neuron. [5]

# ICSE Examination PAPER 2019

## Biology (Fully Solved)

### General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

### Section-I

[40 Marks]

Answer **all** questions from this section

1. (a) Name the following : [5]

- (i) The layer of the eyeball that provides nourishment to the eye.
- (ii) One gaseous compound which depletes the ozone layer.
- (iii) The structure which connects the placenta and the foetus.
- (iv) A pair of corresponding chromosomes of the same shape and size and derived one from each parent.
- (v) The compound formed when haemoglobin combines with carbon dioxide in blood.

(b) Correct and rewrite the statements by changing the biological term that is underlined for each statement : [5]

- (i) The theory of inheritance of acquired characters was proposed by Watson and Crick.
- (ii) The protective sac which develops around the developing embryo is called the pericardium.
- (iii) Maintaining balance of the body and coordinating muscular activities is carried out by the cerebrum.
- (iv) The kidney is composed of number of neurons.
- (v) The part of the eye which can be donated from a clinically dead person is the retina.

(c) Give suitable biological reasons for the following statements : [5]

- (i) The birth rate in India is very high.
- (ii) Carbon monoxide is dangerous when inhaled.
- (iii) Root hairs become flaccid and droop when excess fertilisers are added to the moist soil around them.
- (iv) Acid rain is harmful to the environment.
- (v) All life on earth is supported by photosynthesis.

(d) Match the items given in Column A with the most appropriate ones in Column B and rewrite the correct matching pairs : [5]

Column-A	Column-B
(i) Cranial nerves	– Testosterone
(ii) Leydig cells	– Natural reflex
(iii) Acetylcholine	– 12 pairs
(iv) Spinal nerves	– Prolactin
(v) Sneezing	– Neurotransmitter
	– 18 pairs
	– 31 pairs
	– Conditioned reflex

(e) Choose the correct answer from the four options given below : [5]

- (i) While recording the pulse rate, where exactly does a doctor press on our wrist ?
  - (a) Nerve
  - (b) Vein
  - (c) Artery
  - (d) Capillary

FULLY SOLVED

- (ii) In a human male, a sperm will contain  
 (a) Both X and Y chromosomes  
 (b) Only Y chromosome  
 (c) Only X chromosome  
 (d) Either X or Y chromosome
- (iii) A muscular wall is absent in  
 (a) capillary (b) venule  
 (c) arteriole (d) vein
- (iv) On which day of the menstrual cycle does ovulation take place ?  
 (a) 5th day (b) 28th day  
 (c) 14th day (d) 1st day
- (v) Which one of the following does not affect the rate of transpiration ?  
 (a) Light (b) Humidity  
 (c) Wind (d) Age of the plant
- (f) Identify the **odd** term in each set and name the **category** to which the remaining three belong. [5]

**Example** glucose, starch, cellulose, calcium

Odd term : calcium

Category : others are different types of carbohydrates.

- (i) Addison's disease, Cushing's syndrome, Acromegaly, Leukemia.  
 (ii) Insulin, Adrenaline, Pepsin, Thyroxine.  
 (iii) Axon, Dendron, Photon, Cyton.  
 (iv) Chicken pox, Colour blindness, Haemophilia, Albinism.  
 (v) Polythene bag, Crop residue, Animal waste, Decaying vegetable.
- (g) Expand the following biological abbreviations : [5]  
 (i) ABA (ii) IAA  
 (iii) ATP (iv) DNA (v) TSH
- (h) Study the picture given below and answer the following questions : [5]



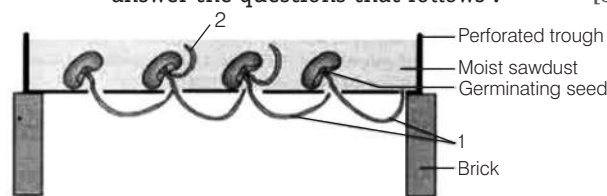
- (i) Identify the type of pollution.  
 (ii) Name one pollutant that causes the above pollution.  
 (iii) Mention the impact of this pollution on human health.  
 (iv) State one measure to control this pollution.  
 (v) What is a pollutant ? Explain the term.

## Section-II

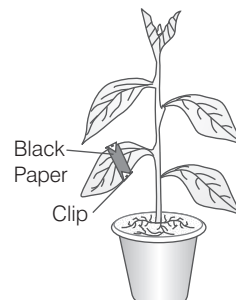
(40 Marks)

Attempt any **four** questions from this section.

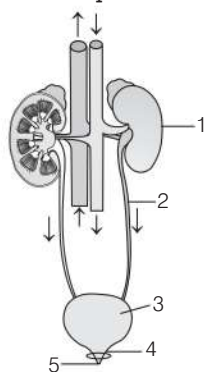
2. (a) Given below is an experimental setup to demonstrate a particular tropic movement in germinating seeds. Study the diagram and answer the questions that follows : [5]



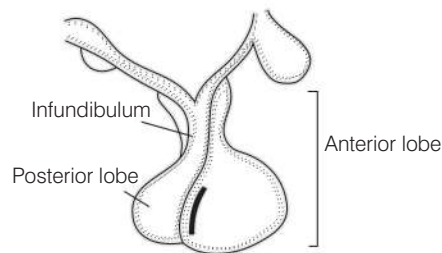
- (i) Label the parts 1 and 2.  
 (ii) Name the tropic movement shown by part 1.  
 (iii) Part 1 is affected by two stimuli. Name them. Which one of the two is stronger ?  
 (iv) What is thigmotropism? Give one example.  
 (v) What is meant by 'positive' and 'negative' tropic movement in plants ?
- (b) Mention the exact location of the following : [5]  
 (i) Testis (ii) Incus [5]  
 (iii) Thylakoids (iv) Amniotic fluid  
 (v) Corpus callosum
3. (a) The diagram given below represents an experiment to prove the importance of a factor in photosynthesis. Answer the questions that follow : [5]



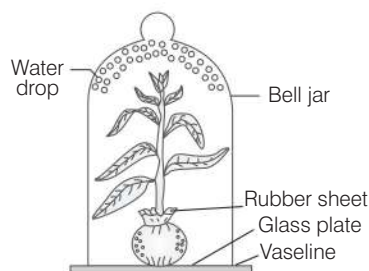
- (i) Name the factor studied in this experiment.
  - (ii) What will you observe in the experimental leaf after the starch test ?
  - (iii) Explain the process of photosynthesis.
  - (iv) Give a balanced chemical equation to represent the process of photosynthesis.
  - (v) Draw a neat, labelled diagram of an experimental setup to show that oxygen is released during photosynthesis.
- (b) State the main functions of the following : [5]
- (i) Medulla oblongata
  - (ii) Cytokinins
  - (iii) Tears
  - (iv) Coronary artery
  - (v) Seminal vesicles
4. (a) The diagram given below represents an organ system in the human body. Study the same and answer the questions that follow : [5]



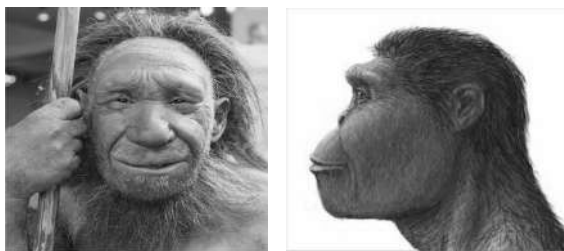
- (i) Identify the system.
  - (ii) Label the parts marked 2 and 4. Mention the function of part 5.
  - (iii) Name the structural and functional units of the part marked 1.
  - (iv) What is the fluid that accumulates in part 3 ? Which is the main nitrogenous waste present in it ?
  - (v) Draw a neat, labelled diagram showing the longitudinal section of part 1.
- (b) The diagram given below represents an endocrine gland in the human body. Study the diagram and answer the following questions : [5]



- (i) Identify the endocrine gland. Where is it located ?
  - (ii) Why is the above gland referred to as the 'Master gland' ?
  - (iii) Name the hormone which in deficiency causes diabetes insipidus. How does this disorder differ from diabetes mellitus ?
  - (iv) Explain the term 'hormone'. What is the role of tropic hormones in the human body ?
  - (v) Which lobe of the above gland secretes
    1. Oxytocin      2. ACTH
    3. Growth hormone ?
5. (a) Given below is an apparatus which was setup to investigate a physiological process in plants. The setup was placed in bright sunlight. Answer the questions that follow : [5]



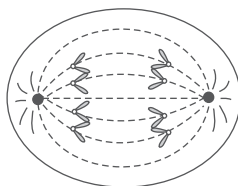
- (i) Name the process being studied. Define the process.
  - (ii) Why was the pot enclosed in a rubber sheet ?
  - (iii) Mention two external factors which can accelerate the above process.
  - (iv) List two adaptations in plants to reduce the above process.
  - (v) Draw a neat, labelled diagram of a stomatal apparatus.
- (b) Given below are two stages in the evolution of man. Study them and answer the questions that follows : [5]



A

B

- (i) Identify *Australopithecus* and Neanderthal man from the above pictures.
  - (ii) Mention two characteristic features each for the two stages.
  - (iii) Who proposed the theory of 'natural selection'?
  - (iv) Name the organism used as an example to explain 'industrial melanism.'
  - (v) Give two examples of vestigial organs in humans.
6. (a) In Mendel's experiments, tall pea plants (T) are dominant over dwarf pea plants (t). [5]
- (i) What is the phenotype and genotype of the  $F_1$ -generation if a homozygous tall plant is crossed with a homozygous dwarf plant?
  - (ii) Draw a Punnett square board to show the gametes and offspring when both the parents are heterozygous for tallness.
  - (iii) What is the phenotypic ratio and genotypic ratio of the above cross in (ii)?
  - (iv) State Mendel's law of dominance.
  - (v) What is a dihybrid cross?
- (b) Given below is a diagram representing a stage during the mitotic cell division. Study the diagram and answer the following questions. [5]

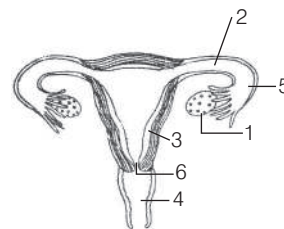


- (i) Identify the stage by giving a suitable reason.

