CBS Confident Pharmacy Series

Fifth Edition

Human Anatomy and Physiology

for First Year Diploma in Pharmacy

Course Code: ER20-14T

As per the latest syllabus prescribed by Pharmacy Council of India

Including
Board Examination Question Papers and Specimen Answer Papers

VN Raje





CBSPD Dedicated to Education
CBS Publishers & Distributors Pvt Ltd

CBS Confident Pharmacy Series

Fifth Edition

Human Anatomy and Physiology

for **First Year Diploma in Pharmacy**

Course Code: **ER20-14T**

As per the latest syllabus prescribed by Pharmacy Council of India

Including
Board Examination Question Papers and Specimen Answer Papers

Salient Features

- Lucid and easy language
- To the point answers
- Remembering the concepts in the simplest way
- Infusing confidence in the reader to appear in the board examinations

Other books by the same author under

CBS Confident Pharmacy Series

- *Pharmaceutical Chemistry,* for First Year Diploma in Pharmacy, 5/e
- *Pharmaceutics,* for First Year Diploma in Pharmacy, 5/e
- *Pharmacognosy,* for First Year Diploma in Pharmacy, 5/e
- *Social Pharmacy,* for First Year Diploma in Pharmacy, 2/e
- *Pharmacy Law and Ethics,* for Second Year Diploma in Pharmacy, 2/e
- *Biochemistry and Clinical Pathology,* for Second Year Diploma in Pharmacy, 5/e
- *Pharmacology,* for Second Year Diploma in Pharmacy, 2/e
- *Pharmacotherapeutics,* for Second Year Diploma in Pharmacy, 2/e
- *Community Pharmacy and Management,* for Second Year Diploma in Pharmacy, 2/e
- *Hospital and Clinical Pharmacy,* for Second Year Diploma in Pharmacy, 5/e

CBS Confident Pharmacy Series

Fifth Edition

Human Anatomy and Physiology

for **First Year Diploma in Pharmacy**

Course Code: **ER20-14T**

As per the latest syllabus prescribed by Pharmacy Council of India

Including
Board Examination Question Papers and Specimen Answer Papers

VN Raje MPharm, MBA

Principal
Gourishankar Education Society's
GES College of Pharmacy (DPharm)
Limb, Satara, Maharashtra

CBSPD

CBS Publishers & Distributors Pvt Ltd

New Delhi • Bengaluru • Chennai • Kochi • Kolkata • Lucknow • Mumbai
Gujarat • Hyderabad • Jharkhand • Nagpur • Patna • Pune • Uttarakhand

Disclaimer

Science and technology are constantly changing fields. New research and experience broaden the scope of information and knowledge. The authors have tried their best in giving information available to them while preparing the material for this book. Although, all efforts have been made to ensure optimum accuracy of the material, yet it is quite possible some errors might have been left uncorrected. The publisher, the printer and the authors will not be held responsible for any inadvertent errors, omissions or inaccuracies.

eISBN: **978-93-498-8177-8**

Copyright © Authors and Publisher

Fifth eBook Edition: 2025

All rights reserved. No part of this eBook may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system without permission, in writing, from the authors and the publisher.

Published by Satish Kumar Jain and produced by Varun Jain for
CBS Publishers & Distributors Pvt. Ltd.

Corporate O ice: 204 FIE, Industrial Area, Patparganj, New Delhi-110092
Ph: +91-11-49344934; Fax: +91-11-49344935; Website: www.cbspd.com; www.eduport-global.com;
E-mail: eresources@cbspd.com

Head O ice: CBS PLAZA, 4819/XI Prahlad Street, 24 Ansari Road, Daryaganj, New Delhi-110002, India.
Ph: +91-11-23289259, 23266861, 23266867; Fax: 011-23243014; Website: www.cbspd.com;
E-mail: publishing@cbspd.com; eduportglobal@gmail.com.

Branches

- **Bengaluru:** Seema House 2975, 17th Cross, K.R. Road, Banasankari 2nd Stage, Bengaluru - 560070, Karnataka Ph: +91-80-26771678/79; Fax: +91-80-26771680; E-mail: bangalore@cbspd.com
- **Chennai:** No.7, Subbaraya Street Shenoy Nagar Chennai - 600030, Tamil Nadu
  Ph: +91-44-26680620, 26681266; E-mail: chennai@cbspd.com
- **Kochi:** 36/14 Kalluvilakam, Lissie Hospital Road, Kochi - 682018, Kerala
  Ph: +91-484-4059061-65; Fax: +91-484-4059065; E-mail: kochi@cbspd.com
- **Mumbai:** 83-C, 1st floor, Dr. E. Moses Road, Worli, Mumbai - 400018, Maharashtra
  Ph: +91-22-24902340 - 41; Fax: +91-22-24902342; E-mail: mumbai@cbspd.com
- **Kolkata:** No. 6/B, Ground Floor, Rameswar Shaw Road, Kolkata - 700014
  Ph: +91-33-22891126 - 28; E-mail: kolkata@cbspd.com

Representatives

- **Hyderabad**
- **Pune**
- **Nagpur**
- **Manipal**
- **Vijayawada**
- **Patna**

Preface to the Fifth Edition

The fifth edition of this book includes Board Examination Question Papers and specimen answer papers. These additional contents are of great importance to the students which give them an exact idea about the framework of question paper pattern and specimen answers as per the examination format given by Pharmacy Council of India (PCI-ER2020).

This edition of book under the CBS Confident Pharmacy Series builds self-confidence in students which helps to get success in the examinations. The book has been written to meet the requirements of students of Diploma in Pharmacy (DPharm) in accordance with the new revised syllabus ER-2020 prescribed by Pharmacy Council of India.

This book is small and humble effort has been put in for compiling necessary information on the subject. An attempt has been made to demystify and simplify the basic concepts for the students of pharmacy and to enable them get an evergreen success in all the board examinations.

The salient features of the present book are:

- Lucid and easy language
- To the point answers
- Remembering facts in the simplest way
- Infusing confidence in the reader to appear in the board examinations.

Hence the series is named

CBS Confident Pharmacy Series

I am confident that this book will be useful to both the students and the teachers of Diploma in Pharmacy as well as the candidates desiring to succeed in competitive examinations for better job opportunities in pharmacy profession such as hospital pharmacists in PHCs, civil hospitals, etc.

Raje Vijay N

to

my beloved family

Acknowledgements

I express my heartfelt thanks to Prof Madan Jagtap, Chairman, Gourishankar Education Society, Satara, Maharashtra, for consistent encouragement and inspiration for writing this book.

I wish to acknowledge the prompt and efficient help given by Prof Milind Jagtap, Mr Jaywant Salunkhe, Mr Appa Rajage, Mr Nitin Mudalgikar, and Mr Shrirang Katekar of Gourishankar Education Society, Satara.

I am also thankful to Shri Satish Kumar Jain, Chairman and Managing Director, and Shri Shantanu Sarkar, General Manager, Mumbai Branch, CBS Publishers & Distributors, for their sustained efforts and keen interest in the publication of this book.

I wish all my beloved students to have a great success in the Board Examinations.

Raje Vijay N

Syllabus

(As per ER-2020)

Human Anatomy and Physiology

Course Code: ER20-14T

1. **Scope of anatomy and physiology:** Definition of various terms used in anatomy.
2. **Structure of cell:** Function of its components with special reference to mitochondria and microsomes.
3. **Tissues of the human body:** Epithelial, connective, muscular and nervous tissues, their sub-types and characteristics.
4. a. **Osseous system:** Structure and functions of bones of axial and appendicular skeleton.
   b. Classification, types and movements of joints, disorders of joints.
5. **Haemopoietic system:** Composition and functions of blood, process of haemopoiesis, characteristics and functions of RBCs, WBCs and platelets, mechanism of blood clotting, importance of blood groups.
6. **Lymphatic system:** Lymph and lymphatic system, composition, function and its formation, structure and functions of spleen and lymph node.
7. **Cardiovascular system:** Anatomy and physiology of heart, blood vessels and circulation (pulmonary, coronary and systemic circulation), cardiac cycle, heart sounds, basic knowledge of ECG, blood pressure and its regulation.
8. **Respiratory system:** Anatomy of respiratory organs and their functions, regulation and mechanism of respiration, respiratory volumes and capacities—definitions.
9. **Digestive system:** Anatomy and physiology of GIT, anatomy and functions of accessary glands, physiology of digestion and absorption.
10. **Skeletal muscles:** Histology, physiology of muscle contraction, disorders of skeletal muscles.
11. **Nervous system:** Classification of nervous system, anatomy and physiology of cerebrum, cerebellum, midbrain, functions of hypothalamus, medulla oblongata,

and basal ganglia, spinal cord—structure and reflexes, names and functions of cranial nerves, anatomy and physiology of sympathetic and parasympathetic nervous system (ANS).

12. **Sense organs:** Anatomy and physiology of eye, ear, skin, tongue and nose.
13. **Urinary system:** Anatomy and physiology of urinary system, physiology of urine formation, renin-angiotensin system, clearance tests and micturition.
14. **Endocrine system (hormones and their functions):** Pituitary gland, adrenal gland, thyroid and parathyroid gland, pancreas and gonads.
15. **Reproductive system:** Anatomy of male and female reproductive system, physiology of menstruation, spermatogenesis and oogenesis, pregnancy and parturition.

Contents

Preface to the Fifth Edition *v*
Syllabus *vii*

1. Introduction and Scope of Anatomy and Physiology 1
2. The Cell 4
3. The Tissue of the Human Body 10
4. The Osseous System (The Skeleton) 18
5. The Haemopoietic System 29
6. The Lymphatic System 43
7. The Cardiovascular System 49
8. The Respiratory System 68
9. The Digestive System 76
10. The Skeletal Muscles 88
11. The Nervous System 94
12. The Sense Organs 104
13. The Urinary System 125
14. The Endocrine System 138
15. The Reproductive System 146

Board Examination Papers

1. Summer Examination 2022 (Question Paper) 161
2. Summer Examination 2022 (Specimen Answer Paper) 164
3. Winter Examination 2022 (Question Paper) 179
4. Winter Examination 2022 (Specimen Answer Paper) 181
5. Summer Examination 2023 (Question Paper) 196
6. Summer Examination 2023 (Specimen Answer Paper) 198
7. Winter Examination 2023 (Question Paper) 218

8. Winter Examination 2023 (Specimen Answer Paper) 221
9. Summer Examination 2024 (Question Paper) 239
10. Summer Examination 2024 (Specimen Answer Paper) 241
11. Winter Examination 2024 (Question Paper) 259
12. Winter Examination 2024 (Specimen Answer Paper) 262

Chapter 1

Introduction and Scope of Anatomy and Physiology

1 Give the scope/importance of anatomy and physiology.

☞ **Scope of Anatomy and Physiology:**

1. Anatomy is the study of structure and physiology is the study of functions of body parts.
2. This subject is designed to impart fundamental knowledge of the structure and functions of the various systems of the human body.
3. This subject helps to understand homeostatic mechanisms.
4. This subject provides the basic knowledge required to understand the various disciplines in pharmacy.
5. The knowledge of anatomy and physiology is useful for understanding pathology of disease and pathological changes.

2 Define the terms.

☞

1. **Anatomy:** It is the study of different parts of the body, their forms, position and relationship with each other.
2. **Physiology:** It is the study of function of the body as a whole and functions of individual structures and systems present in the body.
3. **Cell:** Cell is the smallest, basic, living, structural and functional unit of the body.
4. **Tissue:** A group of cells having similar physical characters performing same specialized function.
5. **Anatomical position:** This is the upright position of the body with the head facing forwards, the arms at the sides with palms of the hands facing forward and the feet together.
6. **Proximal end:** It means the part of the structure nearest to a given point.

7. **Distal end:** It means the part of the structure away from a given point.
8. **Median/medial/axial:** The structure situated actually on the axis is known as median.
9. **Longitudinal:** A line along or parallel to the axis is known as longitudinal.
10. **Lateral:** It means the position present at the side of the axis.
11. **Transverse:** A line across at a right angle to the axis is a transverse.
12. **Superior:** It is the upper end of the body.
13. **Inferior:** It is the lower end of the body.
14. **Ventral/anterior:** It is the aspect of the body which faces viewer.
15. **Dorsal/posterior:** It is the surface of the body at back side.
16. **Fossa:** It is a depression or a hollow.
17. **Meatus:** It is a tube-shaped cavity within a bone.
18. **Foramen:** It is a hole in the structure.
19. **Sinus:** It is a hollow cavity within a bone.
20. **Facet:** It is a small, flat articulating surface.
21. **Condyle:** It is a smooth rounded projection of bone which takes part in joint.
22. **Septum:** It is a partition separating two cavities.
23. **Fissure or cleft:** It indicates narrow slit.
24. **Sutures:** These are fixed joints between bones of skull and cranium.
25. **Articulation:** It is a joint between two or more bones.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. Branch of science that studies the structure of the body is called **anatomy**.
2. The study of tissues is called **histology**.
3. The study of the function of the body is called **physiology**.
4. **Medial** means part "towards the middle" of the body.
5. **Sinus** is a hollow cavity within the bone.
6. The part of the structure nearest to a given point is called **proximal**.
7. **Transverse** means a line across at right angle to the axis.

8. The fluid portion of blood is called **plasma**.
9. A tube-shaped cavity within the bone is **meatus**.
10. The basic smallest, living, structural and functional unit of the body is called **cell**.
11. **Facet** is a small flat articulating surface.
12. The branch of anatomy that deals with the study of specific part of the body is called **regional anatomy**.
13. Anatomical term used for 'nearer to midline of body' means **medial**.
14. The part of the structure away from a given point means **distal end**.
15. Various types of organs join to form a **system**.
16. **Foramen** means a hole in a structure.
17. **Septum** is a portion separating two cavities.
18. The structure away from the head means **inferior**.
19. The other name for anterior is **ventral**.
20. **Superior** means upper end of the body.

Chapter 2

The Cell

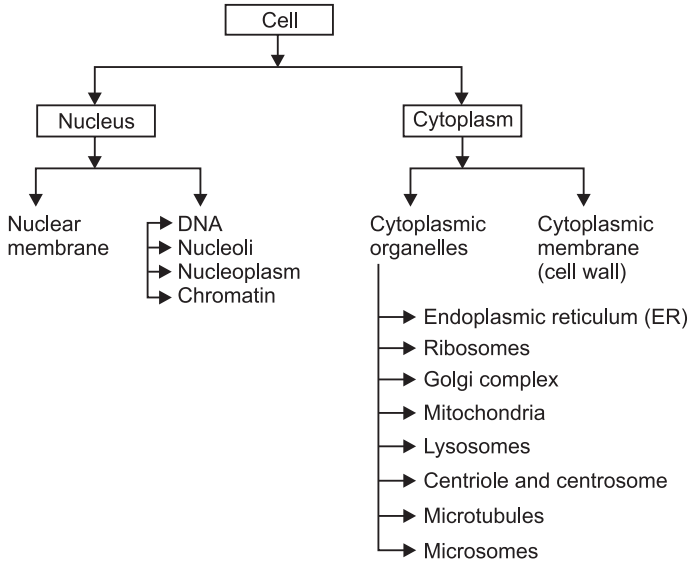
1 Define cell. Enlist different components/parts of cell. OR Enlist different cellular components. (W.22)

☞ **Cell**

The cell is the smallest, basic, living, structural and functional unit of the body.

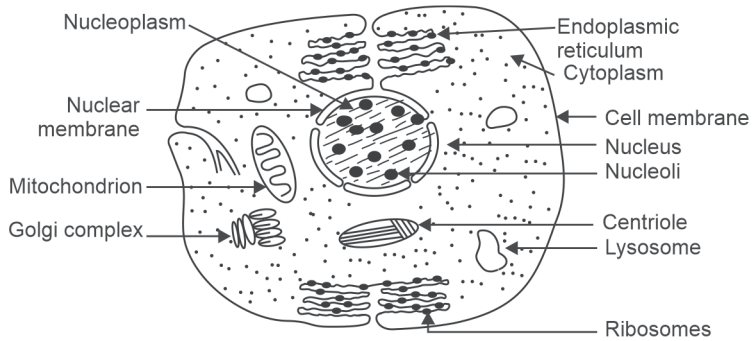
Different Components/Parts of Cell

Major intracellular organs/organelles are as follows.



2 Sketch and label a diagram of cell. (S.22, W.22,23)

☞ **Diagram of Cell**



Cell

3 Write a short note on 1. Nucleus, 2. Endoplasmic reticulum, 3. Golgi complex, 4. Mitochondria, 5. Lysosomes, 6. Cell wall.

☞ **1. Nucleus**

It is a spherical and largest part of the cell. It contains nuclear membrane, nucleoplasm, nucleoli and genetic material DNA. Nuclear membrane is continuous with endoplasmic reticulum.

Functions

(i) It controls all cellular activities.
(ii) It contains DNA, RNA and proteins.
(iii) RNA helps in protein synthesis.
(iv) DNA helps in production of chromosomes.

2. Endoplasmic Reticulum (ER)

It is a network of membrane continuous with cell membrane and nuclear membrane. It is of two types.

(a) **Rough-surfaced ER:** Ribosomes are present at the outer border of the membrane.
(b) **Smooth-surfaced ER:** Smooth-surfaced ER does not possess ribosomes at the outer border of the membrane.

Functions

(i) It provides a surface area for a number of chemical reactions.
(ii) It helps in synthesis of steroids, proteins, etc.
(iii) It provides a pathway for transporting various chemical substances.
(iv) It helps to concentrate the products of synthetic activities of the cell.

3. Golgi Complex/Golgi Apparatus

It consists of 4 to 8 flattened bag-like channels stacked upon each other with expanded areas at the ends. The structure looks like a network of fine threads or irregular granular material, hence called Golgi complex. It is located near the nucleus.

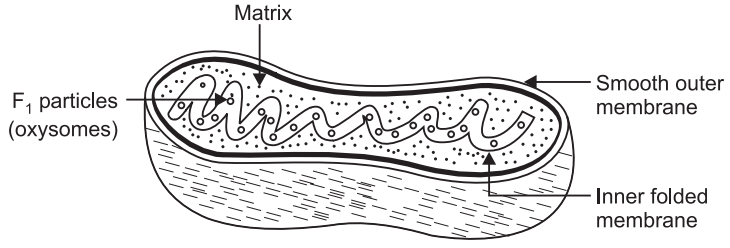
Functions

(i) It helps in packaging of secretory proteins.
(ii) It helps in synthesis of carbohydrates.
(iii) It helps in intracellular sorting of proteins.

4. Mitochondria (S.23)

Mitochondria are small intracellular organelles and are also known as powerhouse of cell or storehouse of energy.

It is bound by inner folded and outer smooth-surfaced membrane. Inner membrane has many cristae and is covered with F_1 particles.



Mitochondria

Functions

(i) It is the main site of synthesis and storage of ATP.
(ii) It is the site for citric acid cycle, β-oxidation and urea cycle, ETS, etc.
(iii) It contains special DNA and is self-replicative.
(iv) It performs the main function of conversion and transfer of cellular energy.

Physiology of Mitochondria

When nutrients and oxygen come in contact with oxidative enzymes present in the mitochondria, they combine to form CO_2, water and liberated energy is utilised to synthesize ATP. The ATP then diffuses throughout the cells and releases its stored energy for performing cellular functions.

5. Lysosomes (Digestive Apparatus of Cell/Suicide Packets)

Lysosomes are described as a separate cytoplasmic organelles. These are membranous vesicles containing powerful digestive enzymes which are capable of breaking down many kinds of molecules.

Functions

(i) It helps in intracellular digestion.
(ii) Autolysis
(iii) Phagocytosis
(iv) Systematic growth and death can be managed by lysosomal activity.

6. Cell Membrane/Cytoplasmic Membrane/Plasma Membrane/ Cell Wall

It is a membrane which covers and protects the cell and surrounds the cytoplasm. It separates the cells from each other and external environment.
The cell wall is composed of proteins, phospholipids, carbohydrates, minerals, etc.

Functions

(i) It covers and protects the cell and organelles.
(ii) It gives shape to the cell.
(iii) It is involved in the transport of molecules in and out of the cells.
(iv) It forms channels of endoplasmic reticulum (ER).
(v) It forms boundaries to the cytoplasm.
(vi) It can act as a physiological sieve (semipermeable membrane).
(vii) It helps in intracellular adhesion and communication.

4 Explain physiology of cell wall.

☞ **Physiology of Cell Wall**

The cell wall forms the boundary of the cell, inside which various organelles and protoplasm are present. The cell wall is mainly composed of proteins, carbohydrates, phospholipids, minerals, etc. The cell wall is a semipermeable membrane which acts as a sieve through which certain substances are allowed to enter the cell while some other substances are allowed to move outside the cell in the form of excreta.

The substances pass through semipermeable membrane and it depends upon their:

(i) Particle size
(ii) Concentration
(iii) Lipid solubility
(iv) Electrical charges
(v) Presence of carrier molecules.

5 Why lysosomes are known as 'suicide bags'/suicide packets/ digestive apparatus of the cell?

☞
- Lysosomes are membranous vesicles containing powerful digestive enzymes which are capable of breakdown of many kinds of molecules.
- Lysosomes are known as suicide bags of cell because they contain lytic enzymes capable of digesting cells and unwanted materials when lysosomes brust, the lytic enzymes within it spill all over the cell, rupturing the cell membrane or cell wall and inducing the death of cell. This is also known as autolysis.

6 Why mitochondria are called powerhouse/storehouse of cell (energy coin/storehouse of energy)? (S.24)

☞
- Mitochondria are tiny organelles present inside the cell.
- They are involved in release of energy from food. This is known as cellular respiration.
- They generate energy rich molecules ATP from cellular respiration which are later used for other processes.
- The energy is stored in the form of ATP.
- It is the main site for citric acid cycle, β-oxidation, urea cycle, ETS, etc. where, ATP is generated.

Hence, mitochondria are called the powerhouse of the cell.

7 What are various stages of cell reproduction or cell division?

☞ **Stages of Cell Reproduction**

1. Prophase
2. Metaphase
3. Anaphase
4. Telophase

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. **Cell** is the basic living structural and functional unit of the body.
2. **Lysosomes** organelle of the cell is concerned with autolysis.

3. **Mitochondria** are called the storehouse/powerhouse/energy coin of the cell.
4. Mitochondria are the storehouses or powerhouse of **ATP**.
5. **Lysosomes** are cell organelles called a suicidal bag.
6. **Albert von Kölliker** observed the 'mitochondria' first.
7. ATP is formed in **mitochondria**.
8. The most important function of endoplasmic reticulum is **protein synthesis**.
9. The major role of Golgi bodies is **glycosidation**.
10. **Mitochondria** are a site for citric acid, beta-oxidation, urea cycle and ETS, etc.
11. **Nucleus** controls all cellular activities.
12. Nucleoli are rich in **DNA, RNA and proteins**.
13. The rupture/breakdown of cell membrane or cell wall and inducing death of the cell is known as **autolysis**.
14. The study of human body cells is termed **cytology**.
15. The term "suicidal bags" is used for **lysosomes**.
16. The function of protein sorting, lipid sorting and secretion is performed by **Golgi complex**.
17. **Endoplasmic reticulum** is the centre of protein synthesis.
18. The network of endoplasmic reticulum is present in the **cytoplasm**.
19. Nucleus is the centre of **gene control**.
20. The **cell wall** is an outer covering of the cell.

Chapter
3

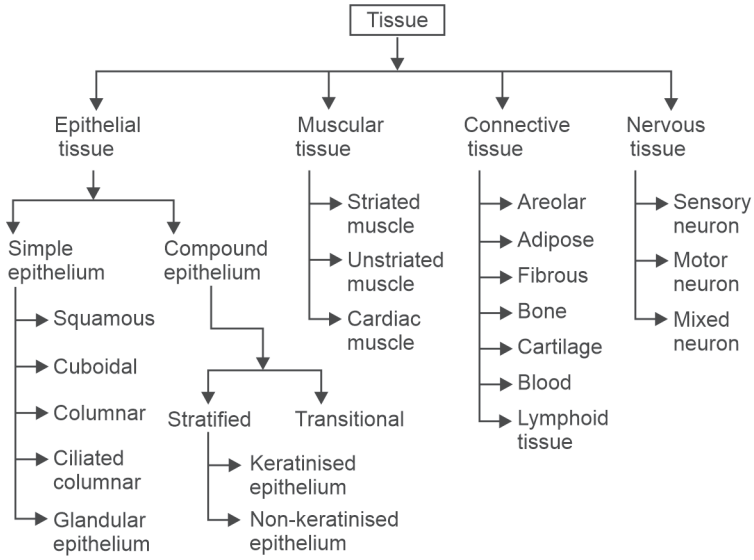
The Tissue of the Human Body

1 Define tissue. Classify various fundamental tissues of the body. (S.22,24, W.23)

☞ **Tissue**

The group of cells having similar physical characters and performing same specialized function, is known as tissue.

Fundamental/Basic Principle/Tissues of the Human Body or Classification/Types of Tissues



2 Give the properties and functions of epithelial tissues. (S.23)

☞ **Epithelial Tissues**

These types of tissues give covering to the body organs and various cavities including mainly digestive passages and respiratory system.

Properties of Epithelial Tissue

(i) It consists of large closely packed cells with extracellular material between adjacent cells.
(ii) Cells are arranged in continuous sheet in either single or multiple layers.
(iii) Epithelial cells have free surface exposed to body cavity and basal surface attached to the basement membrane.
(iv) Epithelial cells have a nerve supply.
(v) They have high regeneration capacity.

Functions of Epithelial Tissue

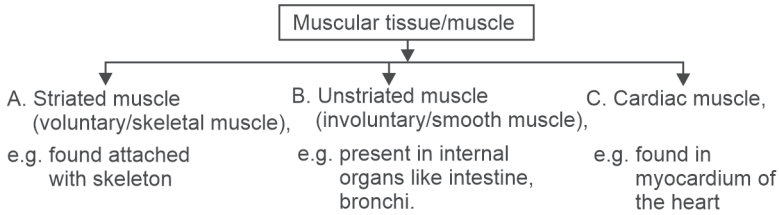
(i) It covers and protects underlying tissues against injury.
(ii) It helps in secretion of special chemical substances.
(iii) It also helps in absorption and distribution of different substances and drugs.
(iv) Outside the body, epithelial tissue forms skin and inside the body, it forms membrane and glands.

3 Classify muscular tissues. Mention the functions of muscular tissue.

☞ **Muscular Tissue**

- Muscular tissues contain muscle fibres which generate force of contraction.
- Muscular tissue is composed of water (75%), proteins (20%), mineral salts, glycogen, fat, glucose, etc. (5%).

Classification/Types/Kinds of Muscular Tissues



Functions of Muscular Tissue

(i) It gives shape to the organs and body.
(ii) It forms walls of the body cavities and gives support to the organ.
(iii) It gives locomotion to the body.
(iv) It maintains body temperature by production of heat.
(v) It maintains fluid balance of the body.

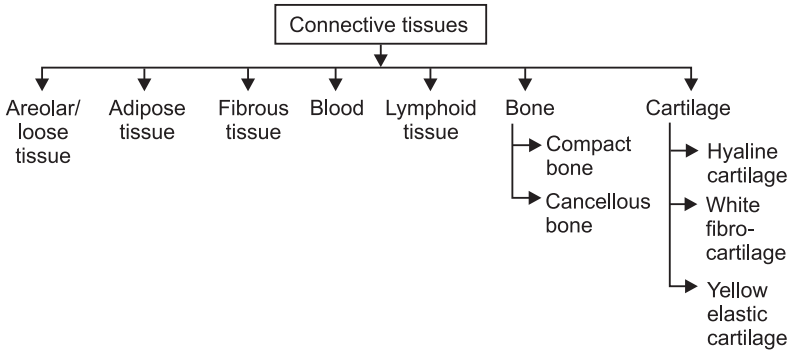
(vi) It helps to protect blood vessels and nerves.
(vii) It helps in the process of respiration, e.g. intercostal muscles and diaphragm are main respiratory muscles.
(viii) The cardiac muscles present in the myocardium of heart help in rhythmic contraction and relaxation.
(ix) Muscular tissue maintains posture (position) of the body.

4 Classify connective tissues. (S.23)

☞ **Connective Tissues**

- These tissues bind together and support more active delicate tissues of the body.
- These contain white fibres and yellow elastic fibres.

Classification/Types of Connective Tissues



5 Define bone. Mention functions of bone.

☞ **Bone**

Definition

Bone is the hardest connective tissue in the body which provides a framework (skeleton) and gives mechanical support and shape to the body.

Functions of Bone

(i) It forms supporting framework (skeleton) of the body.
(ii) It gives mechanical support and shape to the body.
(iii) It provides a store for minerals like calcium and phosphorus.
(iv) It maintains electrolytes balance of the body.
(v) The bones also serve as detoxicating function (removal of toxic substances).
(vi) It helps in the formation of RBCs in the red bone marrow, i.e. haemopoietic function.

(vii) Bones give attachment to the muscles and tendons.
(viii) It gives movement to the body as a whole and parts of the body by forming joints.
(ix) Bones support and protect soft tissues and vital organs of the body.
(x) It forms boundaries for cranial, thoracic and pelvic cavity.

6 What is cartilage? Give location, types and functions of cartilages. (W.23)

☞ **Cartilage**

Definition

Cartilage is a flexible connective tissue found mainly in connection with skeleton and provides support with flexibility.

Location

It is found:

- At the tip of the nose
- In part of trachea (C-shaped rings)
- In part of larynx
- In between vertebrae (intervertebral discs)
- In the pinna of ear.

Types of Cartilages

(i) Hyaline cartilage
(ii) White fibrocartilage
(iii) Yellow elastic fibrocartilage.