- (ii) Is it a plant or an animal cell? Give a reason to support your answer.
- (iii) Draw a neat, labelled diagram of the stage which follows the one shown in the diagram.
- (iv) How many chromosomes will each daughter cell have after the completion of the above division?
- (v) Name the four nitrogenous bases.

7. (a) Answer the following questions briefly : [5]

- (i) How are the cytons and axons placed in the brain and the spinal cord?
  - (ii) Which part of the human ear gives 'dynamic balance' and static balance' to the body?
  - (iii) Explain how the human eye adapts itself to bright light and dim light?
  - (iv) What is parthenocarpy? Give one example.
  - (v) Mention any two objectives of 'Swachh Bharat Abhiyan'.
- (b) The diagram given below represents a system in the human body. Study the diagram and answer the following questions : [5]



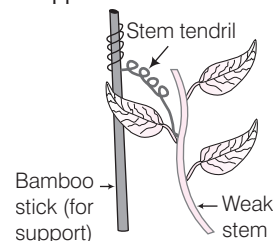
- (i) Identify the system.
- (ii) Label the parts marked 5 and 6.
- (iii) Name the two hormones secreted by 1.
- (iv) Mention the number and the name of the part involved in fertilisation and implantation from the above diagram.
- (v) Mention the surgical methods of contraception in :
  1. Human males.
  2. Human females.

## ANSWERS

1. (a) (i) Middle choroid layer  
(ii) Chlorofluorocarbons (CFCs)  
(iii) Umbilical cord  
(iv) Homologous chromosomes  
(v) Carbaminohaemoglobin
- (b) (i) Jean Baptiste de Lamarck (1744-1829)  
(ii) Amnion  
(iii) Cerebellum  
(iv) Nephrons  
(v) Cornea
- (c) (i) The birth rate in India is very high because
- Illiteracy due to which many people in rural areas do not know the functioning of reproductive system and family planning.
  - Traditional belief that children are the gift of God and a sign of prosperity.
  - Desire for a male child in the family as people believe that male child is usually of great help to the aged parents.
  - Low economic conditions due to which children become helping hands for their parents which also affects their education.
  - The high mortality rate in infants makes people think it is safer to produce more children.
  - Religious and social customs make some families unable to accept family planning norms.
- (ii) When carbon monoxide is inhaled in a large quantity, a person will die because it combines with the haemoglobin in blood with greater affinity which decreases the capacity of the blood to carry and transport oxygen in body.
- (iii) When fertilisers are added to the moist soil around root hairs, it will form hypertonic solution, resulting the protoplasm to shrink. Hence, the root hairs also become limp or flaccid
- (iv) **Acid Rain** When the rainwater contains large quantities of acids like  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  formed by dissolution of oxides of N and S in water, it is called acid rain. The pH of normal rain is about 6, while that of the acid rain is less than 3 or 4, i.e. highly acidic. Acid rain is harmful to the environment in many ways which are as follows
- It damages the fish and other aquatic life by increasing acidity of water.
  - It damages the vegetation by killing the useful soil microbial community.
  - Acid in the rain reacts with the calcium of statues, sculptures and ancient monuments and damages them, e.g. Damage to Taj Mahal.
  - Fine particles of sulphates and nitrates are also harmful for humans.
- (v) Photosynthesis is important for supporting life on earth in the following ways
- It provides food to all organisms through food chain.
  - Photosynthesis gives off oxygen, which acts as a life supporting gas. As a result of photosynthesis, some amount of oxygen produced is used by the plant itself for the process of respiration. But the major amount of  $\text{O}_2$  is diffused out into the atmosphere through stomata. Thus, this oxygen which gets diffused out, is not a waste material because it acts as a life supporting gas for other living organisms including humans on earth.
  - It helps in maintaining balanced level of  $\text{O}_2$  and  $\text{CO}_2$  in the atmosphere.
  - The fossil fuels like coal, petroleum and natural gas are formed by the decomposition of photosynthetic organisms.
- (d)
- |       | Column A       | Column B           |
|-------|----------------|--------------------|
| (i)   | Cranial nerves | 12 pairs           |
| (ii)  | Leydig cells   | Testosterone       |
| (iii) | Acetylcholine  | Neurotransmitter   |
| (iv)  | Spinal nerves  | 31 pairs           |
| (v)   | Sneezing       | Conditioned reflex |
- (e) (i) (c) **Artery** Doctor records pulse rate in order to check heart's rate and rhythm of heart. Each pulse matches up with a heartbeat that pumps blood into the arteries. The force of the pulse also helps to evaluate the amount of blood flow to different area of body.
- (ii) (d) Either X or Y chromosome  
The sex determining mechanism in human beings is XX-XY type. In human beings, male gamete (sperm) contains either X or Y-chromosome, while female gamete (egg) contains only X-chromosome.
- (iii) (a) **Capillary** It is a narrow tube-like blood vessel, comprising of a single layer of endothelial cells.
- (iv) (c) **14th Day Ovulatory Phase** In this period, the rupture of Graafian follicle occurs releasing the egg to travel down the oviduct. It occurs on about 13-14th day of the menstrual cycle.
- (v) (d) **Age of the Plant** The rate of transpiration is not affected by age of the plant.
- (f) (i) Odd term - Leukemia  
Category - Others are hyposecretion of hormones or abnormalities of hormones.
- (ii) Odd term - Pepsin  
Category - Others are example of amino acid derived hormones.
- (iii) Odd term - Photon  
Category - Others are parts of neuron.

- (iv) Odd term - Chicken pox  
Category - Others are hereditary diseases inherited from parents.
- (v) Odd term - Polythene bag  
Category - Others are agriculture wastes and rich in nitrogen and carbohydrates which have potential to produce renewable bio-based energy and chemical products.
- (g) (i) ABA- Absciscic Acid  
(ii) IAA - Indole-3- Acetic Acid  
(iii) ATP - Adenosine Triphosphate  
(iv) DNA - Deoxyribonucleic Acid  
(v) TSH - Thyroid Stimulating Hormone
- (h) (i) Water pollution  
(ii) Sewage or Industrial waste  
(iii) Effects of Water Pollution on Human Health
- Pollution of water may cause many water borne diseases such as typhoid, dysentery, etc.
  - Aquatic animals and sea birds may be killed due to oil spills. Oil does not dissolve in water and it forms layer on water which prevents the oxygenation of sea water, which affects the aquatic organisms.
  - Discharge of excessive nutrients through sewage into the static water leads to death of aquatic life. The organic matter increases growth of algae that consumes a lot of  $O_2$ . This decreases the  $O_2$  causing problem for water organisms. This phenomenon is known as **eutrophication**. It refers to the natural ageing of lake by the nutrient enrichment of its water.
- (iv) Water pollution can be controlled by introducing sewage treatment plants.
- (v) **Pollutants** The agent that cause pollution and bring undesirable changes in the environment are known as **pollutants**. These are classified into two main types
- **Biodegradable pollutants** are the substances which can be degraded by the action of microorganisms, e.g. food and kitchen waste, paper, plant waste, etc.
  - **Non-biodegradable pollutants** are the substances which cannot be degraded by the action of microorganisms, e.g. animal wastes, polythene bags, metals, electric components, pesticides (DDT), etc.
2. (a) (i) Part-1- Radicle, Part -2 - Plumule  
(ii) **Positive geotropism** - when the root tips grows towards gravity, it is known as positive geotropism.  
(iii) Gravity and water are two stimuli which is affected part 1. **Gravity**- considered as stronger factor.  
(iv) **Thigmotropic movement** (stimulus-touch) In thigmotropism, the growth or movement of plants occurs in response to touch.  
For example, the tendrils of plants like sweet pea, grapes, *Cuscuta* are sensitive to touch. When these tendrils come in contact with any support, the part of tendril in contact with the object does not grow as rapidly as other parts of the plant. The tendrils then

start to circle around the object and cling to the available support.



Thigmotropism in plant

- (v) **Geotropic movement** (stimulus-gravity) The movement of plant part in response to gravity is called geotropic movement and the phenomenon involved is called **geotropism**.

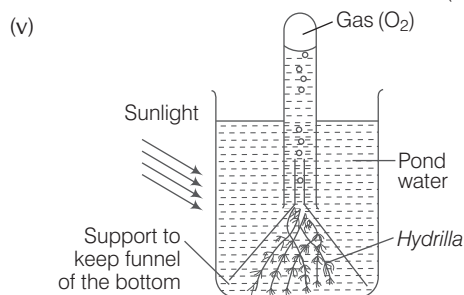
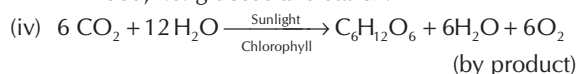
When the tip of the stem grows away from the earth's gravitational force, it is known as **negative geotropism** and when the root tips grow towards gravity, it is known as **positive geotropism**. Roots always move towards centre of gravity (downwards). For example, when bean or gram seed is sown in moist soil. After a few days, the stem grows away from the force of gravity and the root grows towards the force of gravity.



Response of the plant to the direction of gravity

- (b) (i) **Testes** are found in a thin-walled sac called scrotum, outside the abdomen in order to escape from high body temperature.  
(ii) **Middle ear** It contains three ossicles bones called malleus (hammer), incus (anvill) and stapes (stirrup) which are attached to each other in chain like fashion.  
(iii) A membrane system containing a number of disc-like sacs known as **thylakoids** is located in chloroplast.  
(iv) **Amnion** It is thin, double-layered membranous structure enclosing an embryo. The space between the amnion and foetus in the embryo is filled with the **amniotic fluid**.  
(v) **Corpus callosum** is the region that connects the left and right cerebral hemisphere of forebrain.
3. (a) (i) Light  
(ii) Uncovered leaf which was able to get light will turn into blue-black colour which indicates the presence of starch, while the portion which was covered with black paper will turn into brown colour showing absence of starch.  
(iii) Photosynthesis process begins when the sunlight falls on the mesophyll cells of the leaf. The light energy is trapped by the chlorophyll present in the layers of mesophyll

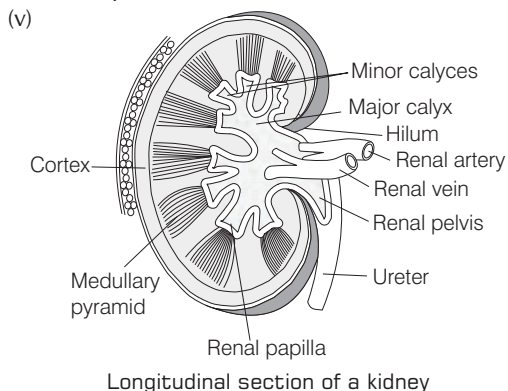
cells. During the process, the raw materials, i.e.  $\text{CO}_2$  and water together with the solar energy trapped by the chlorophyll gets converted into chemical energy in the form of food, i.e. glucose and starch.



Experiment to show that oxygen is given out during photosynthesis

- (b) (i) Medulla oblongata is located in the brain stem, anterior to (in front of) the cerebellum. It helps to regulate breathing, heart and blood vessel function, digestion, sneezing and swallowing.
- (ii) Main function of cytokinins is to promote cell division and organ formation.
- (iii) Major functions of the tears are washing away irritating materials to prevent microbial infection, healing damages, nourishes cornea, etc.
- (iv) Coronary arteries supply oxygenated blood to the heart muscles.
- (v) Seminal vesicles are responsible for producing a milky fluid known as seminal fluid which acts as a medium for transportation of sperms.

4. (a) (i) Excretory system in human
- (ii) Part-2 - Ureter  
Part-4 Sphincter muscles  
Part-5 is urethra → passage through which urine and semen are excreted out of the body.
- (iii) Nephron is known as the structural and functional unit of kidney.
- (iv) Urinary bladder contains the urine until it is released out. Urea is the main nitrogenous waste present in urine.



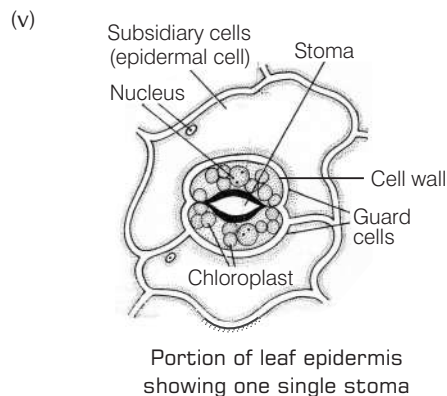
- (b) (i) This endocrine gland is pituitary gland. It is located in the brain between the hypothalamus and pineal gland, just behind the bridge of the nose.
- (ii) Pituitary gland is known as master gland because it produces many hormones that travel throughout the body directing certain processes or stimulating other glands to produce other hormones.
- (iii) Diabetes insipidus is a condition that results from insufficient production of the Antidiuretic Hormone (ADH) called vasopressin. It is characterised by excessive thirst and excretion of large amounts of severely dilute urine. Diabetes mellitus is a group of metabolic disorders characterised by excessive levels of the sugar glucose in the blood.
- (iv) Hormones are chemical regulators that are produced and poured directly into the blood stream. The site of production and actions are different.

Hormones which regulate the secretion of other endocrine glands are known as tropic hormones.

- (v) 1. **Oxytocin** It is released into the blood from the posterior lobe of the pituitary gland.
2. **ACTH** Anterior pituitary lobe releases adrenocorticotrophic hormone to stimulate cortisol production in the adrenal glands.
3. **Growth hormone** Anterior lobe of pituitary gland secretes growth hormone.

5. (a)

- (i) The process being studied is transpiration. The process of loss of water in the form of vapour from the exposed or aerial parts of a plant (such as leaves, etc.) is called transpiration.
- (ii) To prevent the escape of water vapours from the pot.
- (iii) (a) Temperature (b) Humidity
- (iv) Adaptations to reduce transpiration are
- (a) The presence of sunken stomata.
- (b) The presence of thick cuticle on leaves.



- (b) (i) A- Neanderthal man  
B- *Australopithecus*
- (ii) Characteristic features of *Australopithecus*
- Erect posture and omnivorous diet

- Cranial capacity volume (brain size) was 500-700 cc.

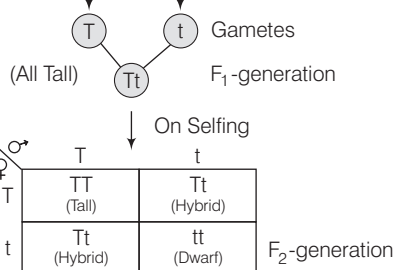
Characteristics of Neanderthal man

- Cranial capacity of Neanderthal man was 1300-1600 cc.
  - They used to kill the large animals by group attack and used knives to butcher.
- (iii) Charles R Darwin postulated the theory of natural selection. He postulated the 'theory of origin of species' by natural selection.
- (iv) *Biston betularia* (Peppered moth)
- (v) • Wisdom teeth - the third pair of molars are vestigial in humans
- Vermiform appendix - the presence of non-functional appendix in man indicates that the ancestors of man had a diet rich in cellulose.

6. (a)

- (i) Phenotype- All tall plants were produced.  
Genotype - Tt (tall plants).

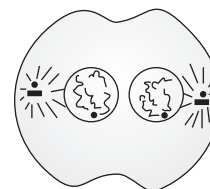
- (ii) Male Parent (Tall Plant) TT × Female Parent (Dwarf Plant) tt



- (iii) Phenotypic ratio – 3 : 1 (Tall : Dwarf)  
Genotypic ratio – 1 : 2 : 1 (TT : Tt : tt)
- (iv) **Law of dominance** (First Law) This law states that when two alternative forms of trait or character are present in an organism, only one factor expressed itself in F<sub>1</sub>-progeny.

This factor is called **dominant factor**, while the other factor which remains hidden is called **recessive factor**. It explains the expression of a gene in a cross and 3 : 1 ratio is obtained in F<sub>2</sub>-generation.

- (v) **Dihybrid cross** This type of cross performed by taking two pairs of contrasting characters at a time.
- (b) (i) **Anaphase** - During this phase, the splitting of chromosomes take place. This splitting occurs due to the division of centromere which attaches two sister chromatids.
- (ii) Animal cell as it contains centrosomes.
- (iii) Telophase



In animal cell

- (iv) Two chromosomes in each daughter cell.

- (v) • Adenine  
• Guanine  
• Cytosine  
• Thymine

7. (a) (i) **Cyton in Brain** The cerebral cortex is the outer folded part of the brain also called grey matter containing all the cell bodies and dendrites of nerve cell.

**Axons in Brain** The inner portion is composed of white matter mainly consists of axons of the neurons. In spinal cord, grey matter is present in the inner side and white matter on outer side.

- (ii) **Dynamic Balance** Sensory cells in semicircular canal are concerned with dynamic balance.

**Static Balance** Utriculus and sacculus.

- (iii) **Pupil** is an aperture surrounded by the iris. The movement of muscle fibres of iris controls the size of pupil and regulates the amount of light entering the eye.

Due to this adjustment, we blink our eyes when see bright light or not able to see when enters a dim light room because pupil takes time to adjust its size according to the amount of light.

- (iv) **Parthenocarpy** Development of fruit without fertilisation, e.g. banana, tomatoes, etc.

- (v) The objectives of this campaign are as follows

- Elimination of open defecation and construction of in house and commercial toilets.
- Cleaning the streets, roads and infrastructure of our country's towns and cities.
- Efficient management and disposal systems to be developed for solid and liquid wastes.

- (b) (i) Female reproductive system

- (ii) Part 5- Funnel of oviduct

Part 6 - Cervix

- (iii) Progesterone, oestrogen

- (iv) Part -2 Fertilisation in Fallopian tube

Part -3 Implantation occurs in uterus

- (v) **Vasectomy** is a surgical procedure for male contraception.

**Tubectomy** is a surgical method for female contraception.

# Latest ICSE Specimen Paper Biology (Fully Solved)

## General Instructions

1. You will not be allowed to write during the first 15 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section I** and any 4 questions from **Section II**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

Time : 2 Hrs

Max. Marks : 80

## Section-I

[40 Marks]

1. (a) Name the following
  - (i) The hormone that regulates the basal metabolic rate.
  - (ii) The part of the internal ear related to the static balance of the body.
  - (iii) The soluble protein in blood plasma responsible for blood clotting.
  - (iv) The gaseous plant hormone.
  - (v) The uptake of mineral ions against the concentration gradient. [5]
- (b) Choose the correct answer from the four options given for each below
  - (i) The rate of transpiration will be fastest when the day is
    - A. hot, humid and windy
    - B. cool, humid and windy
    - C. hot, humid and still
    - D. hot, dry and windy
  - (ii) Cytokinins are predominantly present in
    - A. permanent tissues
    - B. meristematic tissues
    - C. endodermis
    - D. cortical region
  - (iii) A cell has five pairs of chromosomes. After mitotic division, the number of chromosomes in the daughter cells will be
    - A. five
    - B. ten
    - C. twenty
    - D. forty
  - (iv) Learning is related to
    - A. cerebrum
    - B. cerebellum
    - C. medulla oblongata
    - D. hypothalamus
  - (v) The most primitive ancestor of man is
    - A. Homo habilis
    - B. Cro-Magnon
    - C. Neanderthal
    - D. Australopithecus [5]
- (c) The following paragraph is related to absorption of water from the soil. Complete the following paragraph by selecting the correct word from those given below. You may use a term only once.

exosmosis, hypertonic, osmosis, isotonic, hypotonic, cortical, endosmosis, phloem.

Water enters the root hair from the soil by the process of (i) ..... . This is because the solution in the soil is (ii) ..... whereas the cell sap in the root hair cell is (iii) ..... . The water then passes through the (iv) ..... cells by cell to cell (v) ..... and reaches the xylem of the root. [5]
- (d) Give the exact location of each of the following structures
  - (i) Corpus callosum
  - (ii) Adrenal gland
  - (iii) Acrosome
  - (iv) Amnion
  - (v) Monocytes [5]

FULLY SOLVED

- (e) Given below are five sets of terms. In each case arrange and rewrite each set so as to be in a logical sequence.