Functions of Cartilages

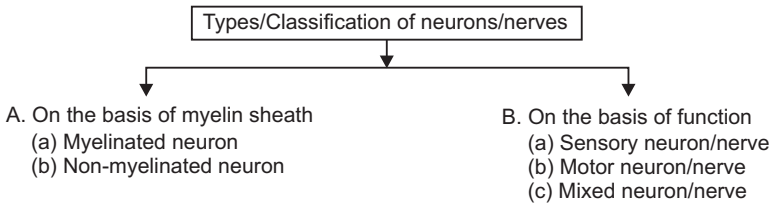
(i) It gives shape and support with certain amount of elasticity.
(ii) Fibrous cartilages act as a strong, flexible, connecting substance between the bones.
(iii) Cartilages present in the joint prevent friction between the bones during movements.
(iv) The C-shaped cartilages present in the trachea help to keep the tracheal tube always in open condition.
(v) The cartilages present in between bodies of vertebrae prevent friction between them and allow very slight movement.

7 Define neuron. Draw and label a diagram of myelinated neuron. (S.24, W.22)

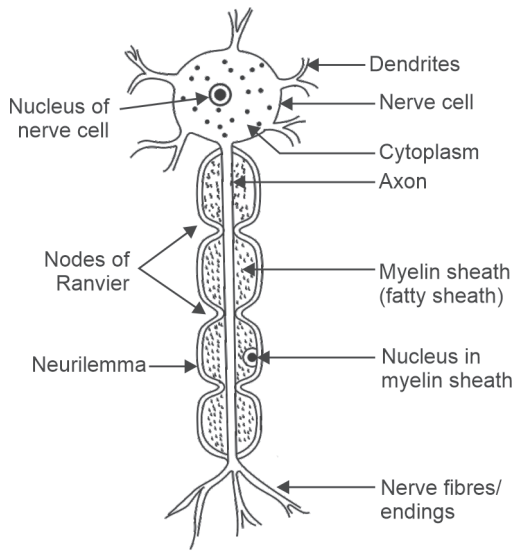
☞ Nervous Tissue

It is a highly specialized tissue which helps in transmission of impulses in the body.

Neurons are the basic structural and functional units of nervous tissue which help to transmit the impulses throughout the body.



Structure



Myelinated neuron/nerve

8 Describe various parts of neuron. (W.22)

☞ Description of Neuron

Each neuron consists of: (a) Nerve cell, (b) Dendrites, (c) Axon.

(a) Nerve Cell

It forms gray matter of nervous system. The nerve cells in group are called ganglia.

Functions

(i) It stimulates impulses.
(ii) It helps in generation and transmission of impulses.

(b) Dendrites

The branches of the nerve cell are called dendrites.

Function

They receive the impulses from synapse towards the nerve cell.

(c) Axon

The elongated main fibre originated from the nerve cell is called axon. It forms white matter of the nervous system.

(i) Axolemma: It is a membrane which covers and protects axon and contains axoplasm.
(ii) Myelin sheath: It is a sheath of fatty material which surrounds axon. The points where myelin sheath is absent are known as nodes of Ranvier.

Functions of Myelin Sheath

(a) It protects the axon from injury.
(b) It contributes to rapid transmission of nerve impulses along myelinated fibres.
(c) It acts as an insulator.
(d) It speeds up the flow of nerve impulses through them.

9 Enlist types of neurons on the basis of functions.

☞ **Types of Neurons/Nerves on the Basis of Function**

A. Sensory Neurons or Afferent Neurons

These neurons transmit the impulses from different parts of the body to the spinal cord and then to the brain where they are interpreted and sensed, e.g. sense of taste, sight, touch.

B. Motor Neurons or Efferent Neurons

These neurons convey the impulses from brain and spinal cord towards various parts of the body, e.g. stimulating glandular secretions and causing muscles contraction.

C. Mixed Neurons/Intercalated Neurons

When sensory and motor neurons are enclosed within the same sheath of connective tissue, they are called mixed neurons. They perform both sensory and motor functions.

10 Define the terms.

☞ Important Definitions

(i) **Cytology:** The branch of science which deals with study of cells is known as cytology.

(ii) **Synapse:** The gap between two neurons where transmission of impulses takes place, is called synapse.

(iii) **Chemical transmitter/neurotransmitter:** The chemical substances which are secreted by nerve cell in the synaptic gap, are called neurotransmitters.

(iv) **Intracellular fluid:** The fluid which is present inside the cell, is known as intracellular fluid, e.g. cytoplasm.

(v) **Extracellular fluid:** The fluid which is present outside the cell, is known as extracellular fluid.

(vi) **Plasma fluid:** The fluid which is present in the blood plasma and lymph, is known as plasma fluid, e.g. blood plasma, lymph.

(vii) **Transcellular fluid:** The fluid which is present in different layers and membranes of the body, is known as transcellular fluid, e.g. CSF, synovial fluid, serous fluid.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. The group of cells having similar physical characters and performing same specialized function are called **tissues**.
2. **Epithelial tissue** serves as protective coverings.
3. Epithelial cells that are adapted for absorption or secretion usually have **microvilli** at their free surface.
4. **Pleura** are called covering of lungs.
5. **Blood** is a fluid connective tissue.
6. **Muscular tissues** maintain posture/position of the body.
7. The strongest cartilage is **fibrous cartilage**.
8. **Haemopoeisis** is a process of formation of RBCs in the red bone marrow.
9. The gap between two neurones is called **synapse**.
10. **Neurotransmitter** is a chemical substance secreted by nerve cells in the synapse.
11. The branch of science which deals with study of cell is **cytology**.

12. Haversian system is the characteristic feature in the histology of **bone**.
13. **Cartilage** is a flexible connective tissue.
14. White fibrous tissue is also called **collagenous tissue**.
15. Tissue which produces movement through its ability to contract is **muscular tissue**.
16. **Bone** is the hardest connective tissue.
17. **Nervous** tissue helps in transmission of impulses in the body.
18. **Cartilage** tissue provides support with flexibility.
19. **Neurones** are the structural and functional units of the nervous tissue.
20. The tip of nose contains **cartilage**.

Chapter
4

The Osseous System (The Skeleton)

1 Define skeleton. Give the functions of skeleton. (S.22)

☞ **Skeleton**

"The bony framework of the body, which supports and protects the soft tissues of the body and provides levers for locomotion and other movements, is called skeleton."

Functions

1. It gives a definite shape to the body.
2. It provides support to different internal parts of the body like brain, heart, lungs, etc.
3. It serves as a storehouse of calcium and phosphate.
4. It provides surface for the attachment for skeletal muscles.
5. It transmits body weight.
6. It gives a rigid internal structural framework to the body.
7. The long bones of skeleton help in formation of RBCs.
8. It gives protection to viscera.
9. It allows various types of movements of various body parts by forming joints or lever.

2 Define bone. Mention the functions of bone.

☞ **Bone**

"Bone is the hardest connective tissue in the body which provides framework of the body and gives mechanical support and shape to the body."

1. It gives shape and mechanical support to the body.
2. It acts as a storehouse for calcium and phosphate.
3. It forms supporting framework of the body (skeleton).

4. It gives movement to body by forming various joints.
5. It maintains electrolyte balance of the body.
6. The bones also perform detoxicating function.
7. The bone performs haemopoietic function (formation of RBCs).
8. It gives attachment to the muscles and tendons.

3 Classify bones/give the types/kinds of bones according to size and shape. (S.23, W.23)

☞ (a) **Long bones:** These are found in the limbs and consist of elongated shaft with two extremities.

Example: The bones of arm and leg, humerus, radius, ulna, femur, etc.

(b) **Short bones:** They have no shaft but consist of smaller masses of spongy bone surrounded by a shell of compact bone.

Example: Carpals, tarsals.

(c) **Irregular bones:** In this type, bones do not have a definite shape.

Example: Vertebrae, bones of the face.

(d) **Flat bones:** It consists of two layers of compact bone between which there is a layer of cancellous bone.

Example: Scapula, innominate bone, bones of skull.

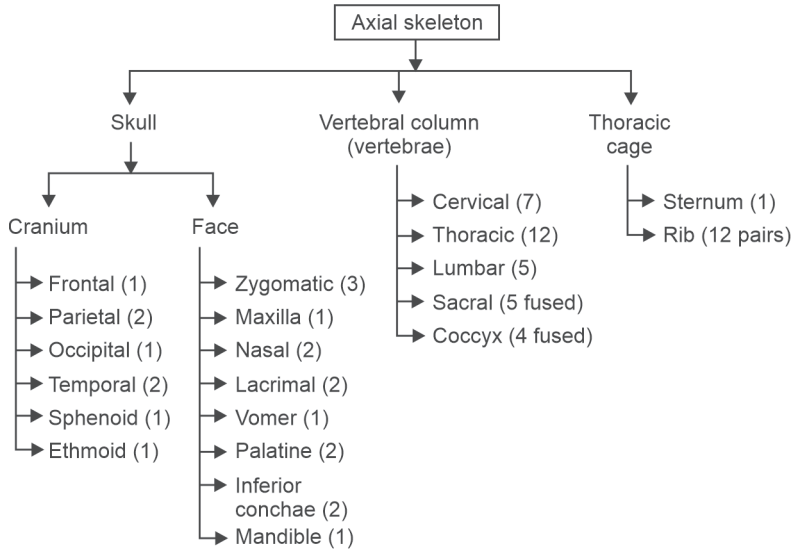
(e) **Sesamoid bone:** These are small bones which are developed in the tendons around the certain joints.

Example: Patella or knee-cap: Patella is a roughly triangular sesamoid bone associated with the knee joint, i.e. it is present in front of the joint formed by femur and tibia bones (knee joint).

4 Define axial skeleton. Name the bones of axial skeleton. (S.22, 24)

☞ **Definition**

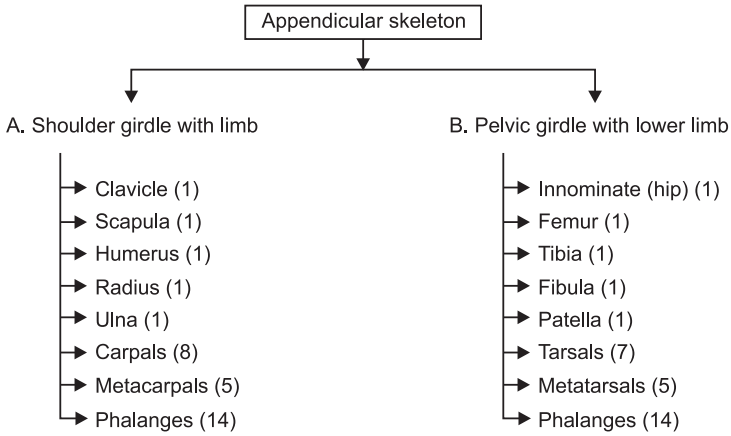
The part of skeleton present along the axis is known as axial skeleton.



5 Define appendicular skeleton. Name the bones of appendicular skeleton.

☞ **Definition**

The bones which are situated at the side of the axis are known as bones of appendicular skeleton.



6 Define vertebral column. Classify vertebrae. Give the functions of vertebral column.

☞ **Vertebral Column**

It is a long, flexible curved bony rod, made up of irregular bones called vertebrae.

Types of Vertebrae

(i) Cervical vertebrae (7)
(ii) Thoracic vertebrae (12)
(iii) Lumbar vertebrae (5)
(iv) Sacral vertebrae (5 fused)
(v) Coccyx (4 fused).

Functions of Vertebral Column

(i) It provides a strong bony protection for the delicate spinal cord.
(ii) It supports the skull.
(iii) It forms axis of the body.
(iv) It gives attachment to ribs, pelvic girdle, muscles of the back.
(v) It provides necessary rigidity and flexibility to the body.
(vi) The intervertebral discs present between the bodies of vertebrae act as shock absorber.

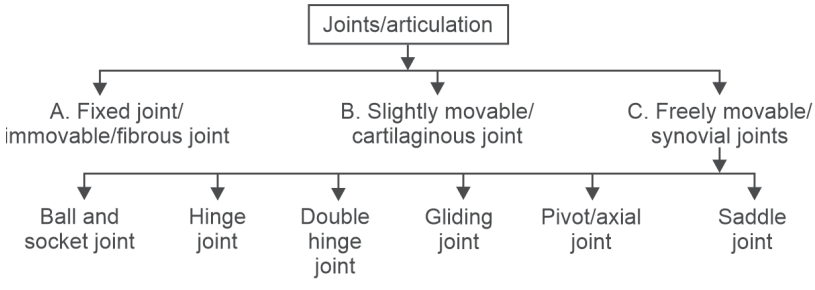
7 Define joint/articulation. Explain various types of joint/articulation. (S.24, W.22)

☞ Joint/Articulation

"The place where two or more bones join together is called a joint or articulation."

Types of Joint/Classification of Joint

According to range of movement, the joints are classified as:



Explanation

A. Fixed/Immovable/Fibrous Joints

- In this type of joint, there is no movement between the bones.
- There is a fibrous tissue between the ends of the bones. Hence, it is called fixed joint, e.g.
  (i) Joints between bones of the skull.
  (ii) Joints between the teeth and maxilla, mandible.

B. Slightly Movable/Cartilaginous Joints

- In this type, there is a pad of cartilage between the articulating bones.
- This allows for very slight movement caused by compression of the pad of cartilage, e.g. joints between the bodies of vertebrae.

C. Synovial Joint/Freely Movable Joints

- The joints which allow free movements to the articulating bones, are called synovial joints/freely movable joints.
- These joints are characterised by synovial membrane and synovial fluid.

Types of Synovial Joint

(i) **Ball and socket joint:** In this type of joint, a globular head of one bone fits into a cup-shaped socket of another bone, which provides free movement, e.g.
   1. Shoulder joint—between scapula and humerus.
   2. Hip joint— between hip bone and femur.

(ii) **Hinge joint:** These joints allow the movements in one direction only, e.g.
   1. Elbow joint—between humerus and radius, ulna.
   2. Knee joint—between femur and tibia, fibula.

(iii) **Double hinge joint:** These allow the movements like a hinge but in two directions, e.g. joints between metacarpals and phalanges.

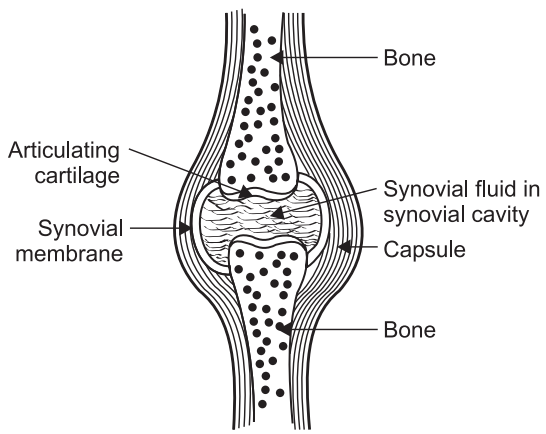
(iv) **Gliding joint/plane joint:** In this type, articulating surfaces of the bones glide/slide over each other allowing free movement in all directions, e.g. joints between carpals, joints between tarsals.

(v) **Pivot joint/axial joint:** In this joint one bone turns on another and movement is around the axis, e.g. radioulnar joint, joints between femur and tibia.

(vi) **Saddle joint:** In this type, one bone is movable on another bone in many directions, e.g. thumb joint: It is the joint between metacarpal of the thumb with carpal of the wrist.

8 Explain typical synovial joint with the help of diagram. (S.23)

☞



A typical synovial joint

Characteristics of a Typical Synovial Joint

- In this joint, there is a small cavity between articulating surfaces of the bones called synovial cavity.
- The synovial cavity is filled with a thick, sticky fluid called synovial fluid.
- The synovial fluid is surrounded by a membrane called synovial membrane.
- The synovial fluid lubricates the joints and provides nutrition to living cells in the articulating cartilages which contain no blood vessels.
- The articulating ends of both the bones are covered by hyaline cartilage.
- The joint is enclosed in a fibrous capsule supported by ligaments.

9 Distinguish between the male and female pelvis/pelvic girdle. (W.23)

☞

	Parts	Female pelvis	Male pelvis
(i)	Bones	Lighter and smaller	Heavier and longer
(ii)	Cavity	Shallow or round	Deep and funnel-shaped
(iii)	Sacrum	More concave anteriorly	Less concave anteriorly
(iv)	Pubic arch (angle)	The angle made by the two pubic bones at the symphysis pubis is wider.	The angle made by the two pubic bones at the symphysis pubis is narrower.
(v)	Girdle	Wider	Less wider
(vi)	Muscle attachment	Not so deeper	Deeper

10 What are ribs? Classify them. Mention the functions of ribs.

☞ **Ribs**

The ribs are long, curved bones which form thoracic cage.

- There are 12 pairs of ribs in thoracic cage.

Types of Ribs

(a) **True ribs:** The first 7 pairs of ribs which are directly joined to sternum in front and to the vertebral column behind, are called true ribs.

(b) **False ribs:** The next 3 pairs of the ribs are joined to the 7th rib and not directly to the sternum, are called false ribs.

(c) **Floating ribs:** The last 2 pairs of ribs which are joined to the vertebral column only, are known as floating ribs.

Functions of Ribs

(i) Ribs form thoracic cage which protects delicate organs of the body.

(ii) Ribs support to the sternum and vertebral column.

(iii) Ribs help in the mechanism of respiration.

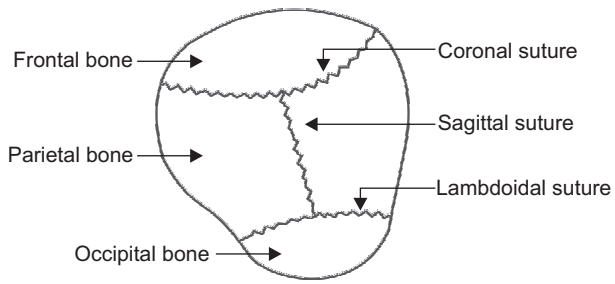
(iv) It gives shape to the chest.

(v) It supports shoulder girdle.

11 What are sutures? Name the important sutures and their positions.

☞ **Sutures**

Sutures are strong fibrous immovable joints between the bones of skull.



Sutures

The important sutures are:

1. **Coronal suture:** The coronal suture is present between the frontal bone and the parietal bones.
2. **Sagittal suture:** The sagittal suture is present between two parietal bones.
3. **Lambdoidal suture:** The lambdoidal suture is present between occipital bone and the two parietal bones.

12 What are the sinuses of skull? Name two such sinuses.

☞ **Sinuses**

The several cavities or chambers present in the bones of skull are known as sinuses of skull.

Examples of Sinuses

1. Frontal sinuses
2. Ethmoid sinuses
3. Maxillary sinuses.

Functions of Sinuses

(i) It lightens the weight of the skull.
(ii) It gives resonance to the voice.

13 Name the bones of upper limb with joints.

☞ **Bones of Upper Limb/Forearm**

Scapula, humerus, radius, ulna, carpals, metacarpals, phalanges.

Joints of the Upper Limb

(a) **Ball and socket joint (shoulder joint):** Between humerus and scapula.

(b) **Hinge joint:** Between humerus and radius, ulna.

(c) **Pivot joint (radioulnar joint):** Between radius and ulna.

(d) **Gliding joint:** Between carpals.

(e) **Metacarpophalangeal joint:** Between metacarpals and phalanges.

(f) **Interphalangeal joints:** Between phalanges.

14 Name the bones of lower limb with joints.

☞ **Bones of Lower Limb/Hind Arm**

Hip bone, femur, tibia, fibula, patella, tarsals, metatarsals, phalanges.

Joints of Lower Limb

(a) **Ball and socket joint (pelvic joint):** Between hip and femur.

(b) **Knee joint:** Between femur, tibia and fibula.

(c) **Pivot joint:** Between tibia and fibula.

(d) **Gliding joint:** Between tarsals.

(e) **Metatarsophalangeal joint:** Between metatarsals and phalanges.

(f) **Interphalangeal joint:** Between phalanges.

15 Explain disorders of bones and joint. (W.22)

☞ 1. **Arthritis:** Inflammation of joint is called arthritis.
   (i) Acute arthritis
   (ii) Chronic arthritis
   (iii) Rheumatoid arthritis
   (iv) Osteoarthritis
2. **Gout:** Gout is a condition where uric acid crystals are deposited in the joints and give pain in the joint.
3. **Osteoporosis:** When the bones have a deficiency of calcium and they become relatively more fragile, the condition is known as osteoporosis.
4. **Fracture:** When the bone is broken, the condition is called fracture.

5. **Dislocation:** When the bone is displaced from its original position, it is called dislocation of bone.
6. **Sprain:** Wrenching or twisting of a joint accompanied by stretching or tearing of ligament or tendons.
7. **Ankylosis:** This is a condition of immovability of a joint.
8. **Synovitis:** It is the inflammation of synovial membrane. The increased fluid in the joint may protrude out as swelling. During motions joint is having severe pain.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. The branch of science which deals with study of bones is called **osteology**.
2. Total number of bones present in the human body is **206**.
3. **Skeleton** is a bony framework of the body.
4. **Articulation** is a joint between two or more bones.
5. The purpose of the rib cage is to **protect the heart and lungs**.
6. The only movable bone of the skull is **mandible**.
7. **Arthritis** means inflammation joint.
8. **Joint** is a place where two bones are joined.
9. **Patella** is known as knee cap.
10. Sacrum vertebrae are **5 fused** vertebrae.
11. **Elbow joint** is present between humerus and radius, ulna.
12. Cranium of man is made up of **8 bones**.
13. Displacement of bone from its original position is called **dislocation**.
14. Bone of tongue is **hyoid bone**.
15. Number of ribs present in man is **24**.
16. The joint between teeth and maxilla is **fixed joint**.
17. The number of floating ribs in human body is **2 pairs**.
18. Shoulder joint and hip joint are the examples of **shoulder joint**.
19. Elbow joint and knee joint are the examples of **hinge joint**.
20. The total number of bones in right arm is **30**.
21. **Ribs** help in mechanism of breathing.
22. Ball and socket joints can be seen in **shoulders**.
23. The joint between radius and ulna is **pivot joint**.

24. The protein present in the bones is known as **ossein**.
25. Femur is a bone of **hind arm**.
26. **Carpals** are known as wrist bones.
27. **Ball and socket joint** is present in the bones of innominate and femur.
28. In man the axial skeleton is made up of **80 bones**.
29. **Cartilagineus joint** occurs between the vertebrae.
30. **Sutures** are the fixed joints between bones of the skull.
31. **Humerus** is a bone of forearm.
32. In man the **thoracic basket** is composed of ribs, sternum and thoracic vertebrae.
33. **Mandible** is a movable bone of the skull.
34. The part of a long bone that takes part in the growth of the bone is **metaphysis**.
35. Gout is a condition where **uric acid** crystals are deposited in the joints.
36. The lower jaw or mandible is made of **one bone**.
37. The small cavity between articulating surfaces of the bone is called **synovial cavity**.
38. There are **2** pairs of false ribs in the body.
39. There are **33** numbers of vertebrae in human body.
40. **Sagittal suture** is present between two parietal bones.

Chapter
5

The Haemopoietic System

1 Define blood. Give the physical characteristics of the blood. (S.24, W.23)

☞ **Blood**

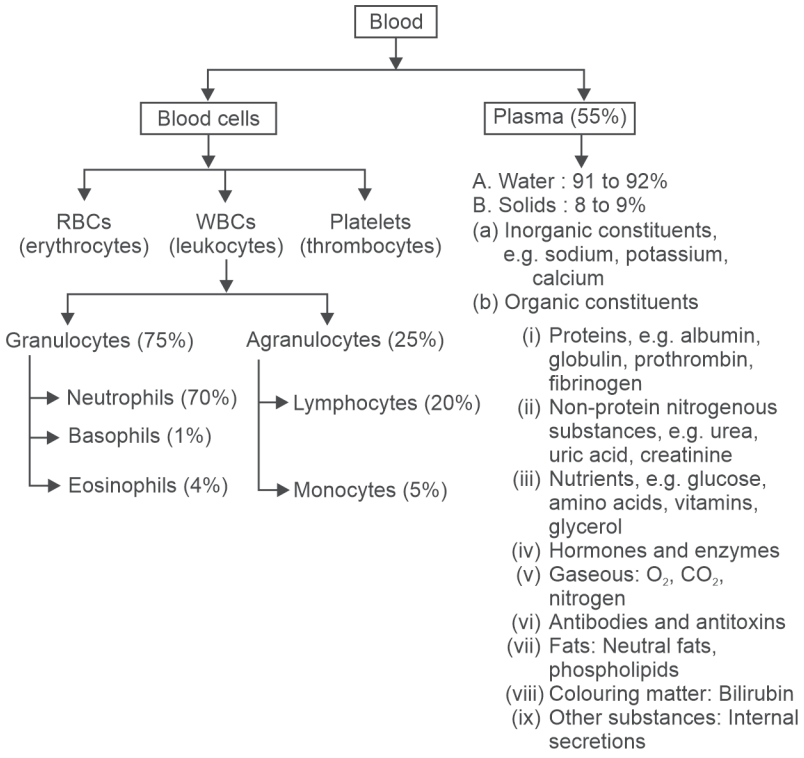
Blood is a red-coloured, viscous fluid connective tissue circulated in the body and is mainly composed of plasma and blood cells.

Physical Characteristics of Blood

(i) Blood is a red-coloured, viscous fluid and is thicker than water.
(ii) Viscosity of blood is from 4.5 to 5.5.
(iii) The blood constitutes about 8% of the total body weight.
(iv) Temperature of blood is 38ºC.
(v) Blood is slightly heavier than water.
(vi) Concentration of salt (NaCl) in the blood is about 0.85 to 0.9%.
(vii) The total amount of blood in the human body is about 5 to 5.5 litres.
(viii) pH of blood is 7.45 to 7.55.

2 Give the composition of blood. (W.22)

☞ Blood is composed of 45% of blood cells and 55% of plasma.



3 Give the functions of blood. (S.22)

☞ Functions of Blood

1. Blood helps to transport the gases from lungs to the tissues (O_2) and from tissues to the lungs (CO_2).
2. Blood helps to transport the absorbed digested materials to the tissues of the body.
3. Blood acts as a vehicle through which many substances are transported to their places of activity.
4. Blood helps to drain out waste materials present in the body.
5. Blood acts as a great defensive mechanism.
6. Blood helps to regulate body temperatures.
7. Blood maintains acid–base balance of the body.
8. Blood has coagulation property due to which it prevents loss of blood from the body.
9. Blood helps to transport the hormones throughout the body.
10. Blood regulates body temperature.

4 Write a note on RBCs/erythrocytes.

☞
- RBCs are small, circular, disc-shaped cells suspended in the blood plasma.
- All the cells in groups, appear as red in colour and thus blood becomes red-coloured.
- RBCs are produced in the red bone marrow. The process of formation of RBCs in the red bone marrow is called erythropoiesis.
- Total lifespan of RBCs is 120 days.
- The RBCs contain a substance known as haemoglobin and is enclosed in the stroma of RBCs.
- Haemoglobin is a complex protein of high molecular weight.
- Haemoglobin consists of a protein material called globin and non-protein material called 'haem'.
- The haem contains iron which gives red colour to the haemoglobin.
- Normal values of RBCs:
  (i) In adult → 5 million/mm^3 of blood.
  (ii) In male → 5 to 5.5 million/mm^3 of blood.
  (iii) In female → 4.5 to 5 million/mm^3 of blood.
- Haemoglobin (Hb) + Oxygen (O_2) → Oxyhaemoglobin (HbO_2)
- Haemoglobin (Hb) + Carbon dioxide (CO_2) → Carboxy-haemoglobin ($HbCO_2$).

Functions of RBCs/Erythrocytes

(i) It transports the gases such as O_2 and CO_2 in the form of oxyhaemoglobin and carboxyhaemoglobin.

(ii) It maintains acid–base balance by buffering action of haemoglobin.

(iii) RBCs help to maintain viscosity of blood.

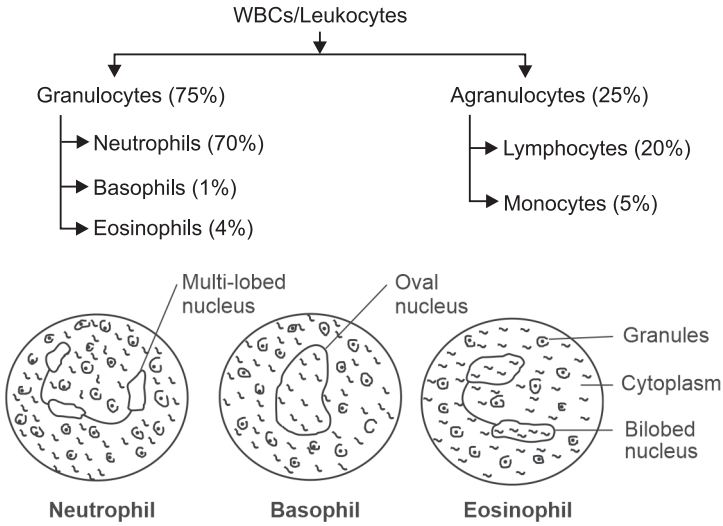
(iv) RBCs maintain iron balance of the body.

(v) Various pigments are derived from the haemoglobin after disintegration of RBCs, e.g. bilirubin, biliverdin.

5 Write a note on WBCs or leukocytes. (S.22, W.23)

☞
- The WBCs are colourless cells having, irregular-shaped large nucleus.
- The normal count of leukocytes is 6000 to 10,000/mm^3 of blood.

Classification of Leukocytes (WBCs)



A. Granulocytes

They constitute about 75%. These contain granules in the cytoplasm, hence called granulocytes.