One is done as an example for you

**Example** Large intestine, Stomach, Mouth, Small intestine, Oesophagus.

**Ans** Mouth, Oesophagus, Stomach, Small intestine, Large intestine.

- (i) Metaphase, Interphase, Anaphase, Prophase, Telophase  
 (ii) Vagina, Sperm, Uterus, Oviduct, Cervix  
 (iii) Pinna, Cochlea, Tympanum, Ossicles, Auditory canal  
 (iv) Posterior vena cava, Renal artery, Aorta, Renal vein, Kidney  
 (v) Synapse, Axon endings, Cyton, Node of Ranvier, Dendrite [5]

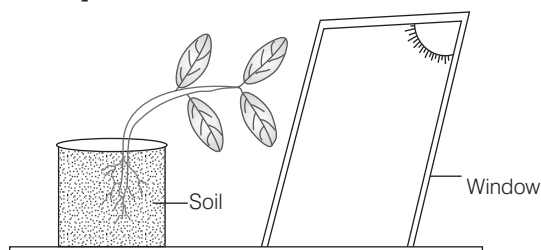
- (f) Identify the odd term in each set and name the category to which the remaining 3 belong.

**Example** Ovary, Fallopian tube, Ureter, Uterus.

**Odd term** Ureter

**Category** Parts of female reproductive system.

- (i) Basophil, Neutrophil, Eosinophil, Lymphocyte  
 (ii) Pulmonary vein, Hepatic vein, Renal vein, Post caval  
 (iii) Gibberellin, Auxin, Vasopressin, Absciscic acid  
 (iv) Wind energy, Tidal energy, Petroleum, Solar energy  
 (v) Plastic, Paper, Glass, Aluminium [5]  
 (g) The diagram given below represents a plant growing in a glass jar. The glass jar is placed near a window. Study the diagram and answer the questions that follows



- (i) Name the tropic movements shown by the shoot and roots.  
 (ii) What is the stimulus that made the shoot bend towards the window?  
 (iii) Which plant hormone caused the above effect?

- (iv) Explain the role of the hormone in bending the shoot towards the window. [5]

- (h) Match the items of Column I with those in Column II and rewrite the correct matching pairs

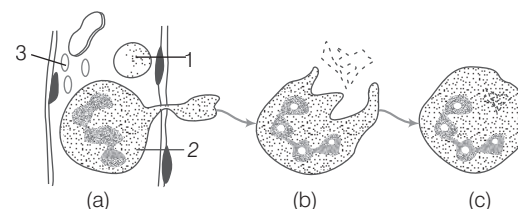
Column I	Column II
A. Diabetes mellitus	1. Hypersecretion of thyroxine
B. Diabetes insipidus	2. Hyposecretion of thyroxine
C. Cretinism	3. Hyperglycemia
D. Insulin shock	4. Hyposecretion of growth hormone
E. Exophthalmic	5. Hypoglycemia
	6. Hyposecretion of ADH
	7. Oversecretion of adrenalin

[5]

## Section-II

[40 Marks]

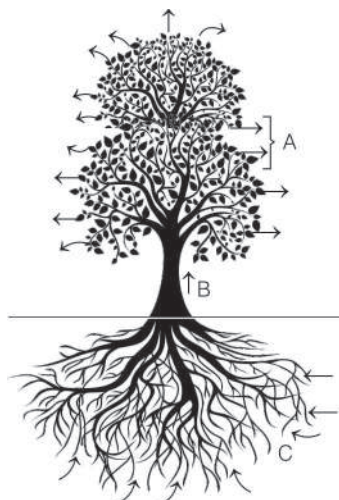
2. (a) Study the diagrams given below and answer the questions that follows



- (i) Name the cells numbered 1, 2 and 3.  
 (ii) Identify the phenomenon occurring in (a). Explain the phenomenon.  
 (iii) Mention two structural differences between 1 and 2.  
 (iv) Name the process occurring in (b) and (c).  
 (v) State the importance of this process in the human body. [5]  
 (b) Give one difference between each of the following pairs on the basis of what is given in the brackets  
 (i) Mitral valve and Aortic semilunar valve [location]  
 (ii) Hydrotropism and Thigmotropism [stimulus]  
 (iii) Metaphase and Anaphase [position of chromatids]  
 (iv) Demography and Population density [definition]

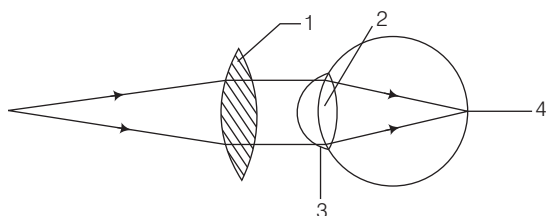
- (v) Turgid cell and Plasmolysed cell [tonicity of the surrounding solution] [5]

3. (a) An outline sketch of a tree is shown in the diagram below. Study the same and answer the questions that follows



- Name the phenomenon that is labelled A in the diagram.
  - Explain the phenomenon occurring in A.
  - What is the importance of this phenomenon in plants?
  - Explain the role of any three external factors that will increase the rate of the phenomenon.
  - What do the direction of arrows in B and C indicate? [5]
- (b) Mention the exact function of the following structures
- Iris
  - Plasma membrane
  - Nephron
  - Thylakoids
  - Hydathodes [5]

4. (a) Given below is a diagrammatic representation of a defect of the human eye which has been corrected using a suitable lens. Study the diagram and answer the questions that follows

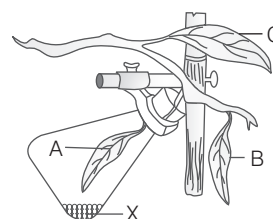


- Identify the defect that has been corrected.
- Mention two reasons for the above defect.
- Label the parts numbered 1 to 4.
- State the functions of the parts numbered 3 and 4.
- What maintains the shape of the eyeball? [5]

- (b) Give the biological/technical terms for the following

- The quick actions which are involuntary and controlled by the spinal cord.
- The structure formed after the release of ovum from the Graafian follicle.
- The surgical technique used in human females to prevent pregnancy.
- The stage of cell division in which the nuclear membrane disappears and the chromosomes become short and thick.
- The onset of menstruation in a young girl of 13 years.
- The canal through which testes descend into the scrotum just before birth in a human male baby.
- The repeating components of each DNA strand lengthwise.
- The site of photosynthesis in a plant cell.
- The constituents which cause the natural quality of the environment to deteriorate.
- The defect of vision in which some parts of the objects are seen in focus while the others are blurred. [5]

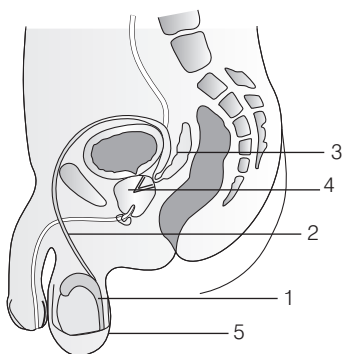
5. (a) The diagram below represents an experiment to demonstrate a particular aspect of a physiological process in plants. Study the diagram and answer the questions that follows



- What is the aim of the experiment?
- What is the chemical substance named X in the diagram? What is the special condition created inside the flask due to the presence of the substance X?
- In what way will the three leaves A, B and C differ at the end of the experiment when tested with iodine solution?

- (iv) Write the overall chemical equation for the process mentioned in (i).
- (v) Explain the term 'destarching.' [5]
- (b) Briefly explain the following
  - (i) Plasmolysis
  - (ii) Gestation
  - (iii) Synapse
  - (iv) Photophosphorylation
  - (v) Lamarck's theory of use and disuse of organs. [5]

6. (a) Given below is the diagram of the male reproductive system and its associated parts in the human body. Study the diagram and answer the questions that follows



- (i) Name the parts numbered 3-5.
- (ii) State the function of the part marked 2 and 3.
- (iii) What is the significance of the part numbered 5.
- (iv) Mention the hormone secreted by the part numbered 1.
- (v) Draw a neat labelled diagram of a human sperm. [5]

- (b) Give scientific reasons for the following statements
  - (i) Foetus cannot develop without placenta.
  - (ii) Throat infections can lead to ear infections.
  - (iii) We feel blinded for a short while entering a dark room when coming from bright light.
  - (iv) Urine is slightly thicker in summer than in winter.
  - (v) Loss of nucleus and mitochondria make erythrocytes more efficient in their function. [5]

7. (a) A homozygous purple flower variety of pea plant [PP] is crossed with white flower variety of pea [pp]. Answer the questions that follows
- (i) Mention the phenotype and genotype of the  $F_1$ -generation of offsprings.
  - (ii) If the offsprings of the  $F_1$ -generation are crossed, what will be the phenotypic and genotypic ratios of the  $F_2$ -generation?
  - (iii) State Mendel's law of dominance.
  - (iv) What is the scientific name of pea plant?
  - (v) Name two genetic diseases in humans.[5]
- (b) Answer the following questions briefly
- (i) Mention two features of a Neanderthal man.
  - (ii) What are the age restrictions for marriage by law for boys and girls in India?
  - (iii) State two objectives of 'Swachh Bharat Abhiyan'.
  - (iv) Mention two functions of the amniotic fluid.
  - (v) List two reasons for the population explosion in India. [5]

## ANSWERS

### Section-I

1. (a) (i) Thyroxine hormone  
 (ii) Vestibule  
 (iii) Fibrinogen  
 (iv) Ethylene  
 (v) Active transport  
 (b) (i) (D) hot, dry and windy  
 (ii) (B) meristmatic tissues  
 (iii) (A) five  
 (iv) (A) cerebrum  
 (v) (D) *Australopithecus*.

- (c) (i) endosmosis (ii) hypotonic  
 (iii) hypertonic (iv) cortical cells  
 (v) osmosis
- (d) (i) **Corpus callosum** is found in forebrain. It connects right and left cerebral hemispheres.  
 (ii) **Adrenal glands** are present on optical part of each kidney.  
 (iii) **Acrosome** forms cap in anterior portion of sperm head.  
 (iv) **Amnion** is an extraembryonic or foetal memberane that encloses developing embryo. It is followed by chorion and allantois.

- (v) **Monocytes** are type of leucocyte or white blood cells. They are produced by bone marrow. After circulating in blood stream for 1-3 days, it moves into tissues and differentiates into macrophages and dendritic cells.
- (e) (i) Interphase, Prophase, Metaphase, Anaphase and Telophase.  
 (ii) Sperm, Vagina, Cervix, Uterus, Oviduct.  
 (iii) Pinna, Auditory canal, Tympanum, Ossicles, Cochlea.  
 (iv) Aorta, Renal artery, Kidney, Renal vein, Vena cava.  
 (v) Dendrite, Cyton, Node of Ranvier, Axon endings, Synapse.
- (f) (i) **Odd term** — Lymphocyte  
**Category** — Granular white blood cells.  
 (ii) **Odd term** — Pulmonary vein  
**Category** — Rest contain deoxygenated blood  
 (iii) **Odd term** — Vasopressin  
**Category** — Types of plant hormones  
 (iv) **Odd term** — Petroleum  
**Category** — Renewable source of energy  
 (v) **Odd term** — Paper  
**Category** — Non-biodegradable.
- (g) (i) The shoot shows positive phototropic movement while roots show negative phototropic movement.  
 (ii) Direction of sunlight made the shoot of plant to bend towards the window.  
 (iii) Auxin hormone is responsible for bending of plant towards light.  
 (iv) Auxin hormone causes uneven growth of plant stem as this hormone is active in dark (non-illuminated) side of stem, thus causes more growth in that portion. As a result, plant stem bends towards light.

(h)

A. Diabetes mellitus	3. Hyperglycemia
B. Diabetes insipidus	6. Hyposecretion of ADH.
C. Cretinism	2. Hyposecretion of thyroxine
D. Insulin shock	5. Hypoglycemia
E. Exophthalmic goitre	1. Hypersecretion of thyroxine.

## Section-II

2. (a) (i) The cell numbered as 1 is erythrocytes, 3 is blood platelets and 2 is WBC.  
 (ii) The phenomenon occurring in part (a) is diapedesis, i.e. the movement of leucocytes from blood capillaries into the tissues. Here, it differentiates to form macrophages and dendritic cells.  
 (iii) Structural differences between 1 (RBC) and 2 (WBC) are

Part 1 (RBC)	Part 2 (WBC)
Biconcave in shape	Amoeboid in shape
Nucleus absent	Nucleus present

- (iv) Phagocytosis is the process occurring in (b) and (c).  
 (v) During this phenomenon, the WBC engulfs the disease causing germs that enter the body and thus, defend our body from these organisms.
- (b) (i) Mitral valve lies between the left atrium and the left ventricle, while aortic semilunar valve is present between left ventricle and the aorta.  
 (ii) Hydrotropism is the movement in response to external stimulus of water while thigmotropism movement is caused due to contact with foreign body.  
 (iii) In metaphase stage, chromosomes align themselves at the equatorial plate while in anaphase stage daughter chromatids start migrating towards their respective poles.  
 (iv) The scientific statistical study of human population is called demography.  
 Population density is the measurement of population per unit area or per unit volume at a given time.  
 (v) When a cell is placed in hypotonic solution, it takes up water by osmosis and becomes turgid while, when it is placed in hypertonic solution, it shrinks and loses water and gets plasmolysed.

3. (a) (i) The label A shows the process of transpiration.

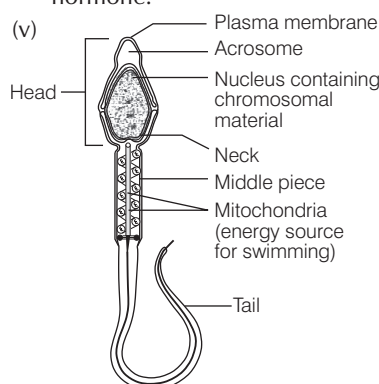
- (ii) **Transpiration** is the evaporative loss of water by the aerial parts of plants (such as leaves, etc.) in the form of water vapour.

Transpiration can be of following types depending on the parts of the plant

- **Stomatal transpiration** This occurs through stomata present in leaves.
- **Cuticular transpiration** This occurs through cuticle of leaves and stems of plants.

- **Lenticular transpiration** This occurs through the open structure present on the bark of the woody stems known as lenticels.
  - (iii) **Significance of transpiration** Transpiration acts as a significant phenomenon for the plants.  
Some major advantages of transpiration are given below
    - Helps in exchange of gases in the plants.
    - Provides cooling effect.
    - Increases the upward movement of water into xylem.
    - Also influences the movement of minerals along with water absorption.
    - Maintain the shape and structure of plant parts by keeping the cells turgid.
    - Control the rate of absorption of water by roots through transpiration pull.
  - (iv) The rate of transpiration can be increased by following factors
    - **Temperature** Transpiration increases with increase in temperature and **vice-versa**.
    - **Velocity of wind** Transpiration increases with the velocity of wind.
    - **Leaf area** Larger leaves lose more water than smaller one.
  - (v) Direction of arrows B and C indicates upward-movement of water.
- (b)
- (i) Pigments of iris are responsible for the colour of the eye.
  - (ii) Plasma membrane is a semipermeable membrane that allows only certain substances to pass through it.
  - (iii) Nephrons are functional unit of kidney.
  - (iv) The function of thylakoid is to trap the light energy and to transform this energy into chemical energy forms, i.e. ATP and NADPH to be used in dark reactions.
  - (v) Hydathodes are minute pores present along leaf margin that are involved in guttation.
4. (a) (i) The given figure shows the hypermetropia (long sightedness) defect of eye.
- (ii) This defect arises due to following reasons.
    - Focal length of eye lens becomes large.
    - Eyeball becomes too short so that the image is formed behind retina.
  - (iii) These are as follows
    1. Convex lens      2. Cornea
    3. Eye lens        4. Retina
  - (iv) Cornea is transparent portion of sclerotic layer that covers the coloured part of eye.  
Retina is the innermost layer of the eye which is sensitive to light.  
Formation of image takes place here.
- (v) Ciliary muscles control /maintain the shape of the eyeball.
- (b)
- (i) Reflex action                      (ii) Corpus luteum
  - (iii) Tubectomy                        (iv) Prophase
  - (v) Menarche                          (vi) Inguinal canal
  - (vii) Nucleotides
  - (viii) Chloroplast in mesophyll cells
  - (ix) Pollutants
  - (x) Stereoscopic vision. [5]
5. (a)
- (i) The aim of experiment is to show that  $\text{CO}_2$  is necessary for photosynthesis.
  - (ii) The chemical substance X is KOH. It is used to remove  $\text{CO}_2$  from the flask.
  - (iii) Leaf A does not turn blue-black while leaf B and C turned blue-black at the end of the starch test.
  - (iv) 
$$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2 \uparrow \text{ (byproduct)}$$
  - (v) To destarch the leaves, they are kept in a dark room (with no exposure of natural or artificial light) for 1 or 2 days. By doing this all starch from the storage organs of the leaves will be removed.
- (b)
- (i) **Plasmolysis** is the phenomenon which occurs when water moves out of the cell when placed in a hypertonic solution by the process of osmosis. Due to plasmolysis, plant cell loses its original appearance, i.e. protoplasm shrinks and plasma membrane is pulled away from the cell wall. This makes the cell to look flaccid in appearance.
  - (ii) **Gestation** It is the time period during which the embryo remains in the uterus (after the last day of menstruation to the day of childbirth). The gestation period is of about 9 months or 280 days in human females.
  - (iii) **Synapse** It is the point of contact between the nerve endings of one neuron and the dendrites of another neuron separated by a fine gap.
  - (iv) **Photophosphorylation** It is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate group, i.e. inorganic phosphate (Pi), utilising the energy from the photons.  
$$\text{ADP} + \text{Pi} \longrightarrow \text{ATP}$$
  - (v) According to Lamarck's theory of use and disuse of organs, if an organ is used continuously and constantly, it will tend to become highly developed, whereas disuse results in its degeneration.

6. (a) (i) These are as follows
3. Seminal vesical
  4. Prostate gland
  5. Scrotum
- (ii) Vas deferens (label 2) carry sperms to penis. Seminal vesicle (label 3) secrete mucus and watery alkaline fluid that contains nutrients (fructose) and hormone like prostaglandin.
- (iii) Testes are found in a thin-walled sac of skin known as scrotum, outside the abdomen in order to escape from the high body temperature. This is because sperms mature at a temperature of around  $2-3^{\circ}\text{C}$  lower than the normal body temperature.
- (iv) The labelled part secretes testosterone hormone.



Structure of sperm

- (b) (i) Placenta is a disc-shaped organ formed inside the female body attached to the uterine wall. It gives nutritive support to the developing embryo through a cord known as umbilical cord. It contains blood vessels which connect the placenta to the uterus through which a growing embryo or foetus gets its nutrition and  $\text{O}_2$  supply.
- (ii) Eustachian tube connects the pharynx with inner ear. Thus, due to this, infection in throat may also lead to ear infections.
- (iii) The movement of muscle fibres of iris controls the size of the pupil. This adjustment of size of pupil regulates the amount of light entering the eye. Due to this adjustment, we blink our eyes when see bright light or not able to see when enters the dim room because pupil takes time to adjust its size according to the amount of light.
- (iv) During summer, as the temperature is high, we lose a considerable amount of water through perspiration, due to which more water is absorbed by the kidneys, thus making the urine more concentrated.

- (v) Mature RBCs are enucleated, i.e. they lack nucleus and endoplasmic reticulum which makes them more flexible thus, increasing their surface area to volume ratio for carrying more oxygen.

They lack mitochondria which means that red cells cannot use oxygen by themselves instead all the oxygen absorbed from the lungs is transported to all other tissues.

7. (a) (i)  $\text{F}_1$ -generation-Phenotype-All are purple Genotype-Pp.
- (ii)  $\text{F}_2$ -generation-Phenotype-Three purple and one white coloured Genotype-PP, Pp, pP, pp.
- (iii) **Law of dominance** (First Law) This law states that when two alternative forms of trait or character are present in an organism, only one factor expressed itself in  $\text{F}_1$ -progeny. This factor is called dominant factor, while the other factor which remains hidden is called recessive factor. It explains the expression of a gene in a cross and 3 : 1 ratio is obtained in  $\text{F}_2$ -generation.
- (iv) *Pisum sativum*.
- (v) Two genetic diseases of humans are haemophilia and colour blindness.
- (b) (i) Neanderthal man have brain size 1400 cc. They used hides to protect body and buried their dead.
- (ii) The marriageable age of boys and girls at present is 21 yrs for boys and 18 yrs for girls in India.
- (iii) Swachh Bharat Abhiyan is a campaign in India that aims to clean up the streets, roads and infrastructure of India's cities, smaller towns and rural areas. The objectives of Swachh Bharat include eliminating open defaecation through the construction of household-owned and community-owned toilets and establishing an accountable mechanism of monitoring toilet use.
- (iv) Amniotic fluid helps in protecting embryo from mechanical shocks and physical damage. Fluid also allows only restricted movements of foetus and prevents the sticking of foetus to the amnion.
- (v) The factors responsible for the increase in population in India are as follows
- Illiteracy due to which many people in rural areas do not know the functioning of reproductive system.
  - High natality rate, i.e. high birth rate.