1. **Neutrophils:** The granules of these cells are stained by neutral dye. The nucleus is multi-lobed.
   - ***Function:*** They ingest the microbes and destroy it by phagocytosis.
2. **Basophils:** The granules of these cells are stained by basic dye. The nucleus is usually oval or slightly kidney-shaped.
   - ***Function:*** They are responsible for destruction of products of antigen–antibody reactions.
3. **Eosinophils:** The granules of these cells are stained by red acidic dye called eosin. The nucleus is *bilobed*.
   - ***Function:*** Phagocytosis.

B. Agranulocytes

These are mononuclear cells and they do not show presence of granules in their cytoplasm.

1. **Monocytes:** These are large cells with large nucleus. The nucleus is convoluted kidney-shaped.
   - ***Function:*** They give phagocytic action.
2. **Lymphocytes:** These are produced in the lymph glands, hence called lymphocytes.
   (i) **Small lymphocytes:** The thin rim is present around nucleus and is stained by basic stains.
   (ii) **Large lymphocytes:** The nucleus is oval, rounded or kidney-shaped and is stained by basic stains.
   - ***Function:*** They are responsible for the development of immunity against foreign substances such as micro-organisms.

6 Mention the functions of leukocytes/WBCs.

☞ **Functions of WBCs/Leukocytes**

(i) WBCs help in the process of phagocytosis.
(ii) WBCs help in the formation of fibroblasts to repair the areas of inflammation.
(iii) WBCs give secretion of heparin which helps to prevent intravascular clotting (thrombosis).
(iv) WBCs prevent allergic reactions by antihistaminic action.
(v) Lymphocytes play an important role in the production of antibodies.

7 Give the normal values of the following. **(W.23)**

☞ **1. Erythrocytes (RBCs):**
   (a) Average: 5 million/mm^3 of blood
   (b) In male: 5 to 5.5 million/mm^3 of blood
   (c) In female: 4.5 to 5 million/mm^3 of blood.
2. **Leukocytes (WBCs):** 6,000 to 10,000/mm^3 of blood.
3. **Thrombocytes (platelets):** 3 to 4 lacs/mm^3 of blood.
4. **Haemoglobin:**
   (a) Average: 15 g/100 ml of blood.
   (b) In male: 14 to 18 g/100 ml of blood.
   (c) In female: 12 to 16 g/100 ml of blood.

8 Define the terms.

☞ (i) **Bleeding time:** It is the time interval between moment at which the bleeding starts to the moment at which it exactly stops. Or
It is the time required for cessation of bleeding from a small skin puncture.
- **Normal value:** 1 to 3 min (by Duke's method).

(ii) **Clotting time/coagulation time:** It is the time interval between the moment at which blood escapes from the vessel to the moment at which clot is formed.
- **Normal value:** 3 to 6 min (by Wright's capillary method).

(iii) **Blood serum:** It is the fluid remaining after formation of clot.

9 Define blood coagulation. Explain stages of blood coagulation. Or What is blood clotting? Explain mechanism of blood clotting. Or Explain how clot is formed.

(S.22, 23)

☞ **Blood Coagulation**

"When there is an injury to blood vessel, blood comes out and within a few minutes, it loses its fluidity and forms a red-coloured, semisolid jelly-like mass, i.e. clot. This process is known as blood coagulation or blood clotting."

Mechanism of Blood Coagulation/Process of Blood Clotting

Step I

The injury to blood vessel leads to formation of a rough surface. The platelets when come in contact with rough surface, they are ruptured and thromboplastin is released. It is also released by damaged tissues. This thromboplastin in the presence of calcium converts inactive prothrombin present in the blood into active thrombin.

$$\underset{\text{(inactive)}}{\text{Prothrombin}} + \text{Thromboplastin} + Ca^{2+} \longrightarrow \underset{\text{(active)}}{\text{Thrombin}}$$

Step II

The active thrombin converts inactive fibrinogen into insoluble fibrin threads which form a network-like structure.

$$\underset{\text{(active)}}{\text{Thrombin}} + \underset{\text{(inactive)}}{\text{Fibrinogen}} \longrightarrow \underset{\text{(insoluble)}}{\text{Fibrin threads}}$$

Step III

In the holes of network of these fibrin threads, the blood cells get entangled to form a red-coloured semisolid jelly-like mass, i.e. clot.

Thus, the process of blood coagulation completes.

Fibrin threads + Blood cells ⟶ Clot
(red-coloured semisolid jelly-like mass)

10 Mention the factors affecting/influencing blood coagulation. (S.22)

☞ **A. Factors Hastening/Accelerating/Increasing Blood Coagulation**

(i) Contact of blood with rough surface and injury to blood thrombocytes.
(ii) Temperature slightly excess than body temperature may increase blood coagulation.
(iii) Excessive slowness of blood flow.
(iv) Snake venom.
(v) Presence of calcium salt.
(vi) Resting condition.

B. Factors Hindering/Retarding/Preventing Blood Coagulation

(i) Contact with smooth surface.
(ii) Lowering body temperature.
(iii) Removal of Ca^{2+} ions from the blood by addition of Na, K and citrate ions.
(iv) Presence of greasy material like oil, wax or grease.
(v) Deficiency of vitamin K.
(vi) Calcium deficiency in the blood.
(vii) Use of heparin.

11 Write a note on plasma proteins.

☞ **Plasma Proteins**

"The number of proteins present in the blood plasma are called plasma proteins," e.g. serum albumin, serum globulin, prothrombin, fibrinogen.

Functions of Plasma Proteins

1. Plasma proteins maintain colloidal osmotic pressure of the blood and help in regulating the distribution of fluid between the blood and tissues of the body.

2. Prothrombin and fibrinogen are essential for blood clotting process.
3. Plasma proteins mainly globulins are responsible for maintaining viscosity of blood which ultimately maintains the blood pressure.
4. The plasma proteins act as a buffer which maintain acid–base balance.
5. Plasma proteins act as a storehouse of proteins, from which the tissues can draw proteins during inadequate protein diet.
6. Plasma proteins combine with certain substances and help to carry them in bloodstream.
7. Plasma proteins help in binding of drug and increase the duration of action of drugs.
8. Plasma globulins help in the formation of antibodies which give protection against infection.

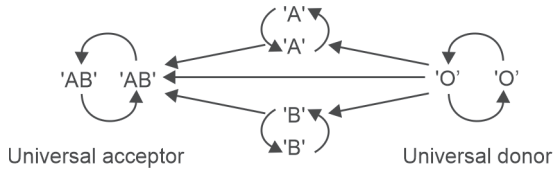
12 Write a note on blood groups. Write a note on ABO group system. Explain how blood group matching is done.

☞
- ABO blood group system was discovered by Karl Landsteiner in 1900.
- The blood of one person is not always compatible with that of another person, hence before transfusion (donation) of blood, it must be tested or compatibility of acceptor's blood is assured.
- Only compatible blood is to be transfused.
- If incompatible blood is transfused, then agglutination of erythrocytes occurs which leads to haemolysis of transfused blood cells (breakdown of RBCs). Therefore, Rh +ve blood is not given to Rh –ve persons.
- **There are four main blood groups:** Blood group 'A', Blood group 'B', Blood group 'AB', Blood group 'O'.
- **Blood donor:** A person who gives or donates the blood to another person, is known as blood donor.
- **Blood recipient/blood acceptor:** A person who requires or accepts the blood from another person is known as blood acceptor.
- **Universal donor:** A person who donates the blood to all types of blood groups, is known as universal donor.

- **Universal acceptor:** A person who accepts the blood from all the other blood groups is known as universal acceptor.
- The membrane of erythrocytes contains antigens called agglutinogens and people have natural antibodies in the plasma known as agglutinins.
- The agglutinogens are genetically determined and are of two types, i.e. 'A' and 'B'.
- The agglutinins in the plasma are of opposite type.

Blood group	Agglutinogens in RBCs	Agglutinin in plasma
'A'	'A'	'b'
'B'	'B'	'a'
'AB'	'A' and 'B'	No agglutinin
'O'	No agglutinogen	'a' and 'b'

Compatibility of Blood Groups (Matching of Blood Groups)



Blood group	Receives blood from	Donates blood to
'A'	'A', 'O'	'A', 'AB'
'B'	'B', 'O'	'B', 'AB'
'AB'	'A', 'B', 'AB', 'O'	'AB'
'O'	'O'	'A', 'B', 'AB', 'O'

Importance of Blood Group

(i) Blood group study has a great value in blood transfusion.
(ii) Blood group study helps in the study of various blood disorders.
(iii) Blood group study is useful in forensic medicines.
(iv) Blood group study is helpful in experimental purposes.

13 What is Rh factor/Rh-antigen/Rhesus factor? Give its significance.

☞ Rh Factor

It is an agglutinogen (antigen) of 'Rhesus monkey'.

- Apart from antigen 'A' and antigen 'B' about 80 to 90% of the people contain one or more antigens on the membranes of RBCs called Rh-antigen or Rhesus factor.
- If Rh factor is present in the person's blood, then blood group is described as Rh +ve and if Rh factor is absent in the person's blood, then blood group is described as Rh –ve.

Significance/Importance of Rh Factor

(i) Rh factor has a great value in blood transfusion because transfusion of Rh +ve blood to Rh –ve person stimulates the immune response which causes haemolysis of transfused blood cells.

(ii) Rh factor is helpful in detecting the blood group of child by considering father's and mother's blood group study.

14 Explain the terms in short.

☞ (i) Thrombosis (Intravascular Clotting)

Definition: The process of formation of blood clot inside the blood vessel which may block the blood circulation is known as thrombosis.

The clot which is formed inside the blood vessel is known as 'thrombus'. Thrombosis may be caused because of slow blood-flow or infection to inner side of the blood vessels.

(ii) Embolism (Em-in, bolus-mass)

Definition: The process of formation of embolus in the bloodstream which blocks the blood circulation, is known as embolism.

The embolus may be bubble of air or in some cases blood clot or debris particle.

(iii) Phagocytosis

The process in which the cell engulfs or ingests the microbes, foreign particles and digests or destroys them within the cell is called phagocytosis, e.g. neutrophils and monocytes actively show phagocytic action.

(iv) Haemolysis (Laking of Blood)

- Haemolysis means breakdown of RBCs.
- The haemoglobin comes into the plasma after breakdown of RBCs. This phenomenon is known as laking of blood.

(v) Fibrinolysis

The process of breakdown of fibrin threads within the clot by the action of proteolytic enzymes is known as fibrinolysis.

15 Explain various disorders of blood.

☞ 1. Anaemia (W.22)

Anaemia means decrease in number of RBCs in the blood, or decrease in percentage of haemoglobin in the blood.

Causes/Reasons of Anaemia

(i) Excessive loss of blood.
(ii) Failure of function of red bone marrow to produce RBCs.
(iii) Destruction of RBCs by haemolysis.
(iv) Deficiency of iron in the body.
(v) Defective formation of RBCs.

Types of Anaemia

(i) Pernicious anaemia
(ii) Megaloblastic anaemia
(iii) Microcytic anaemia
(iv) Sickle cell anaemia
(v) Iron deficiency anaemia

2. Polycythemia

"It means an abnormal increase in RBCs in the blood."

In this case, the skin and mucous membranes of the mouth are red and conjunctiva is also red.

3. Leukaemia

"Leukaemia means uncontrolled increase in production of WBCs in the blood." It is also called cancer of blood.

Causes

- Ionising radiations produced by X-rays.
- Some chemicals cause the changes in the genetic make up of the white cell precursor.

4. Leucopenia

"Leucopenia means the conditions in which there is a decrease in number of WBCs below 4000/mm^3 of blood."

5. Leucocytosis

This is a condition in which the number of circulating leukocytes increases in the blood circulation.

Pathological leukocytes (abnormal) occurs when a blood leukocyte count is above 11,000/mm^3 of blood.

6. Haemophilia (Bleeding Disease)

- It is the condition in which bleeding occurs continuously even with a minor injury or a cut.
- In this case, blood does not clot.
- It is a hereditary disease which runs in the families.

7. Erythroblastosis Foetalis

It means the death of the foetus due to mass destruction of its red cells when their Rh –ve blood happens to receive Rhesus antibodies from the blood of mother.

When a pregnant women with Rh –ve blood bears an Rh +ve baby, the problem appears in the last month of pregnancy, because at this stage there is a development of embryonic life of the child. The Rh +ve red blood cells of the baby pass into the blood of the mother who reacts by producing Rhesus antibodies which pass back into the blood of foetus.

As a result of this, the RBCs of the child get destroyed both before and after birth. This leads to death of the foetus. This condition is called erythroblastosis foetalis.

16 What is haemopoiesis/haematopoiesis? Explain the process of haemopoiesis.

☞ **Haemopoiesis/Haematopoiesis**

- Haemopoiesis is the process through which the body manufactures blood cells.
- Haemopoiesis is from Greek language meaning 'to make new blood'.
- It occurs within the haemopoietic system which includes organs and tissues such as the bone marrow, liver and spleen.
- Haemopoiesis begins early in the development of an embryo well before birth and continues for the life of an individual.

Process of Haemopoiesis

- The rate of haemopoiesis depends on the body's needs.
- The body continuously manufactures new blood cells to replace the old ones.
- About 1% of the body's blood cells must be replaced every day.

- White blood cells have the shortest lifespan, sometimes surviving just a few hours to a few days, while red blood cells can last up to 120 days.
- The process of haemopoiesis beigns with a stem cells. These stem cells multiplies and some of these new cells transform into precursor cells.
- These immature cells soon divide and mature into blood components such as red and white cells or platelets.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. The main function of erythrocyte is **transport of oxygen**.
2. The **plasma** part of blood is responsible for carrying wastes, nutrients, and minerals.
3. The **embolus** is a clot that has travelled in the blood vessels.
4. The normal value of WBCs is **6000 to 10000 per cubic mm of blood**.
5. Intravascular clotting is also known as **thrombosis**.
6. **Erythropoietin** controls the rate of erythrocyte production.
7. **Haemolysis** means breakdown of RBCs.
8. Decrease in percentage of haemoglobin or RBCs is known as **anaemia**.
9. **Haemoglobin** is responsible for the red colour of the blood.
10. **RBCs** are responsible for carrying oxygen and carbon dioxide to body cells.
11. **Haemophilia** is a bleeding disease.
12. **Platelets** are responsible for clotting blood.
13. Rh-factor derives its name from **Rhesus monkey**.
14. The normal platelet count in adult is **3 to 4 lacs per cubic mm of blood**.
15. The excess of white corpuscles in the blood is called **leukaemia**.
16. **SVC and IVC** are the largest veins which carries deoxygenated blood.
17. Blood coagulation is assisted by **thrombocytes**.
18. Heredity deficiency of coagulation is referred to as **haemophilia**.
19. **Leucocytes** act as a defence against infection.
20. Lifespan of neutrophils is **10 to 12 hours**.

21. The blood group known as the ABO system is based on the presence of **antigens**.
22. T-lymphocytes originate from **bone marrow**.
23. **Calcium** is required for blood clotting.
24. The normal level of haemoglobin per 100 ml of blood in women is **14 gm**.
25. Platelet plug is associated with **clot retraction**.
26. The blood protein involved in blood coagulation is **fibrinogen**.
27. The blood group in man was discovered by **Karl Landsteiner**.
28. Coagulation will be retarded by lowering **thrombocyte count**.
29. **Haemostasis** means prevention of bleeding.
30. The volume of RBC will increase in **hypotonic solution**.

Chapter
6

The Lymphatic System

1 What is lymph? Give composition and functions of lymph.

☞ Lymph

"The lymph is a thin, watery, clear modified tissue fluid which is formed by the passage substances from the blood capillaries into the tissue space by the process of diffusion."

Composition

(a) Water: 94%
(b) Solids: 6%
  (i) Proteins
  (ii) Fats
  (iii) Carbohydrates
  (iv) Urea
  (v) Non-nitrogenous substances
  (vi) Creatinine
  (vii) Other inorganic substances.

Composition of lymph is similar to blood plasma but concentration of dissolved substances is different.

The lymph contains lymphocytes but RBCs and thrombocytes are absent.

Functions of Lymph

(i) Lymph helps to transport lymphocytes and extra-intestinal fluid from lymph gland into circulation.
(ii) It helps to return fluid and proteins from tissue to blood circulation.
(iii) It helps supply nutrients to such part of body where blood does not reach.
(iv) Lymph helps to carry emulsified fat from intestine to circulation.

(v) **Defensive mechanism:** Lymph helps in drainage of bacteria and toxins along the lymphatics and traps them in lymph nodes.

2 Mention the functions of lymph gland/lymph node. (S.22, 24)

☞ **Functions of Lymph Gland/Lymph Node**

(i) Lymph node helps in filtration of lymph and removes microbes, their toxins and foreign bodies.

(ii) Lymph node produces and supplies lymphocytes to blood.

(iii) Lymph node produces gamma-globulin (γ-globulin) which helps in immunological response of the body.

(iv) Lymph nodes prevent spread of cancer cells.

(v) Lymph node makes screening of lymph by means of phagocytic action.

(vi) Lymph node acts as a mechanical filter to resist the entrance of poisonous substance into circulation.

(vii) Lymph node acts as the first line of defense guarding respective areas through strategic points in the body.

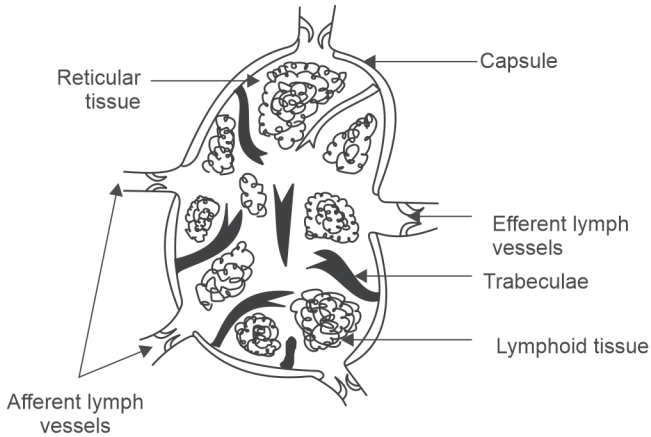
3 What is lymph node? Explain the structure of lymph node/ lymph gland. (S.22,24, W.23)

☞ **Lymph Node/Lymph Gland**

"These are small oval or bean-shaped structures present in the course of lymphatic vessels."

- Lymph nodes are usually distributed in groups.
- They are placed superficially and also deep in the body.
- The main groups of lymph gland are present:
  - (i) In neck
  - (ii) In the axial (arm)
  - (iii) In the thorax
  - (iv) In the abdomen
  - (v) In legs, etc.

- **Section/Internal Structure of Lymph Node/Lymph Gland**



Section of lymph node

Lymph node/lymph gland consists of the following parts:

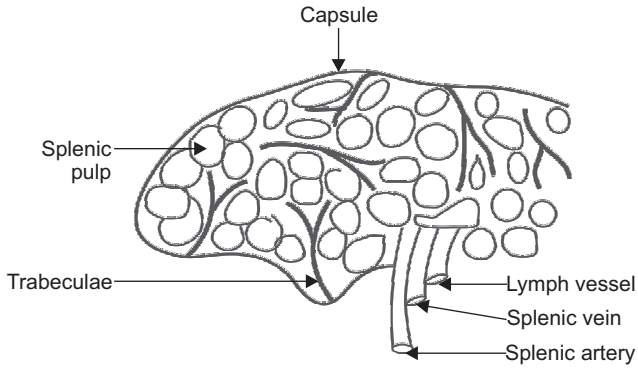
- An outer dense fibrous tissue called capsule.
- Capsule gives rise to fibrous band on inner side called trabeculae. Trabeculae divides substance of lymph node into irregular spaces.
- The space between trabeculae contains lymphoid tissue which produces lymphocytes.
- As many as 4 to 5 afferent lymph vessels may enter in lymph node while only one efferent lymph vessel carries lymph away from lymph node.
- Each lymph node has concave surface called **hilum** where blood vessels supply blood to lymph node and efferent lymph vessel leaves.

4 What is spleen? Describe structure and mention the functions of spleen. (W.22)

☞ **Spleen**

- Spleen is a dark purple-coloured lymphoid tissue.
- It is usually 12 cm long, 6 cm wide and 2.5 cm thick.
- It weighs about 100 g.
- It is highly vascular and bean-shaped.
- It lies between fundus of stomach and diaphragm.

Section of Spleen



Spleen contains the following structures:

1. An outer covering of fibroelastic tissue is called capsule.
2. Trabeculae are structures which arise from capsule on its inner side and divide the spleen into irregular spaces.
3. The space between trabeculae contains splenic pulp.
4. The splenic pulp contains a large number of lymphocytes.
5. Spleen is supplied by splenic artery and is drained by splenic vein.

Functions of Spleen

(i) Spleen helps in formation of blood, i.e. RBCs are produced in spleen during foetal life.
(ii) Spleen acts as a storage of blood and may store erythrocytes and in emergency condition, they are supplied to body.
(iii) **Destruction of blood:** Spleen helps in destruction of matured erythrocytes and breakdowns into products such as bilirubin and iron which are passed to liver.
(iv) Spleen also forms lymphocytes.
(v) Foreign particles, toxins and bacteria all are trapped by spleen and destroyed.
(vi) Spleen also produces antibodies.

5 Name the two main lymphatic ducts. How do they communicate with blood circulation?

☞ There are two main lymphatic ducts which collect lymph from whole body and return into blood.

(a) **Right lymphatic duct:** It receives lymph from right jugular trunk which drains right side of head, neck and right arm.

This duct communicates with right subclavian vein of circulatory system.

(b) **Left lymphatic duct (thoracic duct):** It is the main collecting duct of lymphatic system which receives lymph from left side of head, neck, chest, left upper end and entire body below ribs.

This duct communicates with left subclavian vein of circulatory system.

6 Mention the functions of lymphatic system. (S.23, W.23)

☞ 1. The lymphatic system acts as intermediate transport system between blood vascular system and cells.
2. Lymph glands produce lymphocytes.
3. Lymphatic fluid drains out excess fluid from the tissue back into the blood.
4. In addition to transporting nutrients to tissues, it removes waste materials from the site of their excretion.
5. Lymphocytes protect the body against infection.
6. It absorbs fat from the digested food in the small intestine.
7. Lymphocytes disintegrate to produce plasma proteins like γ-globulin.
8. Spleen as a lymphatic organ produces all types of blood cells during embryonic life. It also acts as a reservoir of blood which is supplied in emergency condition of the body.
9. Lymphatic system is rich in antibodies to counter the infections.
10. Thymus as a lymphatic organ produces T-lymphocytes to fight specific type of infections.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. The lymphatic fluid is rich in **antibodies**.
2. Lymph node produces **gamma-globulin** which helps in immunological response of the body.
3. The T-lymphocytes and B-lymphocytes are the major cells of the **lymph nodes**.
4. **Lymph nodes** act as a first line of defence guarding respective areas through strategic points in the body.
5. Spleen is a dark-purple coloured **lymphoid tissue**.

6. **Tonsils** are the lymphatic organs.
7. The lymphokines secreted by cytotoxic T-lymphocytes increase the activity of **macrophages**.
8. Spleen is called the "graveyard" of the **erythrocytes**.
9. The spleen is situated in **abdominal cavity**.
10. Lymph gland forms **antibodies**.
11. The lymphocytes protect from **pathogens**.
12. Lymph vessels are united to form **thoracic duct**.
13. Lymph is colourless because **RBCs are absent**.
14. **The lymph** serves to return the interstitial fluid to the blood.
15. The lymphocytes provide the principal defence mechanism by producing **immunoglobulin**.
16. **Spleen** serves as storage depot for RBCs.
17. Antibodies of the plasma are partly manufactured by **lymphocyte**.
18. The main function of the lymph node in the man is **collection and destruction of pathogens blood**.
19. Lymph glands and nodes help to **destroy the bacteria**.
20. The function of spleen is **phagocytosis**.

Chapter
7

The Cardiovascular System

- The continuous flow of blood throughout the human body is known as blood circulation.
- The blood is circulated throughout the body by heart and blood vessels.

1 Define different blood vessels.

☞ (i) **Veins:** The vessels which collect the blood from different parts of the body and empty their contents into the heart, are called veins.

(ii) **Arteries:** The vessels which supply the blood from heart to different parts of the body are called arteries.

(iii) **Arterioles:** The smaller branches of arteries which distribute the blood to different parts of the body, are known as arterioles.

(iv) **Venules:** When several capillaries unite to form small veins, these are called venules.

(v) **Capillaries:** Capillaries are very small, thin vessels which make connective link between arterioles and venules.

2 Differentiate between vein and artery.

☞

Veins		Artery	
(i)	The vessel which collects the blood from different parts of the body and empties its contents into the heart is called vein.	(i)	The vessel which supplies the blood from heart to different parts of the body is called artery.
(ii)	It is thin-walled.	(ii)	It is thick-walled.
(iii)	The lumen is bigger.	(iii)	The lumen is smaller.
(iv)	Valves are present.	(iv)	Valves are absent.

Contd...

Veins		Artery	
(v)	Veins are more superficial as compared to arteries.	(v)	Arteries are placed deeper as compared to veins.
(vi)	Veins have less elastic tissue.	(vi)	Arteries consist of elastic fibres and smooth muscles.
(vii)	A number of venules unite to form veins.	(vii)	The smaller branches of arteries are called arterioles.
(viii)	Blood flow is slow.	(viii)	Blood flow is rapid.
(ix)	Blood moves smoothly.	(ix)	Blood moves in them with jerks.
(x)	Veins are bluish in appearance.	(x)	Arteries are red in appearance.
(xi)	Veins carry deoxygenated blood (impure blood) except pulmonary veins.	(xi)	Arteries carry oxygenated blood (pure blood) except pulmonary artery.
(xii)	Veins are full of blood after death.	(xii)	The arteries have no blood in them after death as heart stops beating.

3 Explain layers/walls/coverings/coats of the heart.

☞ The human heart is composed of mainly three layers:

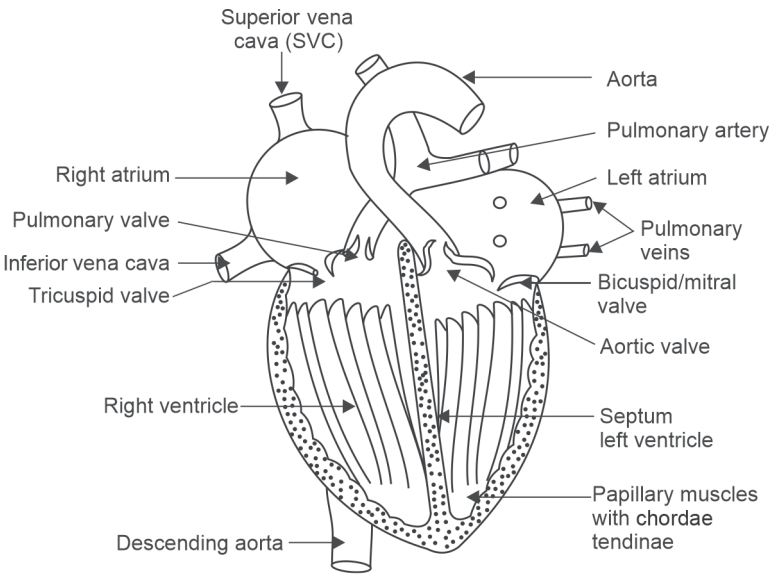
(a) **Pericardium:** It is an outer covering made up of two sacs. Outer sac consists of a double layer of serous membrane. The cells of serous membrane secrete serous fluid into the space between two layers which lubricates these two layers, so that by lubricating action the heart moves freely. The serous fluid is called pericardial fluid.

(b) **Myocardium:** It is the middle layer of heart which is made up of a specialized muscular tissue called 'cardiac muscle'. The cardiac muscle fibres spread the impulse of contraction over a whole sheet of myocardium and contraction of heart takes place.

(c) **Endocardium:** It is the innermost layer of heart. It forms lining to the myocardium. It is a smooth membrane consisting of flattened epithelial cells continuous with the lining of blood vessels and also the valves.

4 Draw and label a diagram of internal structure/interior of heart (LS of heart). (S.24, W.22,23)

☞



The interior of heart

5 Explain various parts of heart/interior of the heart. (S.22, W.22,23)

☞ **Description of Heart**

- The interior of heart is divided into right and left side by a vertical septum, known as interventricular septum.
- Each side is further divided into an upper and lower chambers by the valves.
- The upper chambers are called atrias or auricles and lower chambers are called ventricles.
- Hence, the heart has four chambers:
  (i) Right atrium (iii) Left atrium
  (ii) Right ventricle (iv) Left ventricle
- The two largest veins of the body, namely superior vena cava (SVC) and inferior vena cava (IVC), collect deoxygenated blood from the superior and inferior parts of the body and empty their contents into the right atrium of the heart.

- Two pairs of pulmonary veins collect the blood from two lungs and pour their contents into the left atrium.
- The pulmonary artery originating from right ventricle which further divides into right and left pulmonary branches carrying the blood towards the lungs.
- Aorta is the largest artery originating from left ventricle, which further divides into a number of arteries and arterioles supplying oxygenated blood to different parts of the body.

Valves of the Heart

The heart has four main valves, namely:

(i) **Tricuspid valve:** This valve is present separating right atrium from the right ventricle. Hence, it is also called right atrioventricular valve. Opening of this valve is guarded by three cusps.

Function: This valve prevents back flow of blood from right ventricle to right atrium.

(ii) **Bicuspid valve:** This valve is present separating left atrium from the left ventricle. Hence, it is also called left atrioventricular valve. This valve is also known as mitral valve. The opening of this valve is guarded by two cusps.

Function: This valve prevents back flow of blood from left ventricle to left atrium.

(iii) **Pulmonary valve:** This valve is present between pulmonary artery and right ventricle.

Function: This valve prevents the back flow of blood from pulmonary artery to the right ventricle.

(iv) **Aortic valve:** This valve is present between aorta and left ventricle.

Function: This valve prevents the back flow of blood from aorta to left ventricle.

Actions of Valves/Mechanism of Action of Valves

When blood enters in both atria, they are full and thus get contracted. In this case, tricuspid and bicuspid valves open and blood is forced into the ventricles, respectively. When ventricles contract, both pulmonary and aortic valves open and blood is forced into aorta and pulmonary artery. At the same time, tricuspid and bicuspid valves are closed towards atrium. It should be noted

that both atria contract simultaneously. Similarly, ventricles also contract simultaneously.

6 Define cardiac cycle. Explain various events taking place in cardiac cycle. Or Write a note on cardiac cycle.
(S.22, W.23)

☞ **Cardiac Cycle**

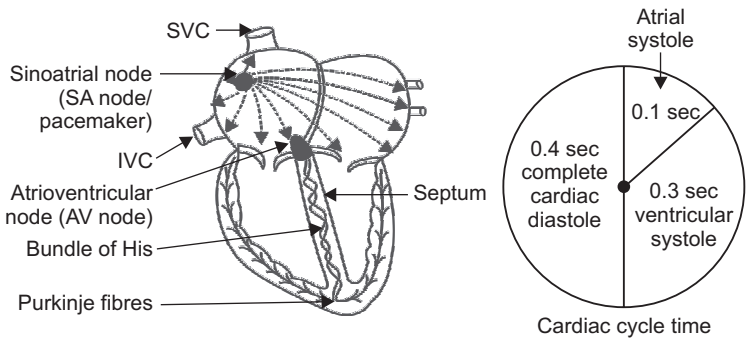
"The events which take place during the circulation of blood through the heart, are collectively called cardiac cycle."

Cardiac Cycle Time

"The time required for one complete cardiac cycle is known as cardiac cycle time."

– Cardiac cycle time is 0.8 sec.
– There are 72 cardiac cycles taking place in 1 minute.

- The cardiac cycle involves four main events, namely:
  (a) Atrial systole, (b) atrial diastole, (c) ventricular systole, (d) ventricular diastole.



- **Systole:** The contraction of chamber of heart is known as systole.
- **Diastole:** The relaxation of chamber of heart is known as diastole.
  1. **Atrial systole:** In this condition, the blood comes into both atria and they are full of blood. Due to this, pressure in the atria increases which stimulates SA node present in the right atrium. SA node produces impulse of contraction which is spread over both atria and atria get contracted. This stage is known as atrial systole.
  2. **Atrial diastole:** After atrial systole, the blood is forced into the ventricle, then atria are relaxed and there is no impulse

of contraction on the atrium. This stage is known as atrial diastole.

3. **Ventricular systole:** When pressure in the ventricle increases, at the same time the impulse of contraction is carried by AV node towards the ventricles through the **bundle of His** which is a conducting tissue present in the septum. This bundle of His further divides into two branches forming a network of Purkinje fibres. These fibres spread the impulse of contraction over both the ventricles and thus ventricles get contracted. This stage is known as ventricular systole.
4. **Ventricular diastole:** After ventricular systole, blood is forced into pulmonary artery and aorta. In this stage, ventricles are relaxed. This is known as ventricular diastole.

In this way, cardiac cycle completes within 0.8 sec.

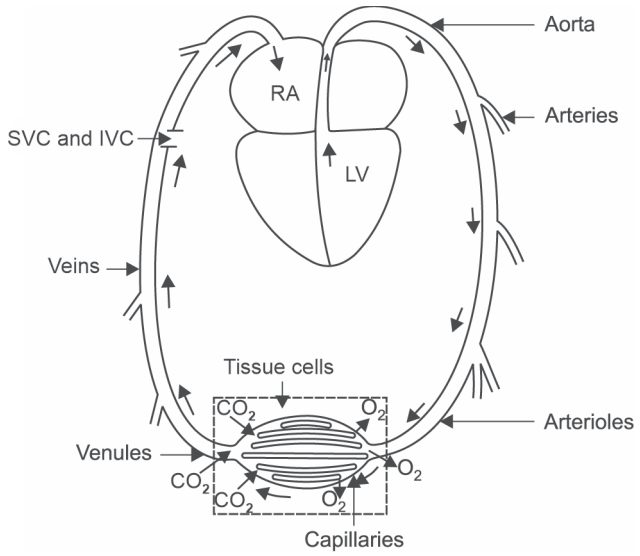
7 Describe the systemic/greater circulation of blood.

☞ Systemic Circulation

"The flow of blood from the left ventricle to various parts of the body and back to the right atrium of the heart, is called systemic circulation."

Description

- The oxygenated blood from the left ventricle is forced into the aorta.
- The blood from the aorta divides into arteries, arterioles and finally comes into the blood capillaries.
- The walls of blood capillaries are very thin, hence oxygen and nutrients from blood in the capillaries diffuse into the tissue fluid. At the same time, CO_2 from the tissue fluid diffuses inside the blood in the capillaries and blood becomes deoxygenated (impure).
- A number of capillaries unite to form venules which collect deoxygenated blood which is then carried by veins towards SVC and IVC. Then from SVC and IVC this deoxygenated (impure) blood passes into the right atrium of the heart.
- This course of blood from left ventricle to right atrium is known as systemic circulation/greater circulation.



Systemic circulation

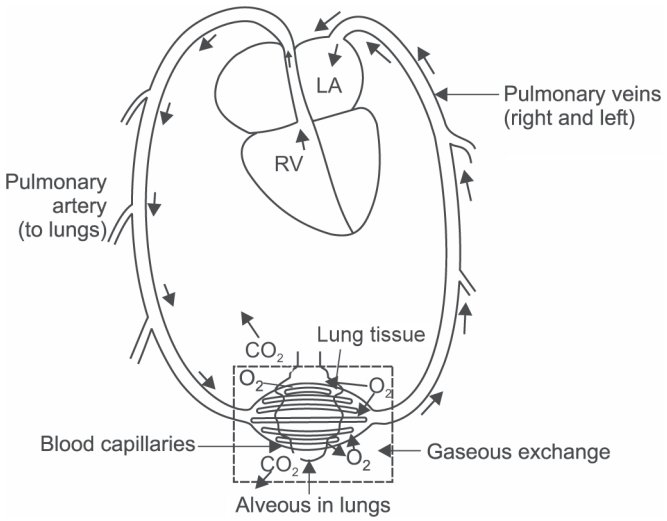
8 Explain pulmonary circulation of blood/lesser circulation.

☞ Pulmonary Circulation

"The flow of blood from right ventricle to the left atrium via lungs is known as pulmonary circulation."

Description

- The deoxygenated (impure) blood from right ventricle is forced into pulmonary artery which divides into right and left pulmonary arteries carrying blood towards right and left lung, respectively.
- These arteries divide and redivide into network of capillaries surrounding the alveoli of lungs.
- The walls of capillary and alveoli form a double membrane called alveolar membrane. The oxygen from alveoli diffuses through these two membranes and passes into the blood in the capillaries and blood becomes oxygenated.
- Similarly, CO_2 from the blood in the capillaries diffuses into the alveoli of lungs and expelled out through the nose by expiration.
- The oxygenated blood from two lungs is collected by two pairs of pulmonary veins and pour their contents into the left atrium. In this way, pulmonary circulation is complete.



Importance of Pulmonary Circulation

(i) **Gaseous exchange:** It helps in exchange of gases within alveoli of lungs.

(ii) **Filtering function:** The fine pulmonary blood vessels act as a filter which traps the emboli that passes through pulmonary capillaries and prevents blocking of vessels in the brain and heart.

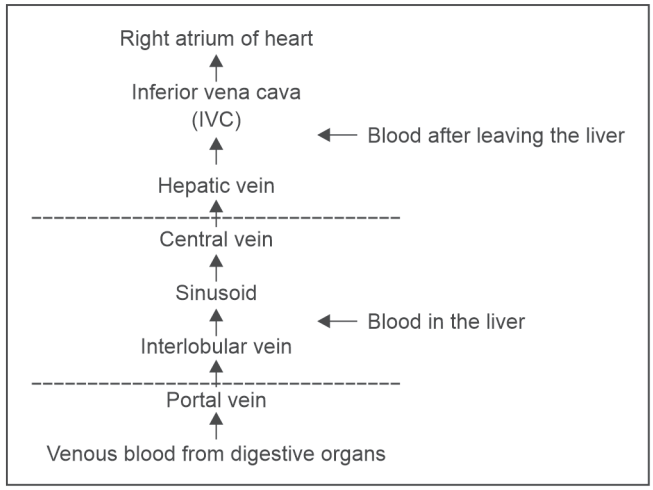
(iii) **Nutrition:** This circulation maintains nutrition of lung tissue.

(iv) **Reservoir for left ventricle:** The left ventricular output is fully dependent upon the return of blood from pulmonary veins into the left atrium. So, any alteration of pulmonary veins will alter the left ventricular function.

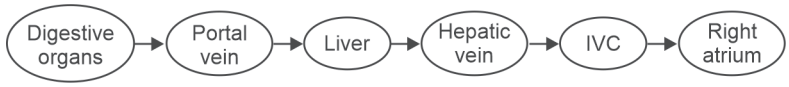
9 Describe hepatic portal circulation/portal circulation.

☞ Hepatic Portal Circulation

"The venous blood from various digestive organs is collected by portal vein carried to the liver first and then into right atrium via IVC. This is known as hepatic portal circulation."



Hepatic portal circulation



Description

- The venous blood from digestive organs such as small intestine, stomach, pancreas is collected by portal vein. Instead of pouring its contents into the IVC, it is poured into the liver. Hence, the high concentration of nutrient materials goes to the liver first.
- Then from the liver blood containing proportionate nutrients is carried by IVC into the right atrium of the heart.
- This course of blood through the liver is called portal circulation.

Importance of Hepatic Portal Circulation

Portal circulation is important because the blood containing nutrients from the digestive organs is taken via liver to heart. In the liver, these nutrients are modified and according to the need of the body, they are transported in the blood circulation and supplied to various parts of the body via heart.

Thus, portal circulation helps in regulating the nutrient material supply to various parts of the body.

10 Write a note on coronary blood circulation.

☞ **Coronary Circulation**

- Coronary circulation is the circulation of blood to heart muscle (myocardium).
- For nourishment of its own muscular walls, the heart has own circulation which consists of coronary arteries and veins.
- Coronary arteries supply oxygenated blood to the heart muscle and coronary veins drain away the blood once it has been deoxygenated.

(a) **Coronary arteries:**

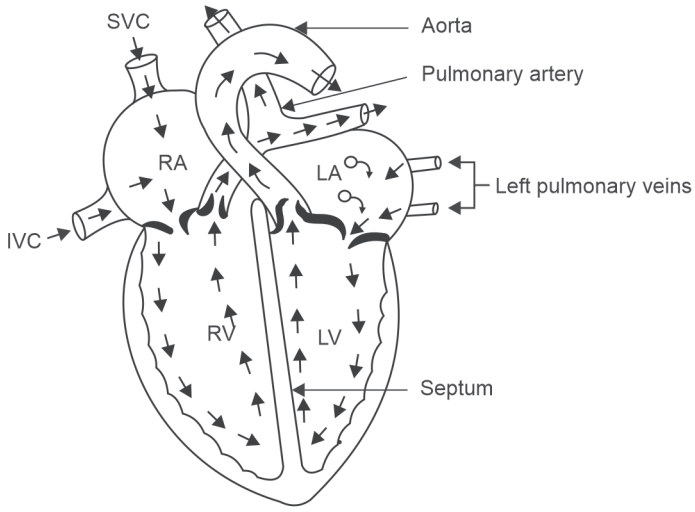
- The right and left coronary arteries are the branches from the ascending aorta and supply oxygenated blood to the myocardium.
- The left coronary artery passes inferier to left auricle and supplies the oxygenated blood to both the ventricles and left atrium.
- The right coronary artery supplies the oxygenated blood to the right atrium.

(b) **Coronary veins**

- After the blood passes through coronary arteries, it flows into capillaries where it delivers oxygen and nutrients and collects carbon dioxide and wastes, and then into coronary vein.
- The deoxygenated blood then drains into a large vascular sinus on the posterior surface of the heart, called coronary sinus, which empties into the right atrium.

In this way, the blood is supplied to heart muscles (myocardium) by coronary arteries. This is called coronary blood circulation.

11 Show diagrammatically the 'conducting system of heart' or blood flow through heart, or blood supply from right side to left side of the heart. (S.23)



Conducting system of heart

12 Explain the terms.

1. Stroke Volume (S.22,24)

"It is the amount of blood ejected from the heart by each contraction of the ventricles."

- Normal value: 70 ml

2. Cardiac Output (S.22,23,24)

"It is the amount of blood ejected from the heart in each minute by the contraction of ventricles."

$$\text{Cardiac output} = \text{Stroke volume} \times \text{Heart rate}$$
$$= 70 \times 72$$
$$= 5040 \text{ ml}$$

- Normal value of cardiac output = 5040 ml

3. SA Node (SAN)/Sinoatrial Node/Pacemaker

It is situated in the wall of right atrium. It originates the impulse of contraction and maintains rhythm, hence also called pacemaker.

- **Function**
  (i) It originates impulse of first contraction.
  (ii) It is responsible for contraction of both atria.

4. AV Node

Atrioventricular node is present at the base of septum. From the AV node, a band of muscle starts called bundle of His which divides

into many branches and forms a network of fibres in the walls of ventricles called Purkinje fibres.

- **Function:** It collects impulses from SA node passes throughout both ventricles via bundle of His and Purkinje fibres.

13 Define blood pressure. Explain factors affecting blood pressure. (S.22,24, W.23)

☞ Blood Pressure

"The lateral pressure exerted by blood on the walls of blood vessels while flowing through it, is called blood pressure."

- **Systolic BP:** The pressure exerted during systole (contraction of chamber), is called systolic blood pressure.
- **Diastolic BP:** The pressure exerted during diastole (relaxation of chamber), is called diastolic blood pressure.
- **Pulse pressure:** The difference between systolic and diastolic blood pressure is called pulse pressure.
- The blood pressure is measured by an instrument called "sphygmomanometer".
- The blood pressure is measured in terms of mm of Hg.
- Normal values of blood:
  - (i) In adult: 120/80 mm of Hg.
  - (ii) In childhood: 80 to 100/60 mm of Hg.
  - (iii) In young adults: Systolic BP—110 to 115 mm of Hg.
    Diastolic BP—60 to 70 mm of Hg.

Factors Affecting/Influencing BP

(i) **Age:** BP increases with age.

(ii) **Sex:** In females, both systolic and diastolic pressure are slightly lower than in males up to the ages of 45 to 50 years.

(iii) **Exercise:** During heavy exercise the blood pressure is higher.

(iv) **Sleep:** During sleep, the systolic BP falls by about 15 to 20 mm of Hg.

(v) **Emotional conditions:** Emotions cause increase of systolic BP, i.e. with emotional stress and more excitement conditions, blood pressure increases.

(vi) **After ingestion of meals:** After meals, there is a slight rise of systolic BP.

(vii) **Endocrine control:** Pituitary gland, thyroid gland and adrenal gland control the BP. Their hypersecretion causes increase in BP and hyposecretion causes decrease in BP.

(viii) **Posture of the body (position):** The diastolic pressure is higher in the standing position than the laydown position or sitting position.

14 How is blood pressure recorded/measured clinically? Give the procedure of measurement of BP. (W.22)

☞ BP is measured by an instrument known as sphygmomanometer.

Methods of Measurement of Blood Pressure

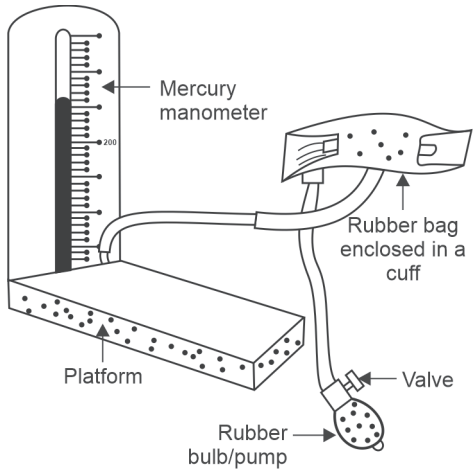
(i) Oscillatory method

(ii) Auscultatory method

(iii) Palpatory method

Auscultatory Method

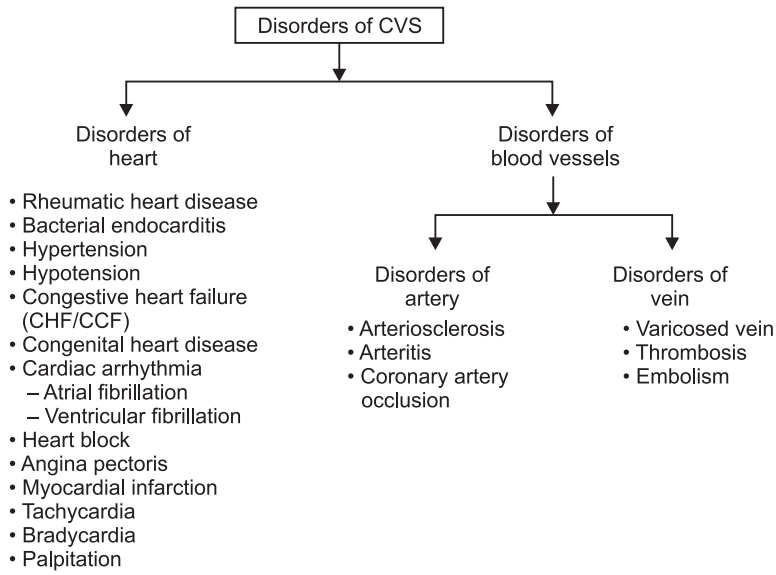
- For the measurement of BP, the patient must be at rest, both physically and mentally.
- The rubber bag is wrapped around the upper arm. With the help of pressure pump, the air is pushed into the rubber bag until the pressure of 200 mm of Hg is reached on the mercury manometer.
- This pressure obliterates the brachial arteries.
- The pulse disappears at the elbow joint.
- Stethoscope is kept at the elbow and heart sounds are observed.
- The air in the bag is slowly released. The stage at which first pulse is heard in which a soft puffing noise is heard at the elbow is noted on the manometer. This is known as systolic BP.
- The air from the rubber bag is further released and the stage at which heart sound stops is recorded on the manometer. This is known as diastolic blood pressure.
- In this way, blood pressure is measured clinically.



Measurement of BP

15 Mention different cardiovascular disorders.

☞



16 Explain the terms.

☞ (a) **Congestive heart failure (CHF/CCF):** In this condition, function of right ventricle is failed, due to which blood is congested in every part of the body. The congestion throughout the systemic circulation takes place. The affected organs are liver, spleen, and kidneys.

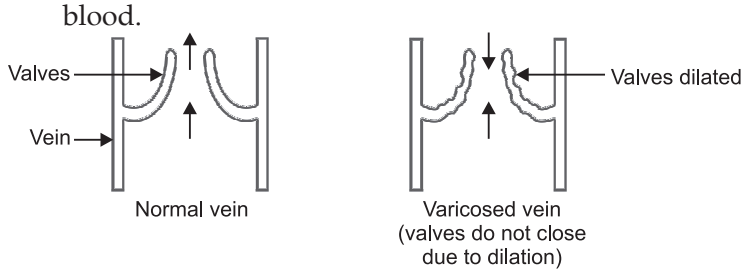
(b) **Angina pectoris:** It means pain in the chest due to an abnormal coronary blood circulation.

(c) **Congenital heart disease:** Heart disease may be congenital. Most of the defects are observed in the formation of septum dividing heart into right and left side. Congenital defects are the points of weakness against bacterial infection.

(d) **Myocardial infarction (loss of impulse in myocardium):** Heart is supplied the blood by coronary arteries. When the vessels of coronary arteries get thickened due to deposition of fat inside it, the narrowing of artery or thrombus present in it causes lower blood towards the walls of the heart is called coronary thrombosis. Because of this, the cells present in the walls are dead (yellowish mass of dead cells) and the heart stops working which is called myocardial infarction.

(e) **Arteriosclerosis:** This is a disease of artery where there is a deposition of fatty material in the walls of artery. This leads to thickening of artery which decreases the internal diameter of artery. This causes resistance in blood circulation and thus increases BP. Cholesterol is one of the important constituents which is a causative factor for arteriosclerosis. In arteriosclerosis there may be a patch generation developed in the 'tunica media' of large and medium-sized arteries. This patch consists of accumulation of cholesterol compounds, excess of smooth muscles and fibroelastic cells. When these 'plaques' grow, they spread along the walls of artery forming swelling which may produce resistance in blood circulation. This condition is called arteriosclerosis.

(f) **Varicosed vein:** In this condition, the valves present in the veins are dilated so that they do not prevent back flow of blood.



(g) **Aneurysm:** Dilatation of the wall of an artery, forming a blood filled sac is called aneurysm of the artery. It occurs

most frequently in the descending aorta, and eventually may rupture, causing haemorrhage and death. Chest pain, laboured breathing are the main symptoms associated with aneurysm in the aorta in the thoracic region. A congenital defect in a cerebral artery known as berry aneurysm is the most common cause of subarachnoid haemorrhage.

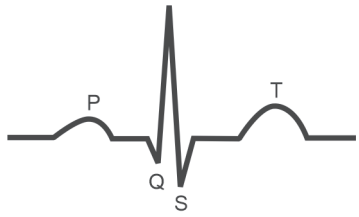
(h) **Stroke:** Stroke is an interruption of blood supply to the brain. The most common cause of stroke is occulsion of cerebral artery by thrombosis. Other causes include thromboembolism, blockage of an artery by a fragment of blood clot that has broken from its site of origin and haemorrhage due to rupture of an artery.

(i) **Stenosis:** An abnormal narrowing of blood vessel.

(j) **Septal defects:** This defect is due to small holes within the septum between the atria or ventricles. Small openings usually cause a little difficulty. Large openings can result in death shortly after birth.

17 Write a note on ECG (electrocardiogram). (W.23)

☞ **ECG:** When muscle contracts, there is a change in electrical potential across the membrane of cardiac muscle fibres. As the body fluids and tissues are good conductors of electrical charges, during contraction of myocardium can be detected by attaching the electrode to the surface of the body. The pattern of electrical activity may be printed on the paper. This tracing is known as electrocardiogram (ECG).



Normal pattern of ECG

- **Interpretation of human ECG shows following waves 'P', 'Q', 'R', 'S', 'T':** 'P' is of atrial origin, hence called 'atrial complex' while Q, R, S, T are of ventricular origin, hence collectively known as 'ventricular complex'.

  (1) **'P':** It is the first upward deflection. It is small but constant wave having rounded or pointed top. This

wave is caused by impulse of contraction within the atria. The normal 'P' indicates:

(a) The impulse is originating at the SA node.

(b) The impulse spreads over atria in usual direction.

(2) **'Q', 'R', 'S', 'T':** These four waves are caused by ventricular activity and are collectively called ventricular complex. These waves indicate spread of impulse of contraction through conductive tissue of ventricular muscle.

(i) 'Q': As soon as the impulse arises at the muscular part of the septum, the latter contracts producing first wave 'Q'. Hence, 'Q' is caused by activity of septum.

(ii) 'R': 'R' is the most constant wave having tallest amplitude. 'R' is mainly caused by activity of right ventricle.

(iii) 'S': It is caused by activity of left ventricle.

(iv) 'T': 'R' is followed by long period after which comes the last upward deflection called 'T'. 'T' is caused by action current due to contraction of basal part of ventricles.

- **Importance of ECG**

1. ECG has diagnostic value. The changes in ECG are observed in the cases of disorders of heart and blood vessels.
2. ECG gives accurate information of the conditions of atrium and ventricle almost in all of its functional areas.
3. In cardiac abnormalities characteristic variations occurred in ECG are helpful in identifying various disorders of heart.
4. Cardiac arrhythmia, ventricular premature beats, ventricular fibrillations are disorders of heart recorded by ECG.

18 Write in brief about "heart sounds". (S.24)

☞ Heart sounds are produced due to contractions and relaxations of the heart muscles and opening and closing of the valves of heart.

When ear or the diaphragm of a stethoscope is placed on the chest wall a little below the left nipple and slightly nearer the midline, the heartbeat/heart sound can be heard.

Two sounds separated by a short pause can be clearly distinguished. They are described in words as 'lup', 'dup'.

- The first sound 'lup', is fairly loud, low-pitched and prolonged and is due to the closure of the atrioventricular valves. This corresponds to ventricular systole.
- The second sound 'dup' is shorter, sharper and high-pitched than the first sound. It is caused due to the closure of the aortic and pulmonary valves. This corresponds with atrial systole.
- The first heart sound is followed by the second sound, after a short pause.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. Cardiac muscles are exclusively found in **myocardium** of the heart.
2. The cardiac cycle time is **0.8 seconds**.
3. **Systole** means contraction of chamber of heart.
4. Least blood pressure is present in **vena cava**.
5. **SA node** is an origin of impulse of contraction in the heart.
6. **Thrombus** is a blood clot inside a blood vessel.
7. Pacemaker of the heart is **SA node**.
8. Bicuspid valve is also called **mitral valve**.
9. Normal diastolic pressure in young man about **80 mmHg**.
10. The blood pressure is high in **arteries**.
11. **Pulmonary blood** circulation helps in purification of blood.
12. The normal value of stroke volume is **70 ml**.
13. ECG records **potential differences**.
14. **Hepatic portal** blood circulation helps in regulating the nutrient material supply to various parts of the body.
15. **Coronary blood circulation** supplies blood to heart muscle (myocardium).
16. The amount of blood ejected from the heart is called **stroke volume**.
17. **Left atrium** of the heart receives oxygenated blood.
18. The normal value of cardiac output is **5040 ml**.

19. **Stroke** is an interruption of blood supply to the brain.
20. SA node is situated in **right atrium**.
21. **120/80 mmHg** is the normal blood pressure range value for an adult healthy individual.
22. **Spleen** can be called a kind of "Blood Bank".
23. The amount of blood ejected from heart in each minute by the contraction of ventricles is called **cardiac output**.
24. The approximate weight of human heart is **250–300 gm**.
25. **Atherosclerosis** is a deposition of fat in the walls of artery.
26. **AV node** is present at the base of the septum.
27. The rate of heart beat is controlled by **autonomic nervous system**.
28. Pains in the chest mean **angina pectoris** condition.
29. Blood return from lungs to heart through **left auricle**.
30. The blood pressure is measured by an instrument called **sphygmomanometer**.

Chapter
8

The Respiratory System

1 Define respiration. Explain types of respiration.

☞ **Respiration**

The exchange of gases (O_2 and CO_2) occurring between atmosphere and body cells, is known as respiration.

Types of Respiration

(a) External Respiration

"The exchange of gases occurring between atmosphere and blood taking place in the lungs, is known as external respiration."

(b) Internal Respiration (Tissue Respiration)

"The exchange of gases occurring between blood and body cells is known as internal/tissue respiration."

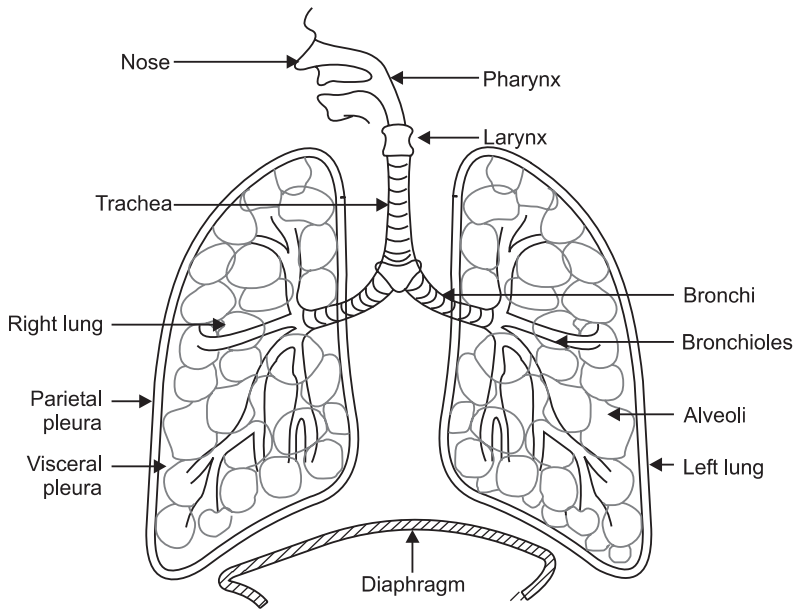
2 Name the organs/parts of respiratory system.

☞ ***Organs of Respiratory System***

1. Nose
2. Pharynx
3. Larynx
4. Trachea
5. Bronchi
6. Bronchioles
7. Alveoli
8. Lungs
9. Pleural layers (coverings)
   - Parietal pleura
   - Visceral pleura
10. The main respiratory muscles
    (a) Intercostal muscles
    (b) Diaphragm.

3 Sketch and label a diagram of respiratory system. (S.23)

☞



The respiratory system

4 Describe in brief various parts of respiratory system.

☞ **1. Nose**

It is the first part of respiratory system through which air enters into the body. The nose is also an organ of sense of smell. The nose is lined with very vascular ciliated columnar epithelium.

Functions

(i) Filtration of air.
(ii) Warming of air.
(iii) Moistening of air.