# Latest ICSE Specimen Papers

**Semester I & II**

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**ICSE Examination  
Paper 2021-22**



# Latest ICSE Specimen Paper Biology (Semester I)

## General Instructions

1. All questions are compulsory.
2. The marks intended for questions are given in brackets [ ].
3. Select the correct option for each of the following questions.

Maximum Marks : 40

Time : 1 hour

## Section A

(15 Marks)

1. Name the following by choosing the correct option. (5)
  - (i) A pair of corresponding chromosomes of the same shape and size, but one from each parent.
    - (a) Autosomes
    - (b) Sex chromosomes
    - (c) Homologous chromosomes
    - (d) Analogous chromosomes
  - (ii) The factor that does not affect the rate of transpiration.
    - (a) Intensity of light
    - (b) Velocity of wind
    - (c) Carbon dioxide
    - (d) Oxygen
  - (iii) Movement of molecules of a substance from their higher concentration to lower concentration when they are in direct contact.
    - (a) Diffusion
    - (b) Endosmosis
    - (c) Imbibition
    - (d) Active transport
  - (iv) The complex molecule consisting of a DNA strand and a core of histones.
    - (a) Centrosome
    - (b) Nucleotide
    - (c) Nucleosome
    - (c) Chromosome
  - (v) The solvent used to dissolve the chlorophyll pigment while testing a leaf for starch.
    - (a) Soda lime
    - (b) Carboic acid
    - (c) Methylated spirit
    - (d) Water
2. Complete the following statements by choosing the appropriate option for each blank. (5)
  - (i) During meiosis ..... daughter cells are formed.
    - (a) 4
    - (b) 2
    - (c) 8
    - (d) 6
  - (ii) Wooden doors swell up during the rainy season due to .....
    - (a) osmosis
    - (b) diffusion
    - (c) imbibition
    - (d) transpiration
  - (iii) The semi-permeable membrane in a plant cell is the .....
    - (a) cell wall
    - (b) cell membrane
    - (c) tonoplast
    - (d) None of the above
  - (iv) Guttation takes place through .....
    - (a) stomata
    - (b) lenticels
    - (c) cuticle
    - (d) hydathodes
  - (v) A plant with variegated leaves is .....
    - (a) *Coleus*
    - (b) Lotus
    - (c) Peepal
    - (d) Mango

3. Choose the correct answer from each of the four options given below. (5)

(i) The pressure exerted by the cell contents on the cell wall.

- (a) Turgor pressure
- (b) Partial pressure
- (c) Wall pressure
- (d) Osmotic pressure

(ii) The cell component visible only during cell division.

- (a) Chromosome      (b) Chromoplast
- (c) Chromatin        (d) Centriole

(iii) Marine fish when placed under tap water bursts, because of

- (a) endosmosis      (b) exosmosis
- (c) diffusion        (d) plasmolysis

(iv) The sites of dark reaction of photosynthesis.

- (a) Grana            (b) Fret
- (c) Stroma           (d) Stoma

(v) The alternative forms of the same gene occupying the same position on homologous chromosomes.

- (a) Chromatids      (b) Alleles
- (c) Autosomes      (d) Centromere

## Section B

(15 Marks)

4. Explain the following terms. (5)

(i) Osmosis

- (a) Movement of water from their lower concentration to their higher concentration through a semi-permeable membrane.
- (b) Movement of solutes from their lower concentration to their higher concentration through a semi-permeable membrane.
- (c) Movement of water from their higher concentration to their lower concentration through a semi-permeable membrane.
- (d) Movement of water from their higher concentration to their lower concentration through a freely permeable membrane.

(ii) Photolysis

- (a) Splitting of water molecules into hydrogen ions and oxygen in the presence of light in grana.
- (b) Splitting of water molecules into hydrogen ions and oxygen in the presence of light in the stroma.
- (c) Splitting of water molecules into hydrogen ions and oxygen in the absence of light in grana.
- (d) Splitting of water molecules into hydrogen ions and oxygen in the absence of light in stroma.

(iii) Law of segregation

- (a) The two members of a pair of factors join during the formation of gametes.
- (b) The two members of a pair of factors separate during the formation of gametes.

(c) The two chromosomes of a pair of factors separate during the formation of gametes.

(d) The two members of a pair of factors separate during the process of germination.

(iv) Guttation

- (a) The loss of water in the form of water droplets from the surface of the leaf.
- (b) The loss of water in the form of water droplets through the stomata.
- (c) The loss of water in the form of water vapour along the leaf margin.
- (d) The loss of water in the form of water droplets along the leaf margin.

(v) Active transport

- (a) Passage of water from its lower to higher concentration through a cell membrane without any expenditure of energy.
- (b) Passage of ions from its lower to higher concentration through a cell membrane without any expenditure of energy.
- (c) Passage of water from its lower to higher concentration through a cell membrane using energy from the cell.
- (d) Passage of ions from its lower to higher concentration through a cell membrane using energy from the cell.

5. State the exact location of the following. (5)

(i) Spindle fibres

- (a) Between the two centrioles
- (b) Between the two centrosomes
- (c) Between chromatid and centromere
- (d) Between two centromeres

- (ii) Root hair
- Extension of the cortex
  - Extension of epithelium
  - Extension of epidermis
  - Extension of endodermis
- (iii) Stomata
- More the upper surface of dorsiventral leaves
  - More on the lower surface of the dorsiventral leaves
  - Both upper and lower surface of the dorsiventral leaves
  - None of the above
- (iv) Thylakoids
- In the inner membrane of the chloroplast
  - Wall of the chloroplast
  - In the chlorophyll
  - In the stroma of the chloroplast
- (v) Palisade parenchyma
- Between the upper and lower epidermis of dicot leaves
  - Between the upper epidermis and spongy parenchyma of dicot leaves
  - Between the lower epidermis and spongy parenchyma of dicot leaves
  - Between the upper and lower epidermis of monocot leaves

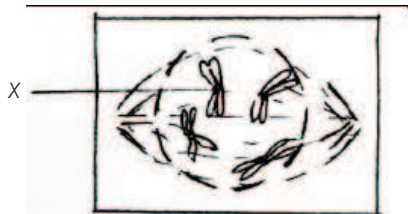
6. State the function of the following. (5)

- (i) Stroma
- Site of photolysis of photosynthesis
  - Site of photochemical phase of photosynthesis
  - Site of light dependent phase of photosynthesis
  - Site of light independent phase of photosynthesis
- (ii) Guard cells
- Regulate the closing of stomata
  - Regulate the opening and closing of stomata
  - Regulate the opening of stomata
  - Regulate the process of photosynthesis
- (iii) Xylem
- Translocation of food from the leaves to the other parts of the plant
  - Conduction of food
  - Conduction of water and food
  - Conduction of water and minerals from the root to the other parts of the plant
- (iv) Chromosomes
- The carriers of heredity
  - The controlling centre of the cell
  - The site for various chemical reactions
  - Intracellular digestion
- (v) Hydathode
- Helps in transpiration
  - Helps in guttation
  - Helps in imbibition
  - Helps in transportation of water

## Section C

(10 Marks)

7. Given below is a diagram representing a stage during mitotic cell division. Answer the questions that follows. (5)



- (i) Identify the stage.
- Telophase
  - Prophase
  - Metaphase
  - Anaphase

- (ii) Label part marked 'X'.

- Centriole
- Centrosome
- Centromere
- Chromatid

- (iii) Name the stage that follows the one shown here.

- Interphase
- Anaphase
- Telophase
- Metaphase

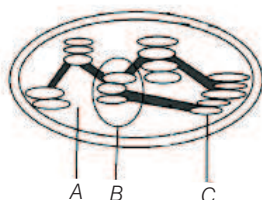
- (iv) What is the diploid number of chromosomes shown in the diagram?

- 6
- 2
- 4
- 8

(v) Mention one important feature of this stage.

- (a) Nucleolus reappears
- (b) Nuclear membrane reappears
- (c) Nuclear membrane disappears
- (d) Chromosomes align on the equator

8. Observe the diagram given below and answer the questions. (5)



(i) Identify the cell organelle.

- (a) Mitochondria
- (b) Lysosome
- (c) Ribosome
- (d) Chloroplast

(ii) Label the parts marked A, B and C.

- A. 1. Granum 2. Stroma 3. Fret 4. Thylakoid  
 B. 1. Granum 2. Stroma 3. Fret 4. Thylakoid  
 C. 1. Granum 2. Stroma 3. Fret 4. Thylakoid

(iii) The unit of light absorbed by chlorophyll is .....

- (a) proton
- (b) photon
- (c) electron
- (d) neutron

## Answers

1.	(i)	(c)	(ii)	(d)	(iii)	(a)	(iv)	(c)	(v)	(c)	5.	(i)	(a)	(ii)	(c)	(iii)	(b)	(iv)	(d)	(v)	(b)
2.	(i)	(a)	(ii)	(c)	(iii)	(b)	(iv)	(d)	(v)	(a)	6.	(i)	(d)	(ii)	(b)	(iii)	(d)	(iv)	(a)	(v)	(b)
3.	(i)	(a)	(ii)	(a)	(iii)	(a)	(iv)	(c)	(v)	(b)	7.	(i)	(b)	(ii)	(c)	(iii)	(d)	(iv)	(c)	(v)	(c)
4.	(i)	(c)	(ii)	(a)	(iii)	(b)	(iv)	(d)	(v)	(d)	8.	(i)	(d)	(ii)	A-2, B-1, C-4	(iii)	(b)				

# Latest ICSE Specimen Paper Biology (Semester II)

### General Instructions

1. You will not be allowed to write during the first 10 minutes. This time is to be spent in reading the question paper.
2. The time given at the head of this paper is the time allowed for writing the answers.
3. Attempt all questions from **Section A** and any three questions from **Section B**.
4. The intended marks for questions or parts of questions are given in brackets [ ].