2. Pharynx

The pharynx is a part of both respiratory and digestive system. Anatomically, pharynx is divided into 3 parts:

(a) **Nasopharynx:** It is a part of pharynx present nearest to nasal cavity.
(b) **Oropharynx:** It is a part of pharynx present behind the oral cavity.

(c) **Laryngopharynx:** It is a part of pharynx present nearest to larynx region.

Functions

(i) It helps in warming and moistening air.
(ii) It helps in filtration of incoming air.
(iii) Pharyngeal tonsils (adenoids) prevent the pathogens from entering the body.
(iv) Pharynx has respiratory as well as digestive function.

3. Larynx

- The larynx is called 'voice box' or 'sound box'.
- Larynx consists of arrangement of vocal cords.
- Vocal cords are responsible for production of sound.
- The larynx is supported by approximately 9 pieces of cartilages which are as follows:
  (i) Thyroid cartilage—1
  (ii) Arytenoid cartilages—2
  (iii) Cricoid cartilage—1
  (iv) Cuneiform and corniculate—2 each (04)
  (v) Epiglottis—1

Functions of Larynx

(i) The larynx acts as a passage between pharynx and trachea.
(ii) The air is further warmed, moistened and filtered in the larynx.
(iii) The vocal cord arrangement in the larynx helps in the production of sound.
(iv) The cartilages of larynx help in the process of swallowing by its upward and downward movements.

4. Trachea

- The trachea is a windpipe and is continuous with larynx.
- The trachea is made up of 16 to 20 C-shaped rings of hyaline cartilages.
- These cartilages are connected by fibrous tissue having opening at the back side.

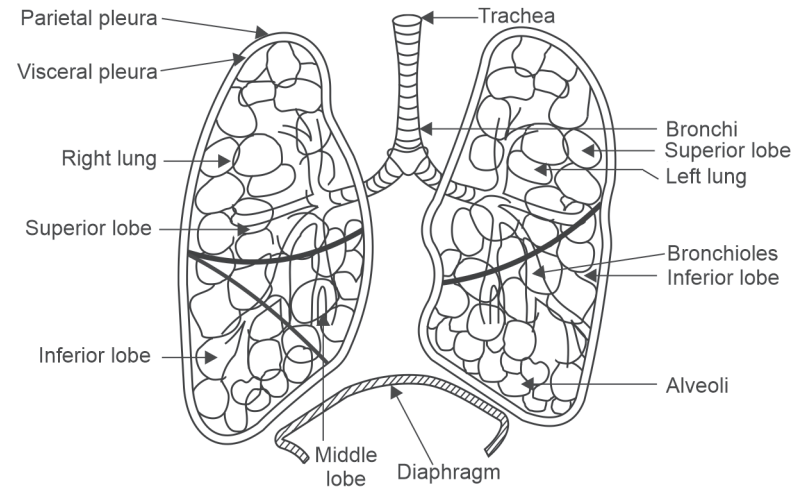
Functions

(i) It provides large passage for respiration.
(ii) The C-shaped cartilages of trachea keep it permanently open for the passage of air.

(iii) The cells of trachea secrete the mucus which is also helpful for removing the dust particles or bacteria and also helps for moistening of incoming air.

5 Describe the structure of lungs.

☞



Lungs

- Lungs are two in number and are the principal organs of respiration.
- The lungs are cone-shaped with apex above.
- The base of the lung is resting on the floor of the thoracic cavity, i.e. diaphragm.
- The right lung has three lobes and left lung has two lobes.
- Each lobe is composed of a number of lobules and contains small bronchioles.
- The lung tissue is elastic, porous and spongy in nature.
- The lung tissue is richly supplied with blood vessels.
- Each lung is surrounded by double serous membrane called pleura.
- Pleuras are composed of two layers:
  (i) Parietal pleura (outer)
  (ii) Visceral pleura (inner).
- In between these pleural layers, there is a serous fluid which lubricates the surface and prevents the friction between the lungs and chest wall during respiratory movements.

Functions of Lungs

The lungs are main organs of respiration in which exchange of gases takes place.

6 Explain mechanism/process of respiration (breathing). OR Describe regulation of respiration. (S.22)

☞ **Mechanism of Respiration**

- Expansion and contraction of lungs show that a regular exchange of gases takes place between alveoli and external air.
- This depends upon the arrangement of pleura, relaxation of intercostal muscles and diaphragm.
- There are approximately 15 cycles of respiration occurring per minute in an adult during normal respiration.

The process of respiration involves three stages:

(a) **Inspiration:** In this stage pressure within the lung is lesser than the atmospheric pressure. The diaphragm is relaxed. Intercostal muscles are also relaxed. Due to this the air is forced into the lungs through respiratory passage and size of thoracic cavity gradually increases due to entry of air in the lungs.

This is known as inspiration.

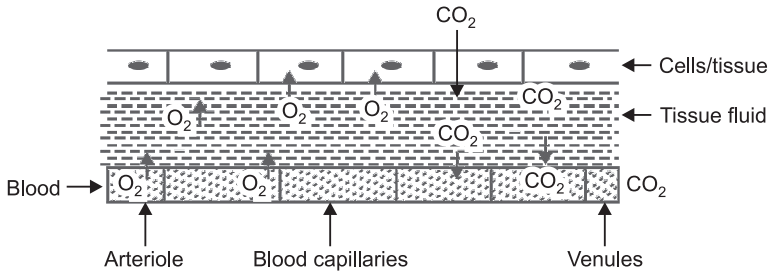
(b) **Expiration:** In this stage, the pressure within the lung is greater than atmospheric pressure. In this stage, diaphragm is pulled upward, exerting a pressure on both lungs. At the same time intercostal muscles get contracted and thus air is forced outside the lung and thus expiration takes place.

(c) **Pause:** After expiration there is a little gap called pause and again second cycle of respiration takes place.

7 Define tissue respiration. Explain physiology of tissue respiration/internal respiration.

☞ • **Tissue respiration:** The exchange of gases takes place in between cells or tissues of the body and blood which is known as tissue respiration.

- **Physiology of tissue respiration/internal respiration**



- The oxygenated blood is supplied to all the tissues of the body by arteries which further divide into arterioles.
- The exchange of gases takes place between arterial end of the capillary and tissue fluid.
- Since the concentration of CO_2 is maximum in arterial blood, oxygen diffuses into the tissue fluid and then it is supplied to the tissues and cells of the body.
- On the other hand, concentration of CO_2 is maximum in tissue fluid, thus CO_2 diffuses inside the blood capillaries and blood becomes deoxygenated which is carried by venules into the veins.
- In this way, exchange of gases takes place between tissues and blood.
- The oxygen and CO_2 are carried in the blood in the form of oxyhaemoglobin and carboxyhaemoglobin.

$$Hb + O_2 \longrightarrow HbO_2 \text{ (Oxyhaemoglobin)}$$
$$Hb + CO_2 \longrightarrow HbCO_2 \text{ (Carboxyhaemoglobin)}$$

8 Define and give normal values of respiratory volumes/ respiratory parameters.

☞ 1. Vital Capacity (S.24, W.22,23)

"The volume of air that can be made to pass into and out of the lungs by most forceful inspiration and expiration, is known as vital capacity."

- Normal value: 3 to 5 litres.

2. Tidal Volume (S.23,24, W.22,23)

"The amount of air which is inspired and expired in an ordinary quite breathing is known as tidal volume."

- Normal value: 500 ml.

3. Inspiratory Reserve Volume

"The amount of air that can be breathed inside and above the tidal volume by deepest possible inspiration, is known as inspiratory reserve volume."

- Normal value: 1800 to 2000 ml.

4. Expiratory Reserve Volume

"The amount of air that can be breathed out after forceful expiration above the tidal volume, is known as expiratory reserve volume."

- Normal value: 1400 ml.

5. Residual Volume (S.24, W.23)

"The amount of air remaining in the lungs after the most powerful expiration, is known as residual volume."

- Normal value: 1200 to 1500 ml.

6. Total Lung Capacity (W.22)

"It is the sum of vital capacity and residual volume."

Total lung capacity = Vital capacity + Residual volume

$$TLC = V_c + R_v$$

9 Explain the terms.

☞ 1. **Cheyne-Stokes breathing:** In this type of breathing there is an alternate increase and decrease in rate and depth of respiration followed by intermittent apnoea (difficulty in breathing).

It is present in coma condition, poisoning, shock condition, head injury and other terminal stages of life.

2. **Bronchial asthma:** Asthma is a chronic disease in which the patient has difficulty in breathing.

Bronchial asthma is a clinical syndrome characterised by breathlessness and cough due to airway resistance in the narrowed bronchi. The narrowing of bronchi is due to bronchospasm edema of bronchial mucosa and thick sticky mucus in the branchial lumen. The patient with bronchial asthma has hyper-reactivity of bronchi which constricts due to allergens, physical and chemical irritants, infection, psychological and hereditary factors.

3. **Anoxia:** It means lack of proper pulmonary ventilation due to non-availability of O_2.

4. **Hypoxia:** A condition in which the tissue is not supplied with enough O_2.
5. **Dyspnoea:** Poor pulmonary ventilation, i.e. deficiency of O_2 to lungs and tissues.
6. **Apnoea:** It means difficulty in breathing.
7. **Hypoxaemia:** Decrease in arterial O_2 tension.
8. **Hypocapnia:** Decrease in arterial CO_2 tension.
9. **Hypercapnia:** Increase in arterial CO_2 tension.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

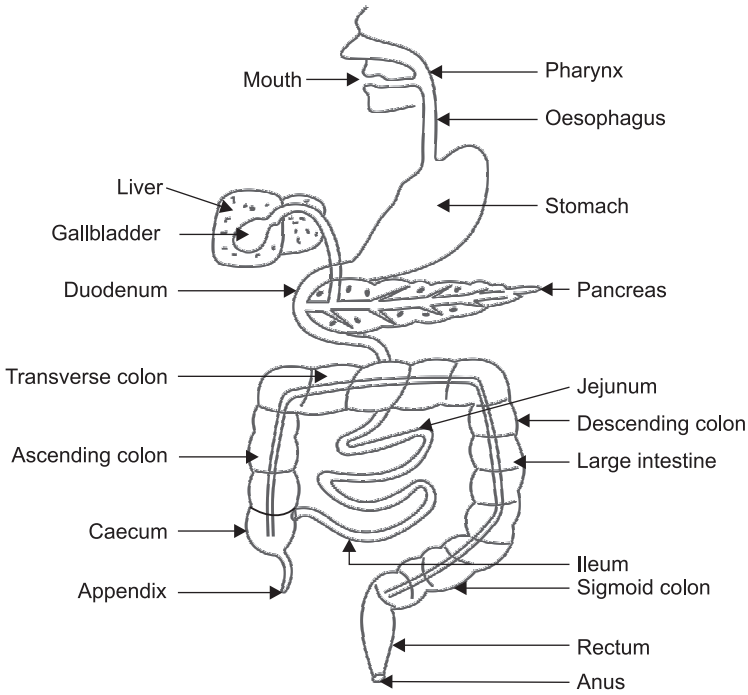
1. The gaseous exchange takes place in the **alveoli** of lungs.
2. Exchange of gases between the blood and the cells is called **internal respiration**.
3. **Larynx** part of the respiratory system is known as voice box/ sound box.
4. **Pharynx** is the common passage of both the respiratory and digestive system.
5. **Mediastinum** is located between two pleural sacs and is the central compartment of the thoracic cavity.
6. **Trachea** is a windpipe which is continuos with the larynx.
7. The trachea is made up of 16–20 C-shaped rings of **hyaline cartilage**.
8. The normal value of vital capacity is **3 to 5 litres**.
9. The total number of alveoli present in the human lungs is around **500 million**.
10. The exchange of gases between the external environment and the lungs is called **external respiration**.
11. The amount of air remaining in the lungs after the most powerful expiration is known as **residual volume**.
12. Anoxia means the condition of **difficulty in breathing**.
13. The maximum volume of air contained in the lung by a full forced inhalation is called **total lung capacity**.
14. The covering of the lung is called **pleura**.
15. The left and right bronchi are subdivisions of the **trachea**.
16. The normal value of tidal volume in human is **500 ml**.
17. The greatest quantity of air that can be expired after a maximum inspiration is its **vital capacity**.
18. Rate of breathing/respiratory rate in an adult human is **14–18/min**.
19. During expiration diaphragm becomes **dome-shaped**.
20. During normal breathing, the amount of air that moves into the lungs and comes out is called **tidal volume**.

Chapter
9

The Digestive System

1 **Sketch and label a diagram of digestive system/alimentary canal.**

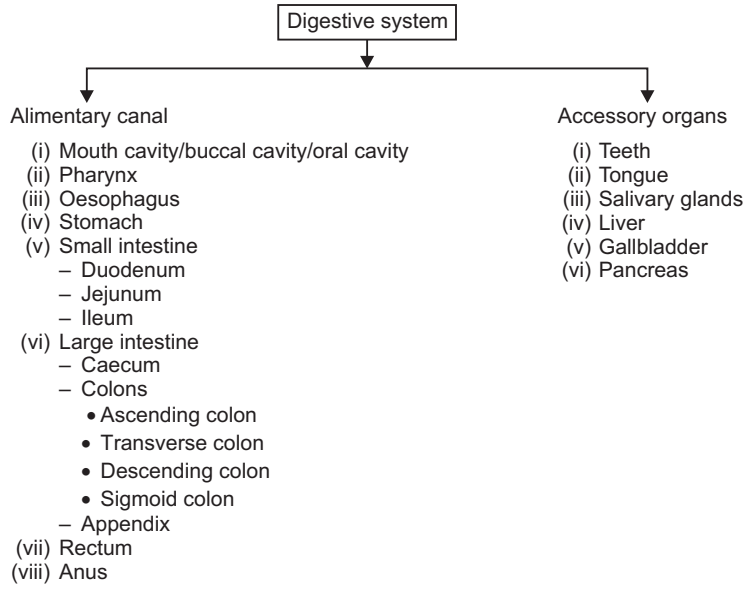
☞



Digestive system/alimentary canal

2 **Enlist different organs/parts of the digestive system/ alimentary canal.** **(S.22)**

☞



3 Explain main activities/functions of digestive system/ alimentary canal.

☞ The main activities of alimentary canal are:

(i) **Ingestion:** The process of taking the food into the alimentary canal (i.e. in mouth) is called ingestion.

(ii) **Mastication:** The process in which there is a movement of jaws, teeth, cheeks, lips and tongue during which the food is cut, ground into smaller particles and mixed with saliva to form a soft mass (bolus) which is then swallowed, is called mastication.

(iii) **Deglutition:** The process of swallowing the food is called deglutition. Deglutition is the main function of oesophagus.

(iv) **Digestion:** Digestion is the process of conversion of complex food material into simpler form so that it is readily absorbed through the walls of alimentary canal into blood circulation.

(v) **Absorption:** The process by which digested food substances pass through the walls of some organs of alimentary canal into the blood and lymph capillary for circulation around the body. This is known as absorption.

(vi) **Excretion/defaecation/elimination:** It is the process by which the waste materials which are not digested are removed from the body.

4 Write a note on salivary glands.

☞ There are three pairs of salivary glands present in the mouth cavity and they help in the secretion of saliva.

Salivary glands are as follows:

(i) **Parotid glands:** These are present one on each side below and slightly in front of the ear.

(ii) **Submandibular glands:** They are present in the region of the mandible bone.

(iii) **Sublingual glands:** These are located beneath the tongue on each side.

Function of Salivary Glands

The function of salivary glands is secretion of saliva which is stimulated by the sight, smell and presence of food in the mouth.

5 What is saliva? Give the composition and functions of saliva. (S.24, W.23)

☞ **Saliva**

"Saliva is a mixed secretion of the three pairs of salivary glands (parotid, submandibular, sublingual glands) which gives moistening to the mouth also cleans the teeth, tongue and helps in the process of mastication."

Composition of Saliva

(i) Water: 10%
(ii) Ptyalin: Salivary enzyme
(iii) Mucin: Thick lubricant
(iv) Calcium salts: In small amounts.

Functions of Saliva

(i) Saliva constantly keeps the mouth cavity clean and moist.
(ii) Saliva moistens and lubricates the food material so that it forms a soft mass (bolus) which is suitable for swallowing.
(iii) Ptyalin which is salivary enzyme, converts cooked starches into maltose.
(iv) Saliva acts as a solvent in which the substances get dissolved and stimulate taste buds.
(v) Saliva has cleansing action and helps to keep the mouth, teeth and tongue free from debris.
(vi) Saliva helps in excretion of heavy metals, urea and certain other substances.
(vii) The dry food material stimulates the sense of taste only after mixing with saliva.

6 Explain the structure of stomach in brief. Mention the functions of stomach.

☞ Stomach is a J-shaped portion of alimentary canal situated between oesophagus and beginning of small intestine. Stomach has three parts—'fundus', 'body' and 'pyloric antrum'. The muscular layer present in the stomach allows for the peristaltic movements. The gastric glands are present in the mucous membrane of stomach which secrete gastric juice containing various digestive enzymes.

Functions of Stomach

(i) It acts as a storage of food material.
(ii) The water present in stomach further liquifies food material which is swallowed.
(iii) It helps in mixing of food.
(iv) The gastric glands present in stomach secrete gastric juice which helps in chemical digestion.
(v) Stomach helps in absorption of water, glucose and certain drugs.

7 What is gastric juice? Give its composition and functions. (S.22,23)

☞ **Gastric Juice**

Gastric juice is secreted by special secretory glands (gastric glands) in the gastric mucosa (stomach).

Composition of Gastric Juice

(i) Water
(ii) Minerals
(iii) Mucus
(iv) Dilute HCl
(v) Intrinsic factor
(vi) Enzymes—pepsinogen (pepsin), renin.

Functions of Gastric Juice

1. Water present in gastric juice further liquifies the food material in the stomach.
2. Dilute HCl:
   (i) It acidifies the food and stops the action of ptyalin.
   (ii) It kills many microbes.
   (iii) It provides acid environment needed for effective digestion by pepsin.

3. The enzyme pepsin converts proteins into peptones.
4. Intrinsic factor present in gastric juice is necessary for absorption of vitamin B_{12}.
5. The mucus prevents mechanical injury to the walls of stomach by lubricating the contents of stomach.
6. The mucus prevents chemical injury by acting as a barrier between stomach wall and other chemical constituents.

8 Explain anatomy and physiology of small intestine.

☞ Small Intestine

It is present in between stomach and large intestine. It is about 5 meters in length and is divided into three parts.

(a) Duodenum (25 cm)
(b) Jejunum (2 m)
(c) Ileum (3 m)

- The inner surface of small intestine is greatly increased by circular folds and by finger-like projections called villi. Blood vessels and lymph vessels are present in the villi. A large number of tubular glands are present in the intestine, called intestinal glands and they secrete intestinal juice.

Composition of Intestinal Juice

(i) Water
(ii) Mineral salts
(iii) Enterokinase, amylase, lipase, peptidase, sucrase maltase, lactase enzymes.

Functions of Small Intestine

1. The peristaltic movements help to forward the food material.
2. It secretes intestinal juice containing enzymes which are necessary for chemical digestion of food.
3. It helps in absorption and digestion of food.
4. The complete digestion and absorption of carbohydrates, proteins and fats take place in the small intestine.
5. It gives protection against infection by microbes that have survived antimicrobial action of HCl in the stomach.

9 Describe the anatomy/structure of large intestine. Mention the functions of large intestine.

☞ Anatomy of Large Intestine

- It measures about 1.5 m in length. The ileum part of small intestine joins with large intestine in caecum. The

small outward projection present at the base of caecum is called appendix.

- The large intestine has mainly four colons.
  (i) Ascending colon
  (ii) Transverse colon
  (iii) Descending colon
  (iv) Sigmoid colon.
- Structurally, it resembles small intestine but diameter is large and length is short.
- The large intestine has three main walls.
  (a) **Inner mucosa:** The villi are present in the inner surface of the mucosa and goblet cells are present in this layer which secrete mucus.
  (b) **Submucosa:** It is the middle layer which contains lymph nodules.
  (c) **Muscular coat:** It consists of a layer of circular muscles inside and longitudinal muscles outside.

Functions of Large Intestine

1. It helps in absorption of remaining glucose, amino acids, vitamins and certain drugs.
2. It gives consistency to the contents of large intestine by absorption of water from the contents and the stools become semisolid in nature.
3. The mucus secreted by goblet cells of large intestine prevents mechanical irritation and acts as a lubricant.
4. The appendix (a collection of lymphoid tissue) prevents the infection.
5. The microflora of large intestine synthesize vitamin K, folic acid and vitamin B_{12}.
6. The heavy metals are excreted from the blood into the large intestine.

10 Write a note on pancreas. (S.24)

☞ **Pancreas**

It is an accessary gland which empties its contents into duodenum. Pancreas is a pale grey gland consisting of broad head, body and narrow tail.

The pancreas consists of a large number of 'lobules'. Each lobule is drained by a small duct and they unite to form a large pancreatic duct. The pancreatic gland secretes pancreatic juice.

Composition of Pancreatic Juice

(i) Water
(ii) Mineral salts
(iii) Trypsinogen (trypsin)
(iv) Chymotrypsin (chymotrypsinogen)
(v) Amylase
(vi) Lipase

Functions of Pancreas

A. Exocrine Functions of Pancreas

Pancreatic juice is an exocrine secretion which performs the following important functions.

(i) Trypsin and chymotrypsin help in digestion of proteins by converting peptones into polypeptides.
(ii) Amylase helps in digestion of carbohydrates which converts polysaccharides into disaccharides.
(iii) The lipase enzyme helps in digestion of fats by converting fats into fatty acids and glycerol.

B. Endocrine Functions of Pancreas

The islets of Langerhans cells in the pancreas secrete two important hormones, namely glucagon (by α-cells) and insulin (β-cells) which perform the following functions.

(i) Insulin reduces blood sugar level.
(ii) Glucagon converts liver glycogen into glucose.

11 Write in brief about gallbladder. (W.22)

☞ Gallbladder is a pear-shaped sac attached under the surface of right lobe of liver. It has three main parts, namely neck, body and fundus.

Functions of Gallbladder

(i) It helps to collect the bile from liver.
(ii) It acts as a temporary storage of bile.
(iii) It helps to concentrate the bile.
(iv) It helps in passage of bile towards the duodenum by contraction of its muscular coat.

12 Define bile. Give the composition and functions of bile.

☞ **Bile**

Bile is an external secretion of liver which is produced in dilute form and is then concentrated by gallbladder.

Composition of Bile

(i) Water: 90%
(ii) Bile salts:
  (a) Sodium glycocholate
  (b) Sodium taurocholate
(iii) Bile pigments:
  (a) Bilirubin
  (b) Biliverdin
(iv) Cholesterol
(v) Mucus.

Functions of Bile

(i) Bile salts are responsible for digestion and absorption of fats.
(ii) Bile salts help in absorption of lipid-soluble vitamins (fat-soluble).
(iii) Bile salts help in emulsification of fats by reducing surface tension.
(iv) Certain substances are excreted through the bile, e.g. toxins, bacteria, some metals like zinc, copper.
(v) Bile helps to maintain the pH of duodenal contents.
(vi) The mucus of bile acts as a buffer and also has lubricating action.
(vii) Bile secretion colourises and deodorises the faeces.

13 Mention the functions of liver. (S.22,24, W.22,23)

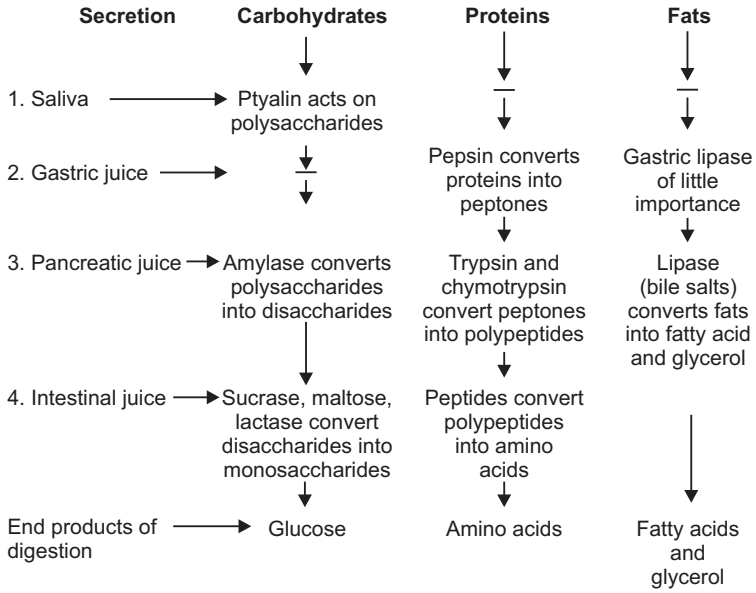
☞ **Functions of Liver**

(i) The hepatic cells of liver secrete the bile which is necessary for digestion and absorption of fats.
(ii) Liver acts as a storage of glycogen.
(iii) Liver helps in the formation of urea which is then carried to the kidney and thrown out in the form of urine.
(iv) Liver helps in metabolism of fats.
(v) Liver helps in production of heat which helps in maintaining body temperature.
(vi) Liver performs detoxication function.
(vii) Liver helps in storage of iron in the form of protein compound called ferritin.
(viii) Liver helps in storage of vitamins A, D, E, K and B_{12}.

(ix) Functions of liver related to blood:
  (a) Formation of RBCs in foetal life.
  (b) Destruction of RBCs and formation of bile pigments.
  (c) Formation of plasma proteins such as albumin, globulin, prothrombin, fibrinogen.
  (d) Formation of heparin which is a natural anticoagulant present in the blood.

14 Explain digestion of carbohydrates, proteins and fats. (S.23)

☞



15 Define the terms 'metabolism' and 'basal metabolic rate' (BMR).

☞ **Metabolism**

The chemical changes occurring during oxidation of nutrient food materials and releasing energy for various activities of the body is called metabolism.

BMR (Basal Metabolic Rate)

"It is the minimum energy required by the body per day, when an individual is at the rest and has eaten no food for 12 hours."

- The unit of measurement of BMR is kilojoules/m^2/hr

- Normal values of BMR:
  (a) Men: 170 kJ/m^2/hr
  (b) Women: 150 kJ/m^2/hr

16 Explain various disorders of digestive system.

☞ (a) Peptic Ulcer

It means ulceration of gastrointestinal mucosa caused by acidic gastric juice. There are two types of ulcers.

(i) Stomach ulcers
(ii) Duodenal ulcers.

(b) Appendicitis

It means swelling or inflammation of appendix.

(c) Achlorhydria

It means absence or less secretion of dilute HCl in the gastric juice of stomach.

(d) Jaundice

When bile appears in the urine, the condition is called jaundice.

The yellow colouration of the skin and conjunctiva is the primary symptom of jaundice.

There are three types of jaundice.

(i) Haemolytic jaundice
(ii) Obstructive jaundice
(iii) Toxic jaundice.

(e) Diarrhoea

- It is a condition characterised by an abnormally frequent discharge of watery stools from the bowel.
- The primary cause of diarrhoea is high intestinal motility.
- Other causes of diarrhoea are:
  (i) Infection
  (ii) Allergy
  (iii) Dietic toxemia.

(f) Dysentery

This disease is marked by evacuation of a frequent watery stools often with blood and mucus.

(g) Constipation

Constipation is a condition in which defaecation is delayed and hard stools are formed due to reabsorption of large amount of water from intestinal contents.

(h) Cirrhosis of Liver

It is a disease related to liver in which hepatic cells are damaged. It may be due to excessive alcohol consumption as well as some secondary infections.

(i) Tonsilitis

It is inflammation of tonsils (adenoids) lymphoid tissue present in the pharynx.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. **Digestion** is the process of conversion of complex food substances into simple absorbable form.
2. The muscular tube that extends from the mouth to the anus is called the **alimentary canal**.
3. Deglutition is the main function of **oesophagus**.
4. **Liver** is the largest gland in the human body.
5. **Ptyalin** is a salivary enzyme.
6. Stomach is a **J-shaped** portion of the alimentary canal.
7. **Pyloric portion** of the stomach opens into small intestine.
8. The hard chewing surface of the teeth is called **Enamel**.
9. The length of small intestine is about **5 meters**.
10. **Pancrease** is called both exocrine and endocrine gland.
11. **Appendix** is a finger-like projection that protrudes from the lower right end of the large intestine.
12. Trypsin and chymotrypsin are the enzymes found in **pancreatic juice**.
13. The number of salivary glands in man is **three pairs**.
14. The name of an enzyme produced by the salivary gland is **ptyalin**.
15. Saliva converts **starch into maltose**.
16. Alpha cells of islets of Langerhans secrete **glucagon**.

17. Beta cells of islets of Langerhans secrete **insulin**.
18. Bilirubin and biliverdin are **bile pigments**.
19. Gall bladder is stimulated by **cholecystokinin**.
20. The **trypsin** enzyme is secreted by pancrease.
21. Bile is secretion of **liver**.
22. In pancreas, pancreatic juice and hormones are secreted by **different cells**.
23. **Amino acid** is the end product of digestion of protein.
24. pH of the pancreatic juice is about **8.4**.
25. BMR means **basal metabolic rate**.
26. **Bile** helps in emulsification of fats.
27. Absence of dil. HCl in gastric juice is called **achlorhydria**.
28. The pH of amylase p resent in saliva is **6.8.**
29. Saliva is secreted from **submaxillary and sublingual glands**.
30. Tonsils are also named **adenoids**.

Chapter
10

The Skeletal Muscles

1 Define muscle. Classify/give types of muscular tissue.

☞ **Muscle**

Muscle is a powerful tissue which contains numerous fibres which are responsible for all movements of the body.

Classification of Muscles

1. Voluntary muscles/skeletal muscles/striated muscles, e.g. found attached to skeleton.
2. Involuntary muscles/unstriated muscles/smooth muscles, e.g. muscles of stomach and intestine.
3. Cardiac muscles, e.g. found in myocardium of heart.

2 Functions of muscles/muscular tissue.

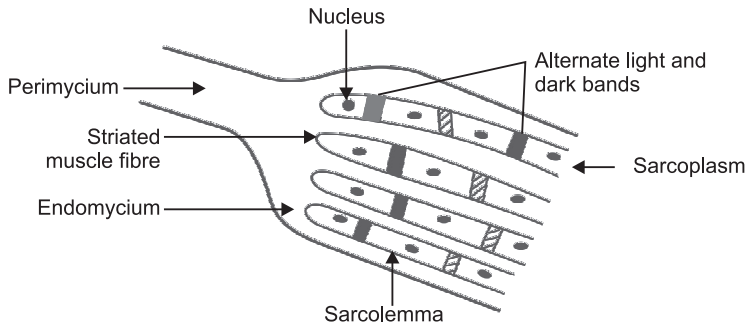
☞
1. Muscles play an important role in locomotion of the body.
2. Muscles make changes in posture (position) of the body, e.g. standing, lying down, sitting.
3. Muscle performs the function of production of heat.
4. Muscle helps to maintain fluid balance.
5. Muscle forms walls or body cavities and supports the organs within the cavities.
6. Muscles give shape to the body.
7. Muscles provide protection to underlying tissues of the body.
8. Muscles maintain circulation of blood by forceful contraction of heart, e.g. cardiac muscles.
9. Muscles help in respiration and maintain acid–base balance of the body, e.g. intercostal muscles and diaphragm.
10. The muscles are the agents of brain by means of which we attend (show) the expression and feeling.

3 Define skeletal muscle. Explain the structure and give functions of skeletal muscles.

☞ **Skeletal Muscle**

The voluntary muscles which are attached to the skeleton are called skeletal muscles.

- They are also called striated or stripped muscles. They work under the control of will power and hence called voluntary muscles. The muscle fibres lie in the skeleton, hence called skeletal muscles.
- Skeletal muscle fibres are roughly cylindrical shaped.
- There are small bundles of fibres enclosed in the perimycium.
- Each fibre attached to the fibrous tissue is called endomycium.
- Sarcolemma is a fine sheath surrounding each fibre.
- Each fibre shows a nucleus and sarcoplasm. They lie parallel to each other and show transverse light and dark bands alternately.



Functions of Skeletal Muscle

(i) To contract and provide the movement to the body according to stimulus.
(ii) It helps in thermogenesis.
(iii) It gives shape to the body.
(iv) It maintains fluid balance in the body.

4 Explain various properties/characteristics of skeletal muscle.

☞ **Properties of Skeletal Muscle**

1. **Muscle tone:** Muscle is never in completely relaxed condition/in resting position but it is always in the state of partial contraction. This is known as muscle tone.

- Muscle tone in the skeletal muscle is responsible for maintaining posture of the body.

2. **Muscle fatigue:** If a muscle is stimulated frequently to contract, its response to stimulus is progressively decreases. Finally, it may not contract by stimulation. Such a condition is called muscle fatigue.
   - Underlying cause of muscle fatigue:
     (i) Constant stimulation of muscle or contraction.
     (ii) Inadequate blood supply to the muscle.
3. **Refractory period:** After stimulation, there is a brief period during which muscle is not excitable to second stimulus, this is known as refractory period.
4. **Muscle contraction:** By adequate stimulus, muscles are excitable. When muscles are excited, they give contractility and this is immediately followed by relaxation.
5. **Extensibility and elasticity:** The skeletal muscle extends when stretched. When tension on the muscle is released, it goes back to the original position. This is known as elasticity of the muscle.
6. **Conductivity:** After stimulation, wave of contraction starts at a point of stimulus and is conducted along the muscle fibre.

5 Name the muscles of facial expressions.

☞ **Muscles of Facial Expression**

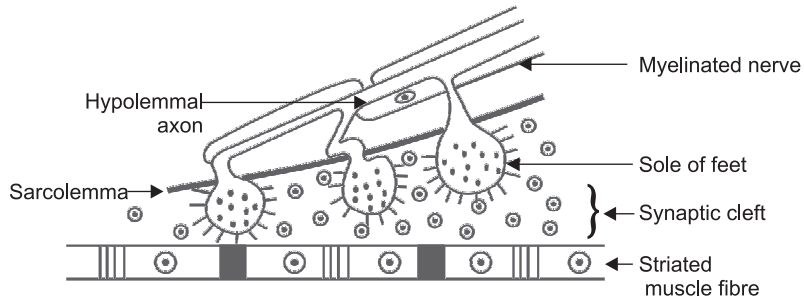
1. Orbicularis: Circular muscle surrounding each eye.
2. Oculi: Muscles close to tip.
3. Levator palpebrae superioris to raise the eyelids.
4. Massetor: Muscles for mastication.
5. Buccinator: Flat muscles of neck.

6 What is neuromuscular junction? Explain physiology of neuromuscular junction (muscle contraction).

☞ **Neuromuscular Junction**

Neuromuscular junction is a connection between ends of large myelinated nerve fibre and skeletal muscle fibre.

Structure of Neuromuscular Junction



Physiology of Neuromuscular Junction/Muscle Contraction

- When a nerve impulse reaches the neuromuscular junction, the passage of action potential over sole feet causes many of small vesicles of acetylcholine to rupture into synaptic cleft.
- Acetylcholine acts on plasma membrane to increase its permeability. This in turn allows spontaneous leakage of sodium causing end plate potential.
- When end plate potential becomes great enough, it stimulates entire muscle fibre.
- When action potential spreads inside of muscle fibre, Ca^{2+} ions are released into the fluid surrounding the fibres. Thus, due to release of Ca^{2+}, muscle contraction takes place.
- Immediately after release of Ca^{2+}, there is a muscle contraction.
- When action potential is over, previously released Ca^{2+} ions recombine with sarcoplasmic reticulum and muscle contraction ceases (stops).

7 Distinguish between skeletal muscle and smooth muscle. (S.22)

☞

	Skeletal muscle	Smooth muscle
(i)	It is described as voluntary or stripped.	It is described as involuntary or visceral muscles.
(ii)	These are found attached with skeleton.	These are found in the walls of blood vessels, alveoli of lung and respiratory canal.

Contd...

Contd...

	Skeletal muscle	Smooth muscle
(iii)	It works under the control of will.	It does not work under the control of will.
(iv)	The cells are rough, cylindrical in shape with several nuclei.	The cells are spindle-shaped with only one central nucleus.
(v)	Conductivity is very fast.	Conductivity is slower.
(vi)	Tonicity depends upon nerve stimulation.	Tonicity is not dependent on nerve stimulation.
(vii)	Percentage of proteins is maximum in skeletal muscle.	Percentage of proteins is less.
(viii)	It works under the control of CNS.	It works under the control of ANS.

8 What are 'biceps' and 'triceps' muscles? Give their functions. (S.22)

☞ **Biceps**

Biceps is a two-headed muscle that lies on the upper arm between the shoulder and the elbow anteriorly.

- **Function:** It stabilises and flexes the shoulder joint and at the elbow joint it assists with flexion and supination.

Triceps

The triceps run along the humerus between the shoulder and the elbow located posteriorly.

- **Function:** Along the biceps, it enables extension and retraction of the forearm. It also stabilises the shoulder joint.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. Striated muscles are found attached to **skeleton**.
2. **Muscle tone** in the skeletal muscle is responsible for maintaining posture of the body.
3. The contraction of muscle of the shortest duration is seen in **eyelids**.
4. **Orbicularis** muscle surrounds the eye.
5. Triceps muscle joins ulna with **humerus**.
6. **Brachialis** muscle moves the forelimb/forearm.
7. The superior rectus muscle **rolls eyeball upward**.

8. Abductor muscles are antagonist of **adductor**.
9. The two principal proteins in skeletal muscle are **actin and troponin**.
10. A muscle bends a part over another means **flexor**.
11. **Sarcomere** is the basic functional unit of skeletal muscle tissue.
12. Biceps are attached with **scapula and radius**.
13. In the structure of skeletal muscle, **perimysium** surrounds the bundle of muscle fibres.
14. Biceps and triceps surround **humerus**.
15. The strongest muscle of the body is found in **jaw**.
16. The total number of muscles in the body of man is **639**.
17. The longest visceral muscle cell is present in **pregnant uterus**.
18. A tendon joins **muscle with bone**.
19. **Myosin** is the contractile protein of muscle.
20. A ligament joins **bone to tendon**.

Chapter
11

The Nervous System

The nervous system is most important organisation which controls and regulates different body functions and maintains stability of internal environment with respect to extreme changes in external environment.

1 Differentiate between CNS and ANS.

☞

	CNS	ANS
(i)	It consists of brain and spinal cord.	It consists of sympathetic and parasympathetic nerves.
(ii)	It is related with sensory and motor activity of brain.	It is related with the activity of heart, various glands and smooth muscles.
(iii)	It enables the person to adjust with external environment.	It enables the person to adjust with internal environment of the body.
(iv)	The functions of CNS occur according to will power.	The functions of ANS do not occur according to will power.
(v)	It supplies the nerves to skeletal muscles (motor nerve) and sensory nerve carries impulses from sense organs to the brain.	It supplies the nerve to smooth muscles of visceral organs such as ureters, uterine tubes, bronchi, trachea, heart, etc.

2 What are meninges? Explain coverings of brain and spinal cord.

☞ **Meninges**

Meninges are the connective tissue membranes which cover and protect different parts of 'CNS'.

There are three meninges.

(i) **Dura mater:** It is an outer, thick, fibrous membrane which gives covering to the brain and spinal cord. The space between dura mater and arachnoid mater is called subdural space.

(ii) **Arachnoid mater:** It is the middle, delicate, thin, vascular membrane situated between dura mater and pia mater. The space between arachnoid mater and pia mater is known as subarachnoid space. The subdural space and subarachnoid space contain a fluid known as cerebrospinal fluid (CSF) which acts as a shock absorber.

(iii) **Pia mater:** It is the innermost, fine, vascular membrane consisting mainly of blood vessels supported by fine connective tissue.

Functions of Meninges

(i) To protect and support the brain and spinal cord.
(ii) To supply the blood and nourishment to the central nervous tissue.

3 What is CSF? Give the composition and functions of cerebrospinal fluid. (S.23,24, W.22,23)

☞ **CSF**

It is a clear watery fluid present in the space between meninges of the brain and spinal cord and is secreted by choroid plexus.

Composition of CSF

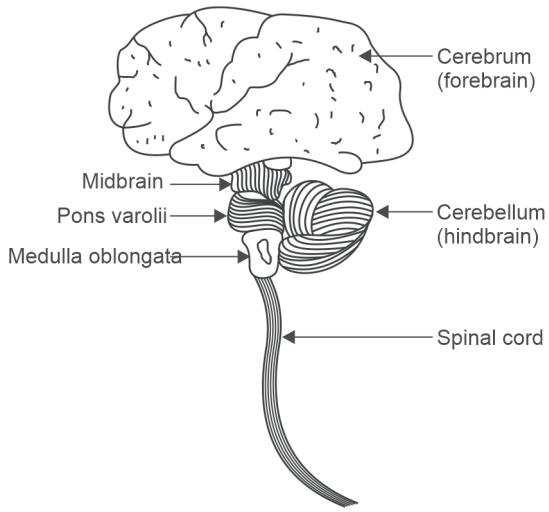
(i) Water
(ii) Amino acid
(iii) Glucose
(iv) Mineral salts
(v) Urea and creatinine in small amounts
(vi) Plasma proteins, i.e. small amounts of albumin and globulin.

Functions of CSF

(i) It acts as a cushion and shock absorber.
(ii) It maintains uniform pressure around the delicate structures of CNS.
(iii) It supports and protects the delicate structures of brain and spinal cord.
(iv) It keeps the brain and spinal cord always moist.
(v) It acts as a medium for the movement of respiratory gases, waste products and nutrients.

4 Sketch and label a diagram of brain. (W.23)

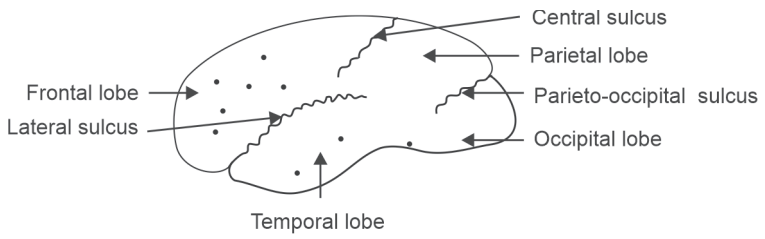
☞



Brain

5 Describe the structure and mention the functions of cerebrum. (S.23)

☞
- Cerebrum is the largest part of the brain and is divided into two equal parts by central longitudinal fissure.
- These two hemispheres are internally connected by a mass of white matter called corpus callosum.
- Each hemisphere is divided into four lobes, namely frontal lobe, parietal lobe, temporal lobe and occipital lobe.
- Each lobe is separated from another by a sulcus or a fissure.
- The central sulcus separates frontal and parietal lobes.
- The lateral sulcus separates frontal and parietal lobes from temporal lobe.
- The parieto-occipital sulcus separates parietal lobe from occipital lobe.
- The outer surface of cerebrum is made up of gray matter and inner side is made up of white matter.
- The gray matter is composed of thalamus and hypo-thalamus.

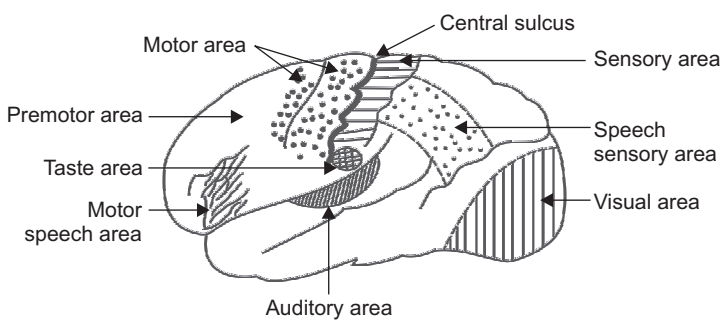


Functions of Cerebrum

1. **Sensory function:** It includes perception of pain, temperature, touch and special senses are sight, hearing, taste, smell from sensory organs which are carried to the cerebrum.
2. **Motor function:** It is associated with initiation and control of contraction of voluntary muscles.
3. **Association:** It includes mental activities like intelligence, sense of responsibility, reasoning, learning which are attributed to higher centres in the cerebrum.

6 Draw and label a diagram showing functional areas of cerebrum. (S.23)

☞



The cerebrum showing the functional areas

7 Give the functions of medulla oblongata. (W.23)

☞ **Medulla Oblongata**

It forms the base of the brain and connects brain with spinal cord.

Functions of Medulla Oblongata

(i) The cardiac centre present in the medulla oblongata controls heart rate and force of contraction of heart.

(ii) The respiratory centre present in medulla oblongata controls rate and depth of respiration.

(iii) The vasomotor centre in the medulla oblongata controls calibre of blood vessels and maintains normal blood pressure.
(iv) The reflex centre present in the medulla oblongata protects from entry of harmful substances into the body.

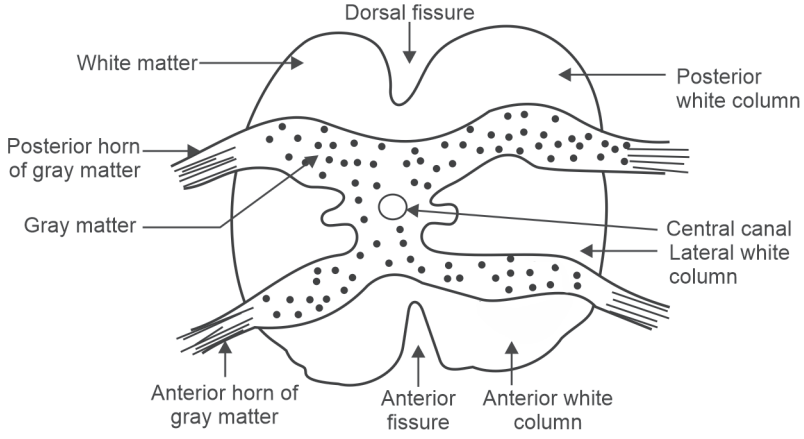
8 Mention the functions of cerebellum.

☞ **Functions of Cerebellum**

(i) It controls and coordinates the activities of various groups of muscles ensuring smooth actions.
(ii) It maintains muscle tone.
(iii) It coordinates activities associated with maintenance of balance of the body and equilibrium of the body.

9 Draw and label a diagram of TS of spinal cord. (S.24)

☞



TS of spinal cord

10 Define spinal cord. Give the functions of spinal cord. (S.24)

☞ **Spinal Cord**

Spinal cord is an elongated and almost cylindrical part of the CNS and extends from medulla oblongata.

It is about 45 cm long and is about thickness of little finger. Spinal cord is surrounded by dura mater, arachnoid and pia mater.

The spinal cord emerges out from an opening in the cranium known as foramen magnum.

Functions of Spinal Cord

(i) It gives connection between peripheral organs and brain.
(ii) It acts as a main centre for various reflex actions.
(iii) It acts as a connecting link between brain and spinal nerves.

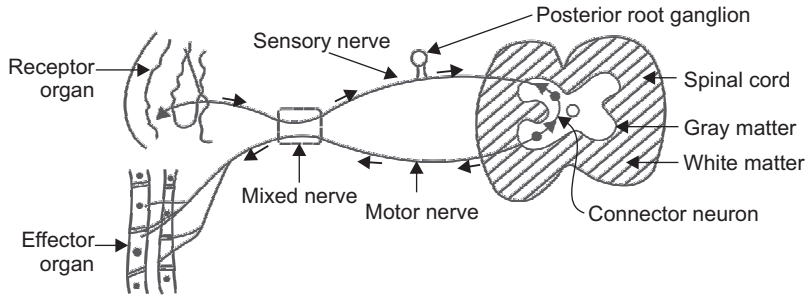
11 What is reflex action? Explain components of simple reflex arc. (S.22, W.22)

☞ **Reflex Action**

The automatic and rapid response to sensory stimulus without involvement of brain is called reflex action.

- **Simple reflex arc:** The path through which impulse travels during reflex action is called simple reflex arc.

Structure of Simple Reflex Arc



Components/Parts of Simple Reflex Arc

1. **Receptor organ:** It is the part where stimulus is received.
2. **Sensory neuron:** It is the nerve cell which carries nerve impulse from sense organ to spinal cord.
3. **Connector neuron:** It converts sensory impulse into motor impulse.
4. **Motor neuron:** It conducts nerve impulses from spinal cord to effector organs.
5. **Synapse:** The space between two neurons is called synapse.
6. **Effector organ:** It is the part of body which gives response.

Significance/Importance of Reflex Action

(i) It gives quick responses and protects the body from any harm or danger.
(ii) It prevents overloading of brain and gives relief of pain.
(iii) The reflex action helps the person to adjust with changing environment.

Examples of Reflex Actions of the Body

(i) Quick closing of the eyelid if eye is touched or something threatens to touch the eye.

(ii) The sudden withdrawal of hand if finger is touched with hot object.
(iii) Quick recovery of the balance of the body to prevent falling after asleep.
(iv) A sudden coughing attack, if any irritating substance is inhaled.
(v) In infants, the act of micturition and defaecation is carried out reflexly.

12 Name different cranial nerves with their functions. (W.23)

☞ Cranial Nerves

The nerves which arise from the brain are known as the cranial nerves.

There are 12 pairs of cranial nerves which are arranged in the following sequence:

	Nerve	Type	Functions
(i)	Olfactory nerve	Sensory	Smell
(ii)	Optic nerve	Sensory	Vision
(iii)	Oculomotor nerve	Motor	Eyeball movement
(iv)	Trochlear nerve	Motor	Eyeball movement
(v)	Trigeminal nerve (largest)	Mixed	Head, face muscle movements
(vi)	Abducent nerve	Motor	Eyeball movements
(vii)	Facial nerve	Mixed	Taste, salivation, tear secretion
(viii)	Auditory nerve	Sensory	Hearing
(ix)	Glossopharyngeal nerve	Mixed	Swallowing
(x)	Vagus nerves	Mixed	Gastric, pancreatic secretion
(xi)	Accessory nerves	Motor	Neck and shoulder muscle movement
(xii)	Hypoglossal nerve	Motor	Tongue movement

13 Explain the physiology of ANS/effect of stimulation of SNS and PSNS. OR What will be the effect of stimulation of sympathetic and parasympathetic nervous systems on the following organs? (S.22,24)

☞

	Organ	Sympathetic stimulation	Parasympathetic stimulation
(i)	Heart	Increases heart rate	Decreases heart rate
(ii)	Myocardium	Increases myocardial contractility	Decreases myocardial contractility
(iii)	Lungs (bronchi)	Bronchodilation	Bronchoconstriction
(iv)	GIT motility	Decreases GIT motility	Increases GIT motility
(v)	Pupils of eye	Dilation of pupils	Constriction of pupils
(vi)	Urinary bladder	Relaxation of smooth muscles of urinary bladder	Increased contraction of urinary bladder
(vii)	Glandular secretions (exocrine)	Decreased secretions of exocrine glands	Increased secretions of exocrine glands
(viii)	Blood vessels	Constriction of blood vessels	Dilation of blood vessels
(ix)	BP	Increases BP	Decreases BP
(x)	Cardiac output	Increases cardiac output	Decreases cardiac output

14 Give comparison/difference between sympathetic nervous system (SNS) and parasympathetic nervous system (PSNS). (S.23)

☞

	Sympathetic nervous system (SNS)	Parasympathetic nervous system (PSNS)
(i)	It is the thoracolumbar system.	It is the craniosacral system.
(ii)	Sympathetic trunk ganglia and collateral ganglia are present.	Parasympathetic ganglia are present.

Contd...

Contd...

	Sympathetic nervous system (SNS)	Parasympathetic nervous system (PSNS)
(iii)	Ganglia are close to the CNS and distant from visceral effectors.	Ganglia are near or within the wall of visceral effectors.
(iv)	The preganglionic nerve fibres are smaller.	The preganglionic nerve fibres are longer.
(v)	The postganglionic nerve fibre is larger.	The postganglionic nerve fibre is smaller.
(vi)	The preganglionic neuro-transmitter is adrenaline.	The preganglionic neuro-transmitter is acetylcholine.
(vii)	The targeted receptors are mostly adrenergic.	The targeted receptors are mostly cholinergic.
(viii)	Distributed throughout the body.	Distribution is limited particularly to head and viscera of thorax, abdomen and pelvis.
(ix)	It is also known as adrenergic nervous system.	It is also known as cholinergic nervous system.
(x)	It has alfa and beta receptors.	It has muscarinic and nicotinic receptors.
(xi)	It is involved in expenditure of energy.	It deals with restoration of body energy.

15 Give the functions of hypothalamus.

☞ **Functions of hypothalamus**

1. It controls autonomic nervous system.
2. It controls appetite.
3. It regulates thirst.
4. It maintains emotional behaviour, personality and social behaviour.
5. It regulates body temperature.
6. It regulates and controls release of hormones from pituitary gland.
7. It controls sexual behaviour.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. **Neurones** are the functional units of the nervous system.
2. **Cerebrospinal fluid** is present in between meninges of the brain and spinal cord.
3. **CSF** acts as a cushion and shock absorber of the brain.
4. The neurone that carries information from the peripheral nervous system to central nervous system is **afferent nerve**.
5. Cerebrospinal fluid is produced by **choroid plexus**.
6. **Meninges** are the coverings of the brain and spinal cord.
7. **Irritability** is the ability of neurone to initiate nerve impulses.
8. The space between the cranium and dura mater of the brain is called **epidural space**.
9. **Trochlear nerve** is the smallest cranial nerve.
10. Learning is related to which part of the human brain? **Cerebrum**.
11. **Hypothalamus** controls emotions like love, anger, and pleasure.
12. **Sulcus** separates the lobes of the brain.
13. **Meningitis** means inflammation of brain and spinal cord membranes.
14. The fluid present between the meninges for protection of the CNS is called **cerebrospinal fluid**.
15. **Optic nerve** is a second cranial nerve.
16. **Corpus callosum** structure connects the cerebral hemisphere.
17. The spinal cord originates **medulla oblongata** part of brain.
18. **Hind brain** regulates posture and balance of the body.
19. A cranial nerve with the highest number of branches is **trigeminal nerve**.
20. **Spinal cord** controls "reflex actions".

Chapter
12

The Sense Organs

1 State different senses along with the organs.

☞ **There are five different senses**

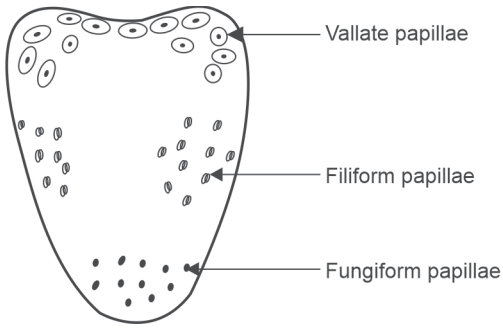
1. Sense of taste	Tongue
2. Sense of touch	Skin
3. Sense of vision (sight)	Eye
4. Sense of hearing	Ear
5. Sense of smell	Nose

2 What are different papillae of tongue? Mention the functions of tongue.

☞ **Tongue**

- Tongue is organ of sensation of taste.
- There are numerous papillae present in the tongue.
- The tongue is a very mobile organ and is covered by mucus membrane.
- The roughness of upper surface of tongue is due to numerous minute elevations, are called papillae.
- The end organs of the sense of taste are called taste buds.

There are three types of papillae found in the area of tongue.



Papillae of tongue

1. Vallate papillae: They form an inverted 'V' shape at the base.
2. Fungiform papillae: These are situated on the sides and at the tip of the tongue.
3. Filiform papillae: These are found mainly on the anterior two-thirds of the tongue.

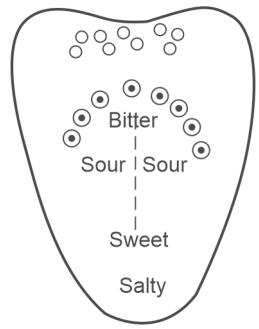
Functions of Tongue

(i) Tongue is an organ of sensation of taste.
(ii) It helps in mixing of food during mastication.
(iii) It also helps in swallowing of food.
(iv) It plays an important role in speech.
(v) It is also sensitive to temperature, pain, touch and pressure.

3 What are different fundamental sensations of the taste? (S.24)

☞ There are four fundamental sensations of taste.
(i) Sweet
(ii) Sour
(iii) Bitter
(iv) Salty

The substances stimulate taste buds in specific parts of the tongue.



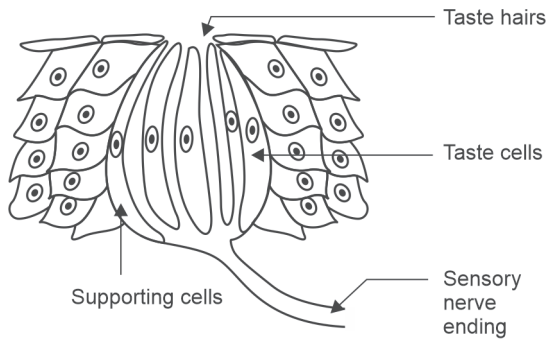
Tongue showing taste areas

- Sweet and salty tastes—at the tip of the tongue.
- Sour—at the sides of the tongue.
- Bitter—at the back of the tongue.

4 What are taste buds? Explain the physiology of taste.

☞ Taste Buds

- The tongue contains taste buds. The end organs of the taste are called taste buds.
- Taste buds contain chemoreceptors (sensory receptors) that are found in the papillae of the tongue and widely distributed in the epithelia of the tongue.
- The taste buds consist of collection of sensory receptor and supporting cells together with sensory nerve ending.
- They consist of small sensory nerve endings of the glosso-pharyngeal, facial and vagus nerves.
- Some of the tastes cells have hair-like cilia on their free border, projecting towards tiny pores in the epithelium, are known as taste hairs.



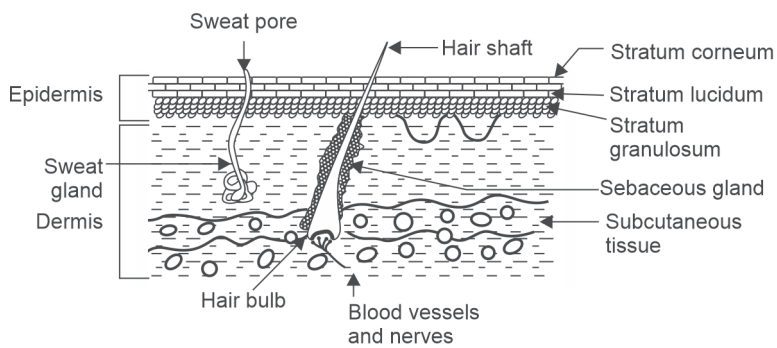
T.S. of taste bud

Physiology of Taste

- There are four fundamental sensations of the taste like sweet, sour, bitter, and salty.
- The sensory receptors are highly sensitive and stimulated by very small amount of chemicals that enter the pores dissolved in saliva.
- The substances in solution enter the pores of the taste buds and stimulate the hair-like endings of the cells.
- Nerve impulses are generated and conducted along the glossopharyngeal, facial and vagus nerves before reaching in the medulla and thalamus.
- The impulses are transmitted to the thalamus and then to the taste area in the cerebral cortex where taste is perceived.