**Maximum Marks : 40**

**Time : 1 hour**

## Section A

(Answer all questions)

**(10 Marks)**

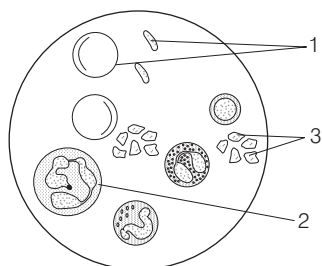
- 1.** Answer the following by choosing the correct answer to the questions from the given options. (Do not copy the question, write the correct answer only.) (10 × 1)
- (i) A muscular wall is absent in  
(a) capillary (b) vein  
(c) venule (d) arteriole
- (ii) The outermost layer of meninges  
(a) piamater (b) arachnoid layer  
(c) grey matter (d) duramater
- (iii) Tear gland is also called  
(a) gastric gland (b) lacrimal gland  
(c) salivary gland (d) sebaceous gland
- (iv) Which one of the following is not a simple reflex?  
(a) Coughing (b) Blinking  
(c) Eating (d) Swallowing
- (v) Loop of Henle lies in  
(a) medulla (b) cortex (c) pelvis (d) ureter
- (vi) The pigment that gives colour to urine  
(a) haemoglobin  
(b) chlorophyll  
(c) urochrome  
(d) melanin
- (vii) The number of spinal nerves in humans  
(a) 12 pairs (b) 23 pairs  
(c) 31 pairs (d) 10 pairs
- (viii) The mineral element needed for the functioning of the thyroid gland  
(a) sodium (b) potassium  
(c) magnesium (d) iodine
- (ix) The part of the brain concerned with memory  
(a) cerebrum (b) cerebellum  
(c) pons (d) medulla oblongata
- (x) The pigmented circular area seen in front of the eye  
(a) cornea (b) lens  
(c) iris (d) ciliary muscles

## Section B

(Attempt **any three** questions from this section)

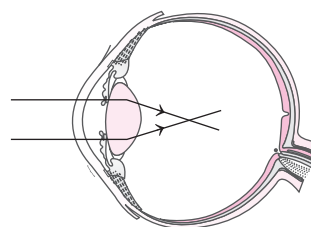
(30 Marks)

2. (i) Explain the term 'tropic hormone'. Give one example of a tropic hormone. (2)  
 (ii) Give the location of pericardial fluid. What is its function? (2)  
 (iii) Given below is the diagram of a human blood smear. Label the parts numbered 1, 2 and 3. (3)



- (iv) Give the biological terms for the three ear ossicles. (3)
3. (i) Mention two structural differences between an artery and a vein. (2)  
 (ii) Where is bicuspid valve located? What is its function? (2)  
 (iii) Draw a neat diagram of a Malpighian capsule and label any two parts. (3)  
 (iv) Define the term 'excretion'. Which are the two main organic wastes present in urine? (3)
4. (i) Name the substance that initiates blood clotting. What is the mineral element essential to form a blood clot? (2)  
 (ii) Give the exact location of adrenal glands. (2)  
 (iii) Mention three functions of adrenaline. (3)  
 (iv) What is the contraction phase of auricles called? Name the two valves that open during this phase. (3)
5. (i) How are cytons and axons arranged in the spinal cord? (2)

- (ii) We cannot distinguish colours in dim light. Explain giving suitable reasons. (2)  
 (iii) Given below is a diagram depicting a defect of the human eye. Answer the questions that follows. (3)



- (a) Give the scientific term for the defect.  
 (b) Mention one possible reason for the defect.  
 (c) What type of lens can be used to correct the defect?
- (iv) What are hormones? Name any two hormones secreted by the pituitary gland? (3)
6. (i) From where the following nerves arise. (2)  
 (a) Optic nerve  
 (b) Auditory nerve  
 (ii) Give the full form of the following abbreviations. (2)  
 (a) TSH (b) ADH  
 (iii) What are the three main parts of the membranous labyrinth? (3)  
 (iv) Complete the following table by filling in the blanks (a) to (c).

Glands	Hormones secreted	Effects of oversecretion
Pancreas	(a) .....	Hypoglycemia
Thyroid	(b) .....	(c) .....

(3)

## EXPLANATIONS

1. (i) (a) Capillary lacks muscular walls and consists of a single layer of squamous epithelial cells.
  - (ii) (d) The outermost layer of meninges is tough and is called duramater.
  - (iii) (b) Tear gland is also known as lacrimal gland.
  - (iv) (d) Swallowing is an acquired reflex.
  - (v) (b) Loop of Henle lies in the cortex region.
  - (vi) (c) Urochrome is the pigment found in urine that gives colour to it.
  - (vii) (c) There are 31 pairs of spinal nerves present in humans.
  - (viii) (d) Iodine is required for the proper functioning of thyroid gland.
  - (ix) (a) Cerebrum is concerned with memory.
  - (x) (c) Iris is the pigmented circular area seen in front of the eye.
2. (i) Tropic hormones are the hormones that which stimulate other endocrine glands to produce their specific hormone such as gonadotropic hormones secreted by anterior pituitary and also stimulate gonads to produce certain hormones.
  - (ii) Pericardial fluid is found in the pericardial cavity (where it is secreted by the serous layer of the pericardium). This fluid helps to reduce friction between the membranes of the heart.
  - (iii) Parts labelled in figure are
 

1 - RBC

2 - Neutrophil

3 - Blood platelets
  - (iv) The biological terms for three ear ossicles are
 

(a) Malleus (hammer)

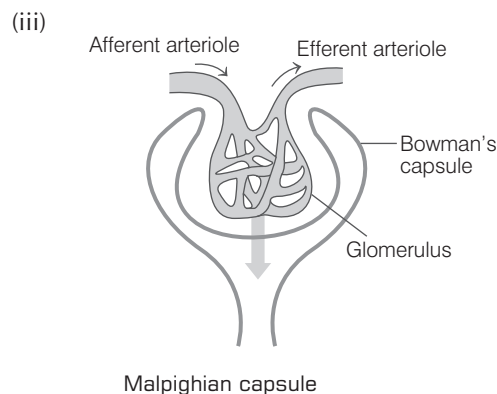
(b) Incus (anvil)

(c) Stapes (stirrup)
3. (i) The two structural differences between artery and vein are

Arteries	Veins
They have thicker walls as compared to veins.	They have thin walls.
They lack valves.	They have valves.

- (ii) Bicuspid valve is located between the heart's left atrium and left ventricle.

The major function of the valve is to prevent blood from flowing back to left atrium, thereby ensuring unidirectional bloodflow.



- (iv) Excretion is the process of metabolic waste eliminating from the body of an organism. It is an essential process in all forms of life.  
Organic constituents of urine include urea, uric acid, creatinine, etc.
4. (i) Thromboplastin initiates blood clotting. Calcium is required for the clotting of blood.
  - (ii) Adrenal glands are cap-like structures present on the top of each kidney.
  - (iii) The three functions of adrenaline are
    - (a) It increases heart beat accompanied by an increase in blood pressure.
    - (b) It increases blood supply to the muscles stimulating the release of more glucose into the liver.
    - (c) Flight or fight response is triggered by the release of stress hormone released by adrenal glands.
  - (iv) Contraction phase of auricles is called atrial systole. In this phase, the atrial contract due to the wave of contraction, stimulated by the SA node.  
Bicuspid and tricuspid valves are open during this phase.

5. (i) The arrangement of cytons and axons is just opposite to that in brain.

In the spinal cord, cyton lies inside and forms the grey matter whereas axon lies outside forming white matter.

- (ii) Retina of human eye consists of rods and cones. Cones are sensitive to bright light and are capable of colour vision whereas rods are sensitive to dim light hence are unable to distinguish between colours.

Thus, it becomes difficult to distinguish colours in dim light.

- (iii) (a) The defect shown in question is myopia.

(b) One possible reason for the defect could be that the lens has become too curved or elongation of eyeball.

(c) The defect can be corrected by using suitable concave (diverging) lens that cause light rays to diverge before striking lens of the eye.

- (iv) Hormones are important secretions from specific cells or glands in the body. They are carried to all parts of the body through blood but the effect produced is on target organ or cells only.

Two hormones secreted by pituitary gland are

- (a) Growth Hormone (GH)  
(b) Antidiuretic Hormone (ADH)

6. (i) (a) Optic nerve arises from optic stalks or diencephalon.

(b) Auditory nerve arises from cochlea.

- (ii) (a) Thyroid Stimulating Hormone

(b) Anti Diuretic Hormone

- (iii) The inner ear or membranous labyrinth has three parts

(a) **Cochlea** It is spiral-shaped and contains sensory organ of hearing.

(b) **Semi-circular canals** It is a set of three canals arranged at right angles to each other in three different planes.

(c) **Vestibule** It shows two parts utriculus and sacculus which contain sensory cells for static balance.

- (iv) (a)–Insulin

(b)–Thyroxine

(c)–Exophthalmic goitre

# ICSE Examination Paper 2021-22

## Biology (Semester I)

### General Instructions

1. You will not be allowed to write during the first 10 minutes. This time is to be spent in reading the question paper.
2. All questions are compulsory.
3. The marks intended for questions are given in brackets [ ].
4. Select the correct option for each of the following questions.