5 Sketch and label a diagram of LS/VS of skin. (S.22, W.23)

☞



LS/VS of skin

6 Mention two layers of the skin.

☞

Skin

Epidermis (outer layer)	Dermis (inner layer)
A. Keratinizing zone	(i) Blood vessels
(i) Stratum corneum	(ii) Nerve ending of sensory nerve
(ii) Stratum lucidum	(iii) Sweat glands
(iii) Stratum granulosum	(iv) Sebaceous glands
B. Germinative zone	(v) Hair follicle
(i) Prickle cell layer	(vi) Apocrine glands
(ii) Basal cell layer	(vii) Nails

7 Describe the epidermis/outer layer of the skin.

☞ Epidermis

- It is an outer layer of the skin also known as superficial layer.
- Epidermis is composed of stratified epithelium consisting of number of cell layers arranged in two zones.

A. **Keratinizing zone (horny zone):** This is a superficial layer consisting of three upper layers.

(i) **Stratum corneum:** The cells of this layer are thin, flat and scale-like structures. These are non-ciliated and protoplasm of these cells is replaced by horny substance called keratin.

(ii) **Stratum lucidum:** It contains clear protoplasm and some of the cells contain nuclei.

(iii) **Stratum granulosum:** The cells of this layer contain nuclei and granules.

B. **Germinative zone:** It consists of two layers of epithelial cells as prickle cell layer and basal cell layer.

- Prickle cell layer holds the cells together.
- The basal cell layer:
  - The basal cells are arranged in wave-like order. They are packed closed together and form the layer of cells, which rest on papillae of the dermis.
  - These cells reproduce rapidly and replace the cells from superficial layer.
  - Between the cells of basal layer, melanocyte layer is present which contains melanoblast cells.
  - Melanoblast cells contain skin pigment 'melanin' which gives colour to the skin.

The epidermis does not contain any blood vessel but the cells of epidermis are bathed in a fluid called a lymph which is collected by different lymphatic vessels.

Functions of Epidermis

1. It covers and protects internal tissues.
2. It prevents entry of microorganisms into the body.
3. It gives support to the hair shaft.
4. It helps in regulation of body temperature.

8 Explain dermis layer/innermost layer of the skin.

☞ **Dermis:** It is an innermost/deepest layer of the skin. The dermis or corium is composed of dense, fibrous and elastic connective tissue.

There are many structures distributed in the dermis layer.

1. **Blood vessels:** The circulation of blood through the dermis layer gives nourishment to the skin and plays an important role in the regulation of body temperature. Dermis contains an extensive network of blood capillaries in the subcutaneous layer. Dermis has a rich network of lymphatic vessels.
2. **Nerves:** The skin provides the body's sensory information and is provided with between sensory nerves and sympathetic nerve fibres. Sympathetic nerve fibres are supplied to the vessels, the smooth muscle of the hair follicle and the secretary cells of the sweat glands.
3. **Sweat glands:** These are found in the skin all over the body, but are mostly present in the palms of the hand, soles of the feet, and on the forehead. Each gland consists of a tube coiled up into a ball present in the dermis and opens on the outer surface of the skin as a sweat pore.

   Functions

   (i) It helps in excretion of sweat.
   (ii) It helps to regulate body temperature by heat loss through the sweat.
4. **Sebaceous glands:** These are found mostly in the skin of the face, scalp and all hairy parts of the body. Sebaceous glands secrete an oily secretion called sebum.

   Functions:

   (i) The sebum keeps the skin smooth, soft and gives shiny appearance to the hairs.
   (ii) The sebum prevents drying and cracking of the skin.
   (iii) The sebum protects the damage of skin by the exposure of heat and sunshine.
5. **Hair follicle:**

- Each hair consists of a free shaft, extending above the skin surface and a root embedded in the skin.
- The hair root is enclosed in a hair follicle. The lower end of the follicle expands to form the hair-bulb.

- At the end of hair bulb, there is a small projection of cells derived from the dermis called the papilla.
- The papilla contains blood vessels, nerve endings and melanocytes.

9 Mention the functions of skin. (S.22,23, W.23)

☞ 1. It protects deeper delicate organs of the body from injury and infection.
2. Skin contains end organs of sensory nerves.
3. The skin absorbs oily substances and drugs.
4. It gives origin to hairs and nails.
5. Skin secretes oily secretion, i.e. sebum from sebaceous gland which keeps the skin soft, smooth and gives shiny appearance to the hairs.
6. Skin helps in excretion of waste materials such as fatty material and water in the form of sweat by sweat glands.
7. Skin contains 7-dehydrocholesterol which is converted into vitamin D by the action of sunlight.
8. Skin gives protection against ultraviolet radiations.
9. Skin and subcutaneous tissue act as storage of water and fats.
10. Skin plays an important role in the regulation of body temperature.

10 Write in brief about sweat gland and sebaceous gland.

☞ **(a) Sweat Glands**

These are mostly present on the forehead, maxilla, parts of nose, and axilla. These consist of a tube originating from dermis and open on the surface by an opening called a sweat pore. These glands secrete sweat.

Sweat

Sweat is a clear watery fluid containing 0.5% of solids and is secreted by sweat glands.

Composition of Sweat

(i) Water
(ii) Sodium chloride (salt)
(iii) Small amount of other mineral salts
(iv) Urea in small amount.

Functions of Sweat Glands

(i) They help in excretion of water and salty material.
(ii) Sweat gland regulates body temperature by heat loss through the sweat.

(b) Sebaceous Glands

These glands are mostly found on forehead, sides of the nose and parts of ear. These glands secrete sebum.

Sebum

Sebum is an oily substance secreted by sebaceous glands that keeps the hair soft and pliable and gives shiny appearance to the hairs.

Functions of Sebaceous Glands

(i) The sebum provides some waterproofing and acts as a bactericidal and fungicidal agent preventing the entry of microbes into the body.
(ii) The sebum keeps the skin smooth, soft and gives shiny appearance to the hairs.
(iii) The sebum prevents drying and cracking of the skin.
(iv) The sebum protects the damage of the skin by the exposure of heat and sunshine.

11 Explain how skin helps in regulation of body temperature.

☞ **Skin regulates the body temperature by the following mechanism.**

- Man is a cold-blooded animal and is capable of maintaining a relatively constant central body temperature which is independent of the surrounding environment.
- The constant level of the body temperature is maintained by a balance between the heat produced and heat loss by the body.

Heat production:

- All the body tissues produce heat from chemical process of metabolism, but the greatest heat production is from the most active tissues such as liver, endocrine glands and muscles.
- Muscular activity accounts for about 30% of body's heat production at resting position.
- Heat may also be gained (increased) by the body when environmental temperature exceeds body temperature.

Heat loss:

- Heat is lost from the body through the skin by radiation, conduction, convection and evaporation.
- A small amount of heat is lost in expired air, urine and faeces.

Explanation

Body temperature is controlled by the temperature-regulating centres of the hypothalamus.

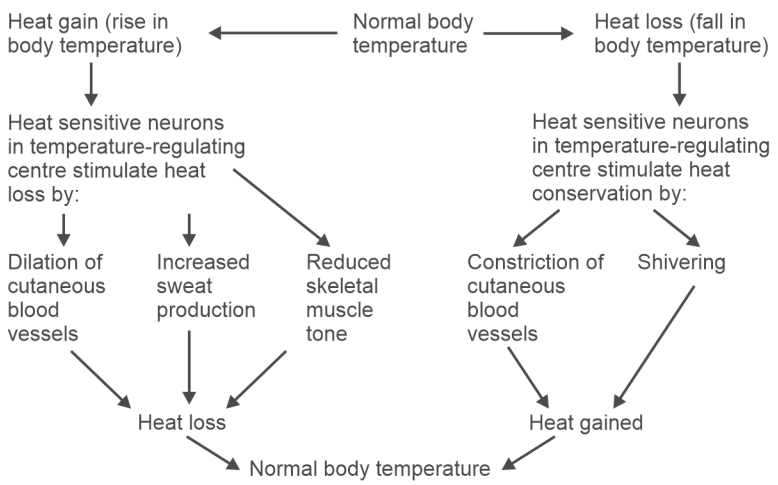
These contain two groups of neurons:

(i) Heat sensitive neurons

(ii) Cold sensitive neurons

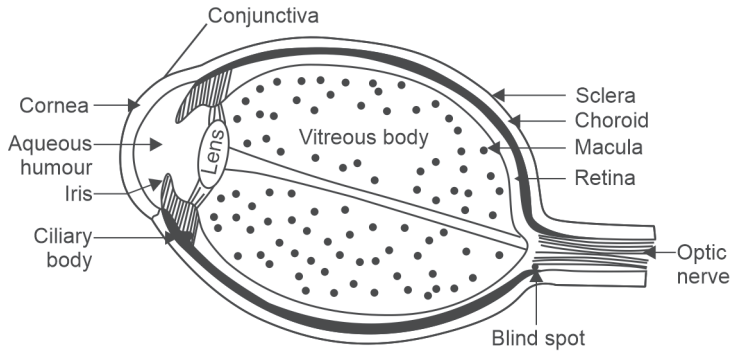
- A fall in body temperature causes the temperature-regulating centres to conserve heat by increasing sympathetic nerve impulses, resulting in constriction of cutaneous blood vessels and stimulates heat production by shivering (involuntary shaking of body).
- A rise in body temperature causes the temperature-regulating centres to inhibit sympathetic nerve impulses to cutaneous blood vessels resulting in dilation of blood vessels and increased blood flow through the skin. Sweat glands stimulated to secrete sweat which is evaporated from the skin surface with consequent loss of heat and body temperature achieves normal level.

Schematic Presentation of Regulation of Body Temperature



12 Sketch and label a diagram of section of eye/ saggital section of eye. (S.23, 24)

☞



Section of eye

13 Name different layers/coverings/coats of the eye. OR State various parts of the eye. (S.23, 24)

☞
- Eye is the organ of vision/sight.
- There are two eyeballs situated in the bony sockets called orbits.
- Eyes are also called 'photoreceptors'.

The structure of eye may be considered in the following way:

Eye

A. Three tunics or layers

1. Fibrous layer—sclera, cornea
2. Vascular layer—choroid, ciliary body, iris, pupil
3. Nervous layer—retina

B. The light transmitting mechanisms

1. Aqueous humour
2. The lens
3. The vitreous body

14 Explain an outermost layer/coat/covering of the eye. (S.24)

☞ **Sclera**

- It is an outermost layer of tissue of the eyeball which is referred to as 'white of eye'.
- Overexposed part of eyeball there is a superficial mucus membrane called 'conjunctiva' which is also reflected along the inner surface of the eyelids.

Functions of Sclera

(i) To maintain shape of eyeball.
(ii) To protect inner layer of eye.
(iii) To provide a surface for attachment of extrinsic eye muscles.

Cornea

- Cornea is an anterior extension of sclera.
- Cornea is also sometimes called 'window of eye'.
- Cornea is transparent epithelial membrane slightly curved or convex.
- Cornea has no blood vessels but it is nourished from aqueous humour.

Function of Cornea

It allows the light to enter the interior of the eye because of transparent nature.

15 Explain middle layer/coat/covering of the eye. (S.24)

☞ The middle layer of eye contains many blood vessels and capillaries, which are derived from the ophthalmic branch of the internal carotid artery and is pigmented.

The middle layer consists of the following structures:

(a) The Choroid

- The choroid is a thin pigmented membrane dark brown in colour, which lines the posterior component of the eye.
- It is situated in between the inner surface of the sclera and the retina.

Function: It helps in absorption of extra light entering in the eyeball.

(b) Ciliary body

It is an anterior continuation of choroid slightly curved inside. It consists of the ciliary muscle and epithelial cells.

Functions

(i) To give suspensory ligaments suspending the lens.
(ii) It helps in contraction and relaxation of ciliary muscles.
(iii) It helps to change the thickness of the lens.
(iv) The epithelial cells of the ciliary body secrete aqueous and vitreous humour.

(c) Iris

- Iris is a circular body and is an anterior extension of the ciliary body present behind the cornea.
- Iris is a pigmented membrane which surrounds the pupil of eye.

- Iris is attached to the ciliary process and is present between cornea and the lens.
- It consists of radiating and circular muscles along with pigment cells.
- The central aperture of the iris is known as pupil of eye.
- The colour of eye is dependent on the pigment present in the iris.

Functions

(i) It regulates the amount of light entering the posterior part of the eye.

(ii) It helps to control the size of the pupil.

(iii) The muscles of iris contract and relax causing dilation and constriction of pupil.

(d) Pupil

- The central aperture of the iris is known as pupil.
- The pupil varies depending upon the intensity of light.
- In dim light, the radiating muscle fibres contract and produce dilation of pupils.

Function: The pupil helps to control the amount of light entering the iris.

16 Describe innermost layer/coat of the eye. OR Describe the retina of the eye. (S.24)

☞ **Retina**

- Retina is the innermost layer of the eye.
- Retina is delicate membrane consisting of nerve cells, nerve fibres, rods and cones.
- The rods and cones are the actual receptors of sight and light reaching them sets up the impulses which are transmitted to the nerves.
- The impulses are generated by the action of light on the photosensitive pigment in the rod cells is known as 'rhodopsin'.
- The cones are responsible for colour vision.
- The retina is purple coloured due to rhodopsin pigment present in the rods.
- The point at which optic nerve emerges out contains no nerve cells, no rods and cone cells. Therefore, it is insensitive to light and is called 'blind spot'.

- Opposite to the lens there is a yellow spot known as 'macula' with only one cone for image focusing.
- Macula is a small area of retina of great sensitivity on which the images are seen directly.

Functions

(i) The retina contains rod cells which have 'rhodopsin' pigment, is responsible for generation and transmission of impulses.
(ii) The cones are responsible for colour vision.

17 Write in brief and mention the functions of the following.

☞ **(a) The Aqueous Humour**

- The fluid present in the anterior chamber of the eye is called aqueous humour.
- Aqueous humour is situated in between cornea, iris and the ciliary body.
- Aqueous humour is secreted by ciliary muscles.

Functions

(i) It keeps the parts of eye moist.
(ii) It gives nourishment to the cornea.

(b) The Lens

- The lens is an elastic, circular, biconvex, transparent body present behind the pupil.
- It is made up of protein fibres and suspended by ligaments.
- The thickness of lens is controlled by ciliary muscles.

Function: The lens helps to focus the rays of light entering the eye through the pupil on the retina.

(c) The Vitreous Body

- It is a colourless, transparent jelly-like substance which fills the posterior four-fifths of the eye.
- The substance present in the vitreous body is known as vitreous humour.

Function: The vitreous humour helps to preserve the spherical shape of the eyeball and to support the retina.

18 Sketch and label a diagram of ear.

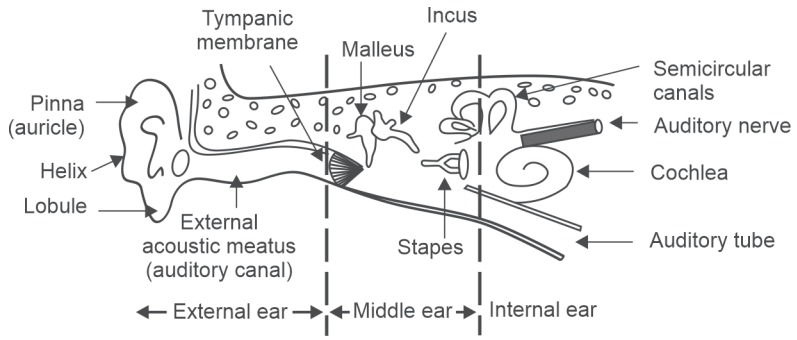


Diagram of ear

19 Mention various parts of the ear.

☞

Ear

External ear	Middle ear	Internal ear
1. Pinna (auricle) 2. External acoustic meatus	1. Tympanic membrane (eardrum) 2. Auditory ossicles (ear ossicles)	1. Bony labyrinth 2. Membranous labyrinth 3. Vestibule 4. Cochlea 5. Semicircular canals 6. Auditory nerve

20 Describe in brief about external ear.

☞ **External Ear**

External ear helps to collect the sound waves. It consists of: (a) Pinna, (b) external acoustic meatus.

(a) Pinna (Auricle)

- It is irregular in shape and is composed of cartilage and fibrous tissue.
- Pinna is deeply grooved and ridged. The most prominent outer ridge is the helix.
- The lobule is soft pliable part present at the lower end and it is composed of fibrous and adipose tissue richly supplied with blood capillaries.

(b) External Acoustic Meatus (External Auditory Canal)

- It is slightly 'S'-shaped tube about 2.5 cm long extending from the auricle to the tympanic membrane.

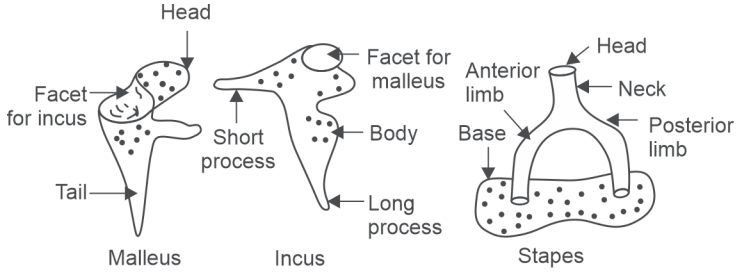
- The meatus or canal is lined by numerous ceruminus glands.
- The ceruminus glands are modified sweat glands. They secrete cerumen (wax) which is sticky material.
- The presence of wax, hairs and curvature of the meatus prevents dust, insects and microbes from reaching the tympanic membrane.

21 What are auditory ossicles (ear ossicles)? Mention the functions of auditory ossicles. (W.22,23)

☞ Auditory Ossicles

Auditory ossicles are three small bones that extend across the cavity from tympanic membrane to oval window in the middle ear.

- Auditory ossicles form a series of movable joints with each other and with medial wall of the cavity at the oval window.



- Auditory ossicles are, namely malleus, incus, and stapes.

(a) **Malleus:** It is a lateral hammer-shaped bone. The handle is in contact with tympanic membrane and the head forms a movable joint with incus.

(b) **Incus:** It is the middle anvil-shaped bone. Its body articulates with malleus and long process articulates with stapes.

(c) **Stapes:** It is a medial stirr-up shaped bone. Its head articulates with incus and its base fits into oval window.

Functions of Auditory Ossicles

(i) The auditory ossicles collect the sound waves from eardrum and are modified due to freely movable joints present in it.

(ii) They help to transmit the vibrations of sound from eardrum to the internal ear.

22 Describe the structure of internal ear.

☞ Internal Ear

- It consists of several cavities which channel the temporal bone.
- These cavities are called the outer bony labyrinth and inside which is the membranous labyrinth.
- The cavities contain fluid and nerve endings for hearing and balance.
- The bony labyrinth contains a fluid called 'perilymph'.

A. Bony Labyrinth

The bony labyrinth consists of three parts.

(i) **Vestibule (1):** It is an expanded part nearest to the middle ear.

(ii) **Cochlea (organ of hearing) (1):** It is a spiral tube twisted on itself resembling a small snails shell. It has a broad base where it is continuous with vestibule. The coils are arranged around a central bony cone-shaped axis called modiolus.

(iii) **Semicircular canals (3):** These are three tubes arranged in superior, posterior and lateral positions. Each canal has swelling at one end called ampulla. These canals are filled with the fluid called perilymph which assists the cerebellum to maintain the equilibrium and sense of position of the body.

B. Membranous Labyrinth

It is present within the bony labyrinth. It is filled with a fluid called 'endolymph'.

Functions of Internal Ear

1. The vibrations from the middle ear are transferred to the perilymph which is then transmitted to endolymph, stimulating the nerve ending of the auditory nerve.
2. The auditory nerve finally conveys the information to the cerebral cortex.
3. The vestibular nerve distributed to the semicircular canal conveys the information to the brain.

23 Explain mechanism/process/physiology of hearing. (W.22)

☞ Mechanism of hearing

The sound waves collected by pinna pass through various parts of ear towards auditory nerve and then are passed to the brain at the auditory centre.

The following are sequence of events shows mechanism of hearing:

Sound waves → Pinna (auricle) → External acoustic meatus (auditory canal) → Eardrum (tympanic membrane) → Malleus → Incus → Stapes → Vestibule → Cochlea (perilymph → endolymph) → Organ of Corti → 8th cranial nerve (auditory nerve) → Temporal lobe of brain.

Explanation

(i) Sound waves collected by pinna are directed in external auditory canal to reach the tympanic membrane. Sound waves strike the tympanic membrane.

(ii) The vibrations are transmitted by malleus, incus, stapes to the membrane covering fenestra vestibule (vestibule).

(iii) From the inner surface, these membrane vibrations are transmitted towards cochlea and semicircular canals and finally to organ of Corti, i.e. vibrations are transmitted from perilymph to endolymph.

(iv) From the organ of Corti (present in the endolymph), the impulses produced by vibrations are carried to the brain through the cochlea portion of auditory nerve.

(v) The nerve fibres then carry the impulses to the auditory centre of the brain which is present in the temporal lobe of the cerebral cortex where interpretation of sound impulses takes place.

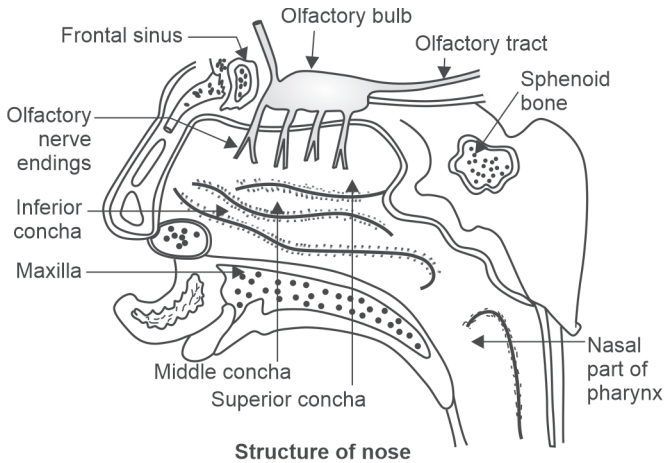
In this way, process of hearing takes place.

24 Describe the structure of nose. Mention the functions of nose.

☞ **Nose:** Nose is an organ of respiratory system as well as an organ of sensation of smell.

Structure of Nose

The nasal cavity is the first part of respiratory system and consists of a large irregular cavity divided into two equal parts by a septum situated in the midline.



Structure of nose

Explanation

- The nose is lined with ciliated columnar epithelium which contains mucus secreting goblet cells.
- Olfactory nerves are the sensory nerves of the smell.
- Olfactory nerves have their origin in special cells in the mucus membrane of the roof of the nose and the superior nasal concha.
- Nerve fibres from the cells are gathered into bundles then pass through the cribriform plate of the ethmoid bone to the olfactory bulb.
- From the bulb, bundles of nerve fibres form the olfactory tract which passes backwards to the olfactory area in the temporal bone of the cerebral cortex in each hemisphere where the impulses are interpreted.

Functions of Nose

1. Nose is the first part of respiratory system through which the incoming air passes.
2. The air is warmed, moistened and filtered in the nose.
3. The cilia of the mucus membrane of the nose help to carry the mucus towards the throat and then it is swallowed.
4. It is an organ of sensation of smell.

25 Explain the terms.

☞ **1. Myopia**

It is a short sightedness. It is caused due to defect in accommodation of eye. Person can see near objects distinctly but distant objects are seen with difficulty. The image falls

short of reaching the retina and person experiences 'blurred image'.

2. Diplopia

It means appearance of double vision.

3. Presbiopia

It is the disorder of eye in which there is an improper functioning of ciliary body.

Here, the image of an object is formed in front of the retina. Thus, distant objects are seen clearly but near objects are not in focus properly. This is caused due to loss of elasticity of the lens and lack of tone of ciliary body. It is the disorder of vision for farthest distant objects due to formation of image in front of the retina. It is due to the defect in the lens.

4. Hypermetropia

It is the disorder of eye causing falling of an image of an object behind the retina due to flattened cornea or lens or shallow eyeballs. This causes difficulty in vision of near distant, i.e. foresightedness.

The distant objects can be seen but the near objects cannot be seen.

5. Cataract

It means thickening of fibrosis of the lens. It is due to nutritional deficiency of sulphur containing amino acids, i.e. cysteine, methionine.

6. Colour Blindness

It is the defect of retina in which the person cannot see more than one colour.

7. Night Blindness

It is caused due to deficiency of vitamin A. It is characterized by absence of defective vision in the dark.

8. Photophobia

It is an abnormal sensitiveness of the eye to the bright light.

9. Xerophthalmia

It means extreme dryness of conjunctiva which loses its luster and becomes skin-like appearance due to lack of intrinsic secretions.

10. Glaucoma

It is the condition where intraocular pressure or tension is increased.

It is the disease caused due to failure of drainage of liquid from the anterior chamber as a result of which more than required amount of liquid accumulates in it and causes pressure on the optic nerve and retina.

11. Scabies

It is an infectious parasitic disease of skin characterized by itching and superficial burrows on the skin.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. **Sebum** secretion prevents drying and cracking of the skin.
2. **Skin** helps in regulation of body temperature.
3. Cornea is sometimes called **window of eye**.
4. Photoreceptors are located in the **eye**.
5. Sweat gland and sebaceous gland are found in the structure of **skin**.
6. The amount of light passing through the pupil of the eye is adjusted by the **iris**.
7. Membranous labyrinth is filled with a fluid called **endolymph**.
8. **Photophobia** means an abnormal sensitiveness of the eye to the bright light.
9. Sclera layer of eye is described as **"white of eye"**.
10. Myopia means **short sightedness**.
11. Light is focused on the lens through the action of **ciliary muscles** on suspensory ligaments.
12. "Organ of Corti" is a part of **inner ear**.
13. **Incus** is anvil-shaped bone of the middle ear.
14. **Cochlea** is a part of inner ear.
15. The central aperture of the iris is called **pupil**.
16. The **eustachian tube** connects the pharynx with the middle ear.
17. **Retina layer** of eye contains rod and cone cells.
18. Thickening of fibrosis of lens means **cataract**.
19. Sound waves are transmitted from the outer ear to the cochlea because of movement of the **oval window**.
20. Receptors of skin are called **somatic receptors**.

21. Photosensitive pigment found in the rod cells of retina layer of the eye is called **rhodopsin**.
22. Colour to the eye is imparted by **iris**.
23. The site from which the nerve impulse for hearing originates is **cochlea**.
24. The lens becomes opaque in **cataract**.
25. Too short eyeball and flat lens produce **farsightedness**.
26. Sound is amplified by the **ear ossicles**.
27. **Aqueous humour fluid** is present in the anterior chamber of the eye.
28. **Ceruminous glands** are present in the external acoustic meatus.

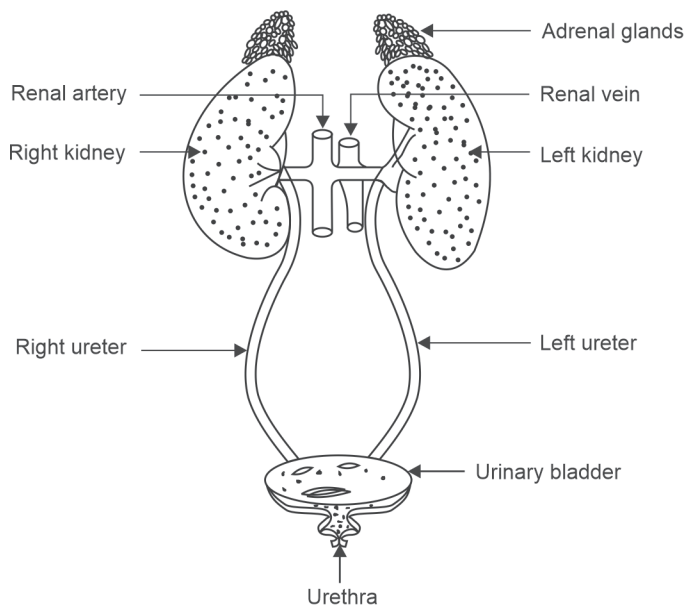
Chapter
13

The Urinary System

- The main function of urinary system is formation and excretion of urine from the body.

1 Draw and label a diagram of urinary system/excretory system/renal system.

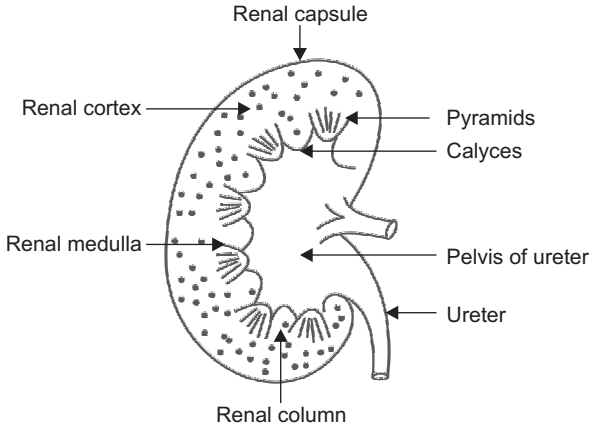
☞



Urinary system

2 Explain the structure of kidney. Mention functions of kidneys. (S.22)

☞ **Structure of Kidney**



LS of kidney

- Kidneys are two in number. Each kidney is bean-shaped and reddish brown in colour.
- Kidneys are about 10 cm in length and 5 cm in breadth.
- In an adult each kidney weights about 140 g.
- Section:
  - Each kidney is enclosed in a capsule of fibrous connective tissue called renal capsule.
  - Outer granular dark zone is renal cortex and inner zone is renal medulla.
  - The medulla is divided into conical projections called renal pyramids.
  - The pelvis at its free ends produces many cup-shaped projections called renal calyces.
  - The renal vein and artery arise from the kidney through hilum region.
  - The kidney contains closely packed microscopic structures known as nephrons.
  - Nephrons are the structural and functional units of kidneys.