Max. Marks : 40

Time : 1 Hrs

**1. Name the following by choosing the correct option.**

- (i) The process of conversion of ADP to ATP during photosynthesis. (1)  
(a) Polymerisation  
(b) Photophosphorylation  
(c) Photorespiration  
(d) Photolysis
- (ii) Permanently open structures seen on the barks of old woody stems. (1)  
(a) Stomata  
(b) Hydathodes  
(c) Lenticels  
(d) Epidermal pores
- (iii) The pressure developed in the roots due to the continuous inward movement of water by cell to cell osmosis (1)  
(a) Root pressure (b) Wall pressure  
(c) Turgor pressure (d) Air pressure
- (iv) The type of gene, which in the presence of a contrasting allele is not expressed. (1)  
(a) Homozygous  
(b) Heterozygous  
(c) Dominant  
(d) Recessive
- (v) After mitosis, a female human cell will have (1)  
(a) 44 + XX chromosomes  
(b) 22 + X chromosomes  
(c) 22 + Y chromosomes  
(d) 44 + XY chromosomes

**2. Complete the following statements by choosing the appropriate option for each blank.**

- (i) At the end of ....., Cytokinesis is completed. (1)  
(a) metaphase (b) prophase  
(c) interphase (d) telophase
- (ii) The genotype of person who cannot roll his tongue is ..... (1)  
(a) Rr (b) RR (c) rr (d) RRr
- (iii) When a cell is placed in a ..... solution it becomes plasmolysed. (1)  
(a) distilled water (b) hypertonic  
(c) isotonic (d) hypotonic
- (iv) The nitrogenous base adenine always pair with ..... (1)  
(a) thymine (b) guanine  
(c) cytosine (d) thiamine
- (v) The basic units of heredity are ..... (1)  
(a) chromosomes (b) chromatids  
(c) genes (d) centrosome

**3. Choose the correct answer from each of the four options given below.**

- (i) NADP is expanded as (1)  
(a) Nicotinamide Adenosine Dinucleotide Phosphate  
(b) Nicotinamide Adenine Dinucleotide Phosphate  
(c) Nicotinamide Adenine Dinucleolus Phosphate  
(d) Nicotinamide Adenosine Dinucleolus Phosphate

- (ii) Transpiration is useful to the plant because it (1)
- creates a suction force for absorption of water from the soil.
  - helps in photophosphorylation
  - synthesises glucose
  - splits water molecules
- (iii) A homozygous pea plant having purple flowers is crossed with a homozygous pea plant bearing white flowers. The phenotypic ratio of the offspring obtained in  $F_2$  - generation is (1)
- 2 : 1
  - 1 : 1
  - 1 : 2 : 1
  - 3 : 1
- (iv) A shoot from a balsam plant is kept in a beaker containing eosin solution (pink). The pink colour will be distinctly seen in the (1)
- xylem
  - phloem
  - epidermis
  - cortex
- (v) Replication of DNA in the cell cycle occurs during the (1)
- $G_1$  -phase
  - Anaphase
  - S-phase
  - $G_2$  -phase

#### 4. Explain the following terms.

- (i) Karyokinesis (1)
- It is the division of nucleus during cell division
  - It is the division of cytoplasm during cell division
  - It is the division of centrosome
  - It is the division of nucleolus
- (ii) Law of dominance (1)
- Out of a pair of contrasting alleles present together, only the recessive allele is able to express itself while the dominant remains suppressed
  - Out of a pair of contrasting alleles present together, only the dominant allele is able to express itself while recessive remains suppressed
  - Out of a pair of contrasting alleles present together, both the dominant and recessive cannot express themselves
  - Out of a pair of contrasting alleles present together, both the dominant and recessive can express themselves
- (iii) Mutation (1)
- It is a sudden change in one or more genes in an organism's cells, which is heritable

- It is a change in the number of centrosomes in an organism's cells, which is heritable
- It is a change in the structure of cell membrane in an organism's cells, which is heritable
- It is a change in the shape of cells, which is heritable

- (iv) Photosynthesis (1)
- It is the synthesis from carbon dioxide by non-green plants using light energy
  - It is the synthesis of glucose by green plants from carbon dioxide using light energy
  - It is the synthesis of glucose from carbon dioxide and water by non-green plants using light energy
  - It is the synthesis of glucose from carbon dioxide and water by green plants using light energy
- (v) Transpiration (1)
- It is the loss of water in the form of droplets from the aerial parts of the plant
  - It is the loss of water in the form of water vapour from the underground parts of the plant
  - It is the loss of water in the form of water vapour from the aerial parts of the plant
  - It is the loss of water in the form of water vapour from all parts of the plant

#### 5. Mention the exact location of the following.

- (i) Aster (1)
- Around the centrioles in the plant cells
  - Around the centrioles in animal cells
  - Around the chromatids in animal cells
  - Around the chromatids in plant cells
- (ii) Guard cells (1)
- Around the root hairs
  - Around the lenticels
  - Around the thylakoids
  - Around the stoma
- (iii) Xylem tissue (1)
- Conducts water and minerals in leaves
  - Does not conduct water and minerals in stems
  - Conducts food and nutrients to roots
  - Conducts food nad nutrients to all part of the plant

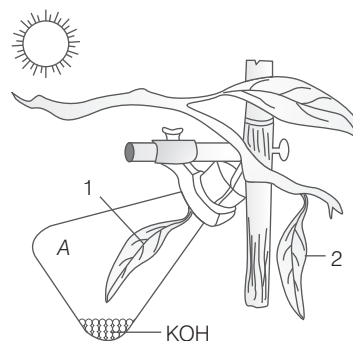
- (iv) Centrioles  
 (a) Found only in plant cells  
 (b) Found inside nucleus  
 (c) Found only in animal cells  
 (d) Found in animal and plant cells
- (v) Genes  
 (a) Present on cell wall  
 (b) Present on chloroplast  
 (c) Present on chromosomes  
 (d) Present on centrosomes

**6. State the functions of the following.**

- (i) Cell wall (1)  
 (a) Regulates entry of solutes in plant cells  
 (b) Regulates entry of solutes in animal cells  
 (c) Gives rigidity and shape to plant cells  
 (d) Gives rigidity and shape to animal cells
- (ii) Centromere  
 (a) It is the point of attachment of two sister chromatids  
 (b) It is the point of attachment of two centrioles  
 (c) It is the point of attachment of two centrosomes  
 (d) It is the point of attachment between two daughter nuclei
- (iii) Cuticle on leaves (1)  
 (a) Prevents photosynthesis  
 (b) Reduces transpiration  
 (c) Protects leaves from grazing animals  
 (d) Gives colour to leaves
- (iv) Hydathodes  
 (a) Transpiration (b) Absorption of water  
 (c) Photosynthesis (d) Guttation
- (v) Grana of chloroplast is not the  
 (a) site of light independent phase  
 (b) site of light dependent phase  
 (c) site of photolysis  
 (d) site of photon absorption

**7. The diagram given below represents an experiment to demonstrate a particular aspect of photosynthesis. The letter 'A' indicates a certain condition inside the flask.**

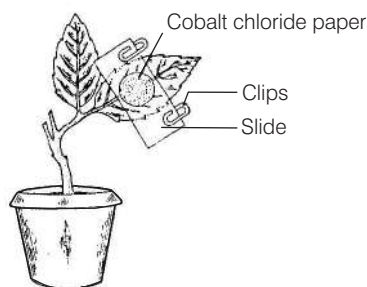
Answer the questions.



- (i) What is the aim of the experiment? (1)  
 (a) To show that oxygen is released during photosynthesis  
 (b) To show that photosynthesis occurs in the presence of KOH  
 (c) To show that chlorophyll is necessary for photosynthesis  
 (d) To show that carbon dioxide is necessary for photosynthesis
- (ii) What is the special condition inside the flask? (1)  
 (a) Air inside the flask is free of oxygen  
 (b) Air inside the flask is free of carbon dioxide  
 (c) Air inside the flask is free of nitrogen  
 (d) KOH purifies the air inside the flask
- (iii) An alternative chemical that can be used instead of KOH is (1)  
 (a) sodium hydroxide  
 (b) sodium chloride  
 (c) potassium chloride  
 (d) potassium permanganate
- (iv) In what manner do the leaves 1 and 2 differ at the end of the starch test? (1)  
 (a) Leaf 1 turns brown, leaf 2 turns blue black  
 (b) Leaf 1 turns blue black, leaf 2 turns brown  
 (c) Leaf 1 turns purple, leaf 2 remains green  
 (d) There is no change in the colour of the leaves
- (v) What is the important step that should be taken before performing this experiment? (1)  
 (a) The plant should be placed in dark for 24 hours to destarch the entire plant  
 (b) The plant should be placed in dark for 24 hours to remove chlorophyll from the leaves

- (c) The plant should be placed in dark for 24 hours destarch the leaves  
 (d) The plant should be placed in dark for 24 hours for the roots to absorb water

8. Given below is the diagram of an experimental setup to study the process of transpiration. Cobalt chloride papers are fixed on the upper as well as lower surface of the leaf.



Answer the questions that follows.

- (i) What is the aim of experiment? (1)
- To prove that more transpiration occurs from the lower surface of a dicot leaf
  - To prove that more transpiration occurs from the upper surface of a dicot leaf
  - To prove that transpiration is equal to both sides of the leaf
  - To prove that transpiration does not take place in a dicot leaf
- (ii) What is the colour of dry cobalt chloride paper? (1)
- Pink
  - Blue
  - Brown
  - White
- (iii) After about an hour, what change if any, would you expect to find in the cobalt chloride paper placed on the upper and lower surface of the leaf? (1)
- Upper surface-pink, lower surface-blue
  - Upper surface-white, lower surface-blue
  - Upper surface-less pink, lower surface-more pink
  - Upper surface-more pink, lower surface-less pink
- (iv) Two adaptations in plants to reduce transpiration are (1)
- narrow leaves, thin cuticle
  - fewer stomata, broad lamina of leaves
  - thin cuticle, sunken stomata
  - narrow leaves, fewer stomata
- (v) The rate of transpiration is less when there is (1)
- high humidity in the air and low temperature
  - Less humidity in the air the decrease in atmospheric pressure
  - Bright sunlight and high temperature
  - More wind and low intensity of sunlight

## Answers

1.	(i)	(b)	(ii)	(c)	(iii)	(a)	(iv)	(d)	(v)	(a)	5.	(i)	(b)	(ii)	(d)	(iii)	(a)	(iv)	(c)	(v)	(c)
2.	(i)	(d)	(ii)	(c)	(iii)	(b)	(iv)	(a)	(v)	(c)	6.	(i)	(c)	(ii)	(a)	(iii)	(b)	(iv)	(d)	(v)	(a)
3.	(i)	(b)	(ii)	(a)	(iii)	(d)	(iv)	(a)	(v)	(c)	7.	(i)	(d)	(ii)	(b)	(iii)	(a)	(iv)	(a)	(v)	(c)
4.	(i)	(a)	(ii)	(b)	(iii)	(a)	(iv)	(d)	(v)	(c)	8.	(i)	(a)	(ii)	(b)	(iii)	(c)	(iv)	(d)	(v)	(a)