Functions of Kidney

(i) It helps in formation of urine.
(ii) It regulates water and electrolyte balance.

(iii) It maintains blood pressure.
(iv) It maintains composition of blood constant.
(v) It removes excess of foreign substances such as drugs, pigments, etc. from the body.
(vi) It maintains total water balance of the body.

3 Write in brief about urinary bladder and urethra.

☞ **(a) Urinary Bladder**

- It is a large muscular pear-shaped sac present in the pelvic cavity.
- The walls of urinary bladder are lined by smooth muscles.
- The urinary bladder stores about 0.5 to 1 litre of urine temporarily.

Functions

(i) It acts as a temporary storage of urine.
(ii) It expels the urine by the contraction of smooth muscles present in it.
(iii) Micturition is an important function of urinary bladder.
Micturition: Means an act of emptying the urinary bladder by contraction of smooth muscles present in it.
(iv) It acts as a reservoir for water to prevent dehydration under the conditions of dryness.

(b) Urethra

- It is a tube-like structure arising from the urinary bladder.
- Urethra in case of male and female shows different structures.
  - **In male:** In males, the urethra extends up to the tip of the penis and acts as a common passage for both sperms and urine.
  - **In female:** In female, the urethra is short tube opening separately just in front of the vagina. Urethra in female carries only urine.

Functions

The urethra is the last part of urinary system and helps in expelling the urine outside the body.

4 Explain, how kidney helps in water balance of the body?

☞ Water constitutes about 60% of adult human body weight. The balance between fluid intake and output is controlled

by kidneys. Thus, kidney helps to maintain water balance by ADH mechanism or urine output mechanism.

Water in the body is less
↓
Osmotic pressure of blood is reduced
↓
Osmoreceptors of hypothalamus are stimulated
↓
Stimulates posterior lobe of pituitary gland
↓
Stimulates secretion of ADH
↓
Increases the reabsorption of water
↓
Increases water level in the body
↓
Effect of ADH is inhibited

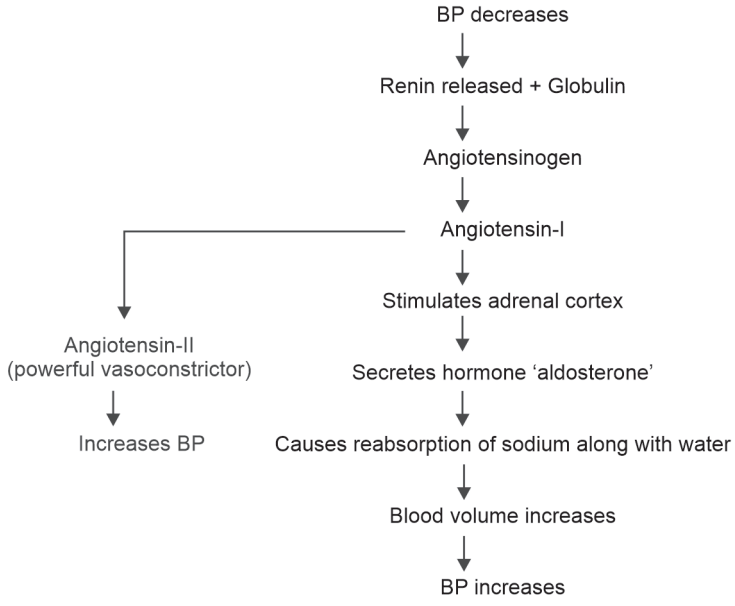
Explanation

- When amount of water in the body is less, .then osmotic pressure of blood is reduced.
- As a result of this, osmoreceptors of hypothalamus are stimulated.
- This activates pituitary gland and secretes anti-diuretic hormone (ADH) from posterior lobe.
- Stimulation of ADH increases reabsorption of water and thus water level of the body increases.
- Once the water level in the body is balanced, the effect of ADH is inhibited.

5 Discuss the role of kidney in maintenance of blood pressure. OR How kidney maintains BP?

☞
- The juxtaglomerular cells in the kidney are responsible for this function.
- When blood pressure decreases, it causes release of hormone renin by the kidneys.
- Renin reacts with globulin in the blood and forms angiotensinogen which in turn forms angiotensin-I.
- This angiotensin-I stimulates adrenal cortex to produce the aldosterone hormone which causes increased reabsorption of sodium.
- This is followed by reabsorption of water and thus the blood volume increases and ultimately increases blood pressure.

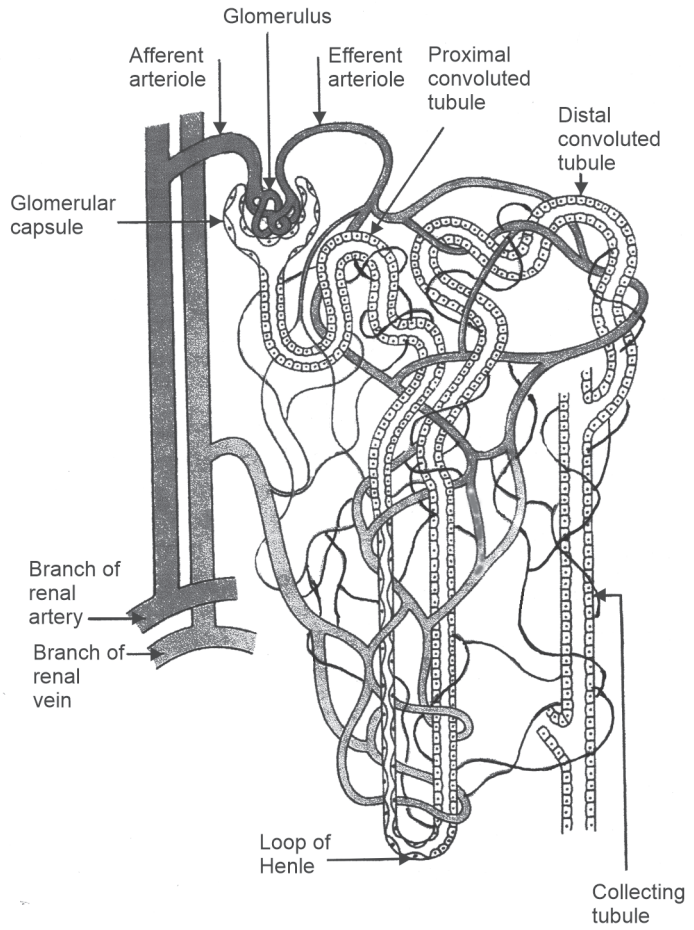
- Angiotensin-I is converted into angiotensin-II by the enzymes in the lungs.
- Angiotensin-II is a powerful vasoconstrictor and thus increases blood pressure.
- Thus, kidney helps to maintain blood pressure by these two ways.



6 Describe the structure of nephron with the help of diagram. (S.24)

☞ **Explanation**

- The kidney is composed of about 1 million of functional units called nephrons.
- The structure of nephron consists of two main parts.



Nephron (uriniferous tubule)

(a) **Glomerular capsule (Bowman's capsule):** It is a cup-shaped structure composed of a network of arterial capillaries, called glomerulus. In glomerulus, blood is filtered under pressure of about 10 mm Hg.

(b) **Renal tubules:** It is a long tube which extends from the neck of the nephron and consists of:

(i) Proximal convoluted tubule (PCT)
(ii) Loop of Henle
(iii) Distal convoluted tubule (DCT)
(iv) Collecting tubule.

Function: Parts of renal tubules help in reabsorption and secretion of substances during formation of urine.

(c) Renal artery and renal veins are supplying and collecting blood vessels throughout the renal tubules.

7 Explain the process of urine formation/mechanism/stages of urine formation. (S.22,24, W.22,23)

☞ **Formation of Urine Involves Three Main Stages**

1. Ultrafiltration (Glomerular Filtration)

- The filtration of blood under pressure is called ultrafiltration.
- It occurs in glomerulus, hence named glomerular filtration.
- The blood containing waste material is carried into the glomerulus by afferent arterioles.
- The walls of glomerular capsule act as a filter and blood is filtered under pressure of about 10 mm Hg.
- About 125 ml of blood is filtered out per minute as a glomerular filtrate.
- **GFR:** Glomerular filtration rate.

  Definition: The volume of blood filtered through glomerulus in 1 hour is called glomerular filtration rate.
- About 1 litre of blood is filtered in 1 hour. Thus, GFR is 10% (100 ml).

2. Selective Reabsorption (Active Reabsorption)

The process by which only useful substances are absorbed from the glomerular filtrate into the blood capillaries, is called selective reabsorption.

- **High threshold substances:** The substances which are essential to the body and are selectively reabsorbed back into the blood circulation are called high threshold substances, e.g. glucose, amino acids, vitamins, water.
- **Low threshold substances:** The substances which are reabsorbed only up to a slight extent, are called low threshold substances, e.g. urea, uric acid.
- **Non-threshold substances/no threshold substances:** The substances which are not reabsorbed at all from the glomerular filtrate are called non-threshold substances, e.g. creatinine, hippuric acid.

3. Active Secretion

Definition

"The process of transport of substances from blood into the filtrate again is called active secretion."

The substances which are not filtered by glomerular capsule are carried in the capillaries of the efferent arteriole and they are cleared by active secretion into the urine.

In this way, process of urine formation completes.

8 What are the abnormal constituents of urine? Give their significance. OR Name the pathological conditions they signify. (S.22,23, W.23)

☞ The following are the abnormal constituents of urine.

	Abnormal constituents	Significance/pathological conditions
1.	Proteins	Proteinuria
2.	Sugar	Glycosuria
3.	Ketone bodies	Ketonuria
4.	Bile pigments and salt	Jaundice
5.	Blood	Haematuria
6.	Pus	Pyuria

1. Proteins

The presence of proteins in the urine is called proteinuria. The presence of albumin and globulin in urine is called albuminuria and globulinuria.

- The proteinuria results in the following pathological conditions:
  - (i) Nephritis
  - (ii) Renal tuberculosis
  - (iii) Bacterial infections in kidney
  - (iv) Mercury poisoning.

2. Sugars

The presence of sugar in urine is called glycosuria. This is associated with the increased blood sugar levels exceeding the threshold level.

- The glycosuria occurs in the following pathological conditions:
  - (i) Diabetes mellitus
  - (ii) Renal glycosuria.

3. Ketone Bodies (Acetone Bodies)

When ketone bodies appear in the urine the condition is called ketonuria.

When ketone bodies appear in the blood the condition is called ketonemia.

Thus ketosis is a process in which ketonemia and ketonuria occur.

The acetone, acetoacetic acid and β-hydroxy butyric acid are described as ketone bodies.

- Ketonuria occurs in the following pathological conditions:
  (i) Carbohydrate starvation
  (ii) Pregnancy
  (iii) In anaesthesia.

4. Bile Pigments and Salts

When bile appears in the urine, the condition is called jaundice. Sodium glycocholate and sodium taurocholate are bile salts while bilirubin and biliverdin are bile pigments.

In defective liver function bile appears in the urine and colour of urine becomes greenish yellow or greenish brown.

- Bile pigments appear in all types of jaundice:
  (i) Haemolytic jaundice
  (ii) Obstructive jaundice
  (iii) Toxic jaundice.

5. Blood

When blood appears in urine the condition is called haematuria. In haemoglobinuria, the only haemoglobin pigment is found in urine.

- **Pathological conditions**
  (i) Haematuria occurs due to kidney lesions.
  (ii) Haemoglobinuria occurs in enteric fever, malaria, and haemolytic poisoning.
  (iii) Snake venom causes haemolysis which results in presence of haemoglobin in urine.

6. Pus

The presence of pus in the urine is termed pyuria.

- Pyuria is caused due to inflammation of the urinary bladder, urethra and pelvis of the kidney.

9 Give the characteristics and composition of normal urine.

☞

Characteristics of urine	Composition of normal urine
(i) Urine is amber in colour. (ii) Specific gravity of urine is 1.020 to 1.030. (iii) Urine is acidic in nature. (iv) Healthy adult passes 1000 to 1500 ml of urine per day.	(i) Water: 96% (ii) Urea: 2% (iii) Uric acid, chlorides, creatinine, phosphates, ammonia, sulphates, sodium, potassium, oxalates, glucose, oxalic acid.

10 Describe the disorders of urinary system/renal disorders/ pathophysiology of renal diseases.

☞ (i) **Anuria:** It means absence of urine or complete suppression of urine.

(ii) **Oliguria:** It means reduced urinary output, i.e. about less than 400 ml of urine per day.

(iii) **Polyuria:** It means excessive secretion and discharge of urine by the kidneys.

(iv) **Dysuria:** It means pains and difficulties during micturition.

(v) **Nephritis:** It means inflammation of kidney.

(vi) **Kidney stone/urinary calculus/renal calculi:** In this condition, there is a formation of stony material in the kidney or urinary tract.

The kidney stone is formed when the normal constituents of urine such as **oxalates, phosphates, urates** and **uric acid** are precipitated. This stone usually consists of more than one substances deposited in layers. Mostly the stone formation originates in the collecting tubule and then passes into the pelvis of kidney where they may increase in size. Those particles which are of large size may block a flow of urine in ureters. Those particles which are passed through ureters may obstruct the urethra.

- **Symptoms of Kidney Stone**
  - (i) Pains in the pelvic region.
  - (ii) Difficulty and pains during micturition.
  - (iii) Passage of pus and blood in the urine.
  - (iv) Evidence of renal failure.
  - (v) Uneasiness.

(vii) **Edema (W.22):** An abnormal or excessive accumulation of tissue fluid in the intracellular spaces of the body is called edema. This increase in tissue fluid increases the volume of that part of the body. The skin appears puffy and when finger is pressed on it a dent is formed which remains for sometime and then reaches the normal level.

Edema is found in the skin below the eyes due to kidney and heart diseases.

Edema may be seen in subcutaneous tissues.

- **Causes of Edema**
  - (i) Blockage of venous drainage flow.
  - (ii) Deficiency of plasma proteins results in decrease in osmotic pressure of blood leading to edema.
  - (iii) Damage to capillary walls leaks the plasma proteins in the tissue spaces which leads to edema.
  - (iv) Blockage of lymphatic vessels may produce edema.
- **Types of Edema**
  - (i) Cardiac edema
  - (ii) Renal edema
  - (iii) Pulmonary edema
  - (iv) Cirrhotic edema
  - (v) Nutritional edema.

11 Write a note on 'micturition'.

☞ Micturition

- Discharge of urine from the urinary bladder is called micturition.
- Micturition is an act of passing urine.
- Micturition is also known as urination or voiding.
- Micturition is an important function of urinary bladder.
- Micturition occurs via a combination of involuntary and voluntary muscle contraction.
- When the volume of urine in the bladder exceeds 200–400 ml, pressure within the urinary bladder increases considerably and there is a stimulus for contraction of the detrusor muscle and relaxation of the internal urethral sphincter muscle and thus urination takes place.

12 Write a note on 'clearance test'/'renal clearance test'/tests for glomerular filtration.

☞ **Clearance Tests:** Clearance tests are used to access the rate of glomerular filtration and renal blood flow.

The renal clearance of a substance is defined as the volume of plasma from which the substance is completely cleared by the kidneys per minute.

This depends on:

(a) Plasma concentration of the substance and its excretion rate
(b) GFR (normal—120 ml/min)
(c) Renal plasma flow.

Clearance of the substance can be calculated by the following equation:

$$C = \frac{U \times V}{P},$$

where, C — clearance of the substances (ml/min)
U — concentration of the substances in urine (mg/L)
P — concentration of substance in plasma (mg/L)
V — volume of urine passed per min.

The substances which are used for clearance test include:

- Endogenous – Creatinine, urea
- Exogenous – Inulin

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. Glomerular capsule is also known as **Bowman's capsule**.
2. The act of contraction of urinary bladder to pass the urine is called **micturition**.
3. **Urethra** is a canal through which urine passes from bladder to outside which differs in males and females having a sphincter which is common.
4. **Nephron** is the basic structural and functional unit of the urinary system/renal system.
5. Nephron is also known as **uriniferous tubule**.

6. The hormone secreted by the hypothalamus to increase fluid reabsorption is **ADH**.
7. **Glucose** would not normally be expected to appear in urine.
8. The urinary bladder stores about **0.5 litres** of urine temporarily.
9. Each kidney contains about a million nephrons, each of which begins in a filtration apparatus called **glomerular capsule**.
10. The volume of glomerular filtrate per day in an adult is **80 litres**.
11. In an adult each kidney weighs about **140 gm**.
12. Each kidney is composed of about **1 million** of nephrons.
13. **Glucose** is an example of high threshold substances.
14. GFR means **glomerular filtration rate**.
15. **Pus** is an abnormal constituent of urine.
16. Inflammation of kidney means **nephritis**.
17. An abnormal accumulation of tissue fluid in the intracellular spaces of the body is called **oedema**.
18. Normal odour of human urine is **aromatic**.
19. About **125 ml** of blood is filtered out per minute as a glomerular filtration.
20. The action of aldosterone is **sodium reabsorption**.
21. The complete suppression of urine means **anuria**.
22. The glomerular filtration rate is about **10%**.
23. The tubular reabsorption occurs at the **PCT**.
24. The anterior half of the proximal convoluted tubules the site of **reabsorption of glucose**.
25. Loop of Henle is meant for absorption of **water**.
26. The presence of pus in the urine is called **pyuria**.
27. The amount of liquid filtered by glomerulus of kidney in a 24 hours period is **170 litres**.
28. Reabsorption of glucose from the glomerular filtrate in the kidney tubule is carried out by **active transport**.
29. Proximal and distal convoluted tubules are parts of **nephron**.
30. **Adrenal glands** are present at the top of each kidney.

Chapter
14

The Endocrine System

1 Define the terms—endocrine glands, exocrine glands and hormones.

☞ **Endocrine Glands**

The ductless glands which secrete the hormones directly into the blood circulation are known as endocrine glands, e.g. pituitary gland, thyroid gland, adrenal gland, testes, ovaries.

Exocrine Glands

The glands having duct which secrete the enzymes/juices on the outer surface of the organs are called exocrine glands, e.g. salivary glands, lacrymal glands, gastric glands.

Hormones **(S.22,24, W.23)**

Hormones are the chemical substances secreted by endocrine glands and are carried by bloodstream to another organ where these have an effect on the organ function, growth and nutrition, e.g. growth hormone, oxytocin, insulin, glucagon.

2 Differentiate between endocrine glands and exocrine glands. (W.22)

☞

	Endocrine glands	Exocrine glands
(i)	These glands do not possess duct and pour their secretions directly into the bloodstream.	These glands possess duct through which their secretions are poured on the outer surfaces of the organs of the body.
(ii)	The secretions of endocrine glands are hormones.	The secretions of exocrine glands are enzymes and juices.

Contd...

Contd...

	Endocrine glands	Exocrine glands
(iii)	Functions of endocrine glands are metabolic, growth and balance of the body.	Functions of exocrine glands are related to digestion and absorption.
(iv)	Endocrine glands form a part of communication system with nervous system.	These do not form a part of communication system with nervous system.
(v)	Secretions of endocrine glands affect particular organs.	Exocrine glands show actions locally.
(vi)	Example: Pituitary gland, thyroid gland.	Example: Sweat glands, salivary glands.

3 Differentiate between hormones and enzymes.

☞

	Hormones	Enzymes
(i)	Hormone is a chemical substance which is formed in one particular organ and is carried by bloodstream to another organ where it has an effect.	Enzymes are chemical substances which convert complex food material into simpler form without itself being changed.
(ii)	Hormones are the secretions of endocrine glands.	Enzymes are the secretions of exocrine gland.
(iii)	Hormones are secreted directly in the blood and pass to the target organs where it has its function.	Enzymes are secreted in the duct which opens near the organs where enzyme has its function.
(iv)	Chemically, hormones are peptides, amines, steroids and derivatives of amino acids.	Chemically, enzymes are proteins which catalyse a number of biochemical reactions.
(v)	Example: ADH, GH, LH, ACTH, aldosterone, etc.	Example: Ptyalin, pepsin, trypsin, etc.

4 Name endocrine glands of the body with their locations. (S.24,W.22)

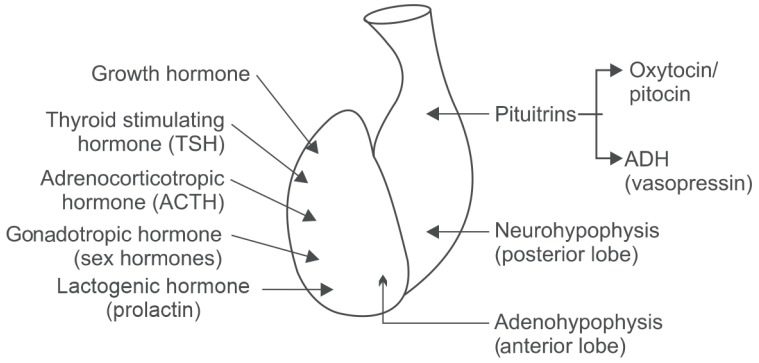
☞ 1. **Pituitary gland:** It is situated in the hypophyseal fossa of the sphenoid bone at the base of the brain.

2. **Thyroid glands:** It is situated in the neck in association with larynx and trachea at the level of Vth, VIth and VIIth cervical and 1st thoracic vertebrae.

3. **Parathyroid glands:** These are embedded in the posterior surface of each lobe of thyroid gland.
4. **Adrenal glands:** These are situated one on the upper pole of each kidney.
5. **Islets of Langerhans cell:** These are found in clusters, irregularly distributed throughout the substance of pancreas.
6. **Pineal gland:** It is a small body situated in the brain below the corpus callosum and posterior to 3rd ventricle of the brain.
7. **Testes in male:** They are suspended in the scrotum (skin) by spermatic cord.
8. **Ovaries in female:** These are situated one on each side of the uterus attached to the broad ligament and below the uterine tubes.

5 Name the hormones secreted by pituitary gland.

☞



Pituitary gland

6 Write in brief about pituitary gland. Why is it called master gland? (W.22)

☞ **Pituitary Gland**

It is a small, reddish-grey-coloured, pea-shaped gland situated near the hypothalamus of brain. Pituitary gland consists of two lobes:

(i) Adenohypophysis (anterior lobe)
(ii) Neurohypophysis (posterior lobe).

The secretions of all other endocrine glands are mostly controlled by pituitary gland. Pituitary gland performs its function by

'negative feedback mechanism'. Hence, called master gland of the body.

7 Give the functions of adenohypophysis/anterior pituitary lobe/gland (APG). (S.23,24,W.23)

☞ **Functions of Adenohypophysis**

1. **Growth hormone:** It controls growth and development of the body.
2. **Thyrotropic hormones (TSH):** It controls the growth and activity of thyroid gland.
3. **Adrenocorticotropic hormone (ACTH):** It stimulates adrenal cortex of the adrenal gland to produce the hormones 'glucocorticoids' and 'mineralocorticoids'.
4. **Lactogenic hormone (prolactin):** In females, it stimulates the growth of breast and secretion of milk.
5. **Gonadotropic hormones (sex hormones):** With the help of FSH and luteinising hormones, it controls secretion of sex hormones such as progesterone, oestrogen and testosterone.

8 Give the functions of neurohypophysis/posterior lobe of pituitary gland. (S.24)

☞ **Functions of Posterior Lobe/Neurohypophysis**

1. Oxytocin/Pitocin

(i) It stimulates contraction of uterus during birth of a baby (parturition).
(ii) It secretes the milk after delivery.
(iii) It helps in the transport of sperms by contracting uterus.

2. Antidiuretic Hormone/ADH/Vasopressin

(i) It contracts the arterial blood vessels and causes rise in blood pressure.
(ii) It reduces urine output, the effect is known as antidiuretic effect.

9 Explain the terms

☞ **(a) Dwarfism**

It is a disorder caused by hypoactivity of pituitary gland, i.e. less secretion of anterior lobe of pituitary gland (mainly growth hormone).

Symptoms

(i) Stunted growth of the body, i.e. adults are about 3 feet in height.
(ii) Bones and other organs do not grow enough.
(iii) Sex organs and secondary sex characteristics do not grow.
(iv) Metabolism is slightly disturbed.

(b) Gigantism

This disorder is caused by hyperactivity of pituitary gland, i.e. excess secretion of growth hormone from anterior lobe of pituitary gland.

Symptoms

(i) The height of individual is 7 to 8 feet.
(ii) Mental confusion may be observed.
(iii) Sweating is increased.
(iv) Metabolism shows hyperglycemia and glycosuria.
(v) Muscles and viscera are proportionally large.
(vi) Organs concerned with metabolism such as heart, lungs, liver are enlarged.

10 Name the hormones of thyroid gland. Give the functions of thyroid hormones.

☞ **Hormones of Thyroid Gland**

(i) Thyroxine (T_4)
(ii) Tri-iodothyronine (T_3)
(iii) Thyrocalcitonin/calcitonin.

Functions of Thyroid Gland/Hormones

(i) Thyroid hormones are essential for normal mental and physical development.
(ii) They are essential for maintenance of healthy skin and hairs.
(iii) They control utilization of oxygen in the body.
(iv) The hormone thyroxin stimulates the absorption of glucose in the body.
(v) They increase fat content and milk secretion from mammary gland.
(vi) They increase heart rate and blood pressure.
(vii) Thyroxin controls the rate of cellular respiration and energy production in the mitochondria.
(viii) The hormone thyrocalcitonin reduces the blood level of calcium.

11 Explain the term goitre.

☞ **Goitre**

It is caused by deficiency of iodine and production of less thyroid hormones from thyroid gland.

Symptoms

(i) An abnormal enlargement of thyroid gland
(ii) Body weight increases
(iii) Swelling of the neck
(iv) Restlessness
(v) Nervousness
(vi) Mental excitement
(vii) Disturbed sleep pattern.

12 Write a note on diabetes mellitus.

The hyposecretion of insulin from the β-cells of islets of Langerhans cells leads to increased blood sugar level. The sugar passes through urine, the condition is called diabetes mellitus.

The 'diabetes' means large volume of urine is passed.

The term 'mellitus' means sweet.

In diabetes mellitus, the blood glucose level exceeds normal renal threshold level (180/100 ml) and hence glucose is found in urine.

Types of Diabetes Mellitus

(i) **Maturity onset type:** It occurs after the age of 40 years. In this case, there is some defect in the release of insulin from β-cells.
(ii) **Juvenile onset type:** It occurs before the age of 20 years. In this case, β-cells are not functional.

Effects or Symptoms/Characteristics of Diabetes Mellitus

(i) Raised blood glucose level (hyperglycemia)
(ii) Glycosuria
(iii) Polyuria
(iv) Polydypsia (excess thirst)
(v) Weight loss
(vi) Dehydration
(vii) Weakness
(viii) Restlessness
(ix) Hyperventilation

(x) Acidosis
(xi) Skin, mouth, tongue become dry
(xii) Increased rate of breathing.

Treatments

(i) Insulin injection
(ii) Low intake of sugar
(iii) Exercise.

13 Differentiate between 'diabetes mellitus' and 'diabetes insipidus'.

☞

	Diabetes mellitus	Diabetes insipidus
(i)	It is caused due to hyposecretion of insulin.	It is caused due to hyposecretion of ADH.
(ii)	It is a disorder of pancreas	It is a disorder of posterior pituitary gland.
(iii)	There is increase in blood sugar level.	No increase in blood sugar level.
(iv)	Glucose is excreted in urine (glucosuria).	No glucosuria.
(v)	Ketone bodies occur in blood and urine.	Ketone bodies do not occur in blood and urine.
(vi)	There is excess of hunger (polyphagia).	No polyphagia.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. **Pituitary gland** is called master gland of the body.
2. The hormone **insulin** is responsible for uptake of glucose from blood by cells.
3. Endocrine glands are ductless glands which secretes **hormones**.
4. **Beta-cells** are found in the pancreas.
5. **ACTH hormone** from the anterior pituitary gland regulates the release of corticosteroid hormones from the adrenal cortex.
6. **Calcitonin** is a hormone secreted by thyroid gland.
7. **Oxytocin** is a hormone released by the posterior lobe of pituitary gland.
8. Sweat gland is an **exocrine gland**.

9. **Pituitary gland** influences the growth and development of the individual.
10. Myxoedema is caused by the deficiency of a hormone secreted by **thyroid gland**.
11. A gland that disappears in the adult but is active during childhood is **thymus**.
12. **Prolactin hormone** stimulates secretion of milk.
13. **Pituitary gland** is located at the base of the brain in the sphenoid bone.
14. **LH and FSH** are hormones known as gonadotrophins.
15. An enlargement of thyroid gland is called **goitre**.
16. **TSH** stimulates growth and activity of thyroid gland and secretion of T3 and T4.
17. ADH is also known as **vasopressin**.
18. Pituitary gland is situated in **hypothalamus**.
19. **Pancreas** is called an endocrine and exocrine gland of the body.
20. Oxytocin hormone stimulates **contraction of uterus**.
21. **Oestrogen and progesterone** are the hormones secreted by ovary.
22. **Dwarfism** means stunted growth of the body caused due to hypoactivity of pituitary gland.
23. Medulla and cortex are the parts of an endocrine gland called **adrenal gland**.
24. **Parathormone** is a hormone secreted by parathyroid gland.
25. **Gigantism disease** is caused by deficiency of hyperactivity of pituitary gland.
26. Deficiency of **thyroxine hormone** produces cretinism.
27. The deficiency of iodine causes **goitre**.
28. Parathormone increases **blood calcium level**.
29. Hormone which helps in production of milk is **prolactin**.
30. Diabetes insipidus is caused due to hyposecretion of **ADH**.

Chapter
15

The Reproductive System

1 Define the terms.

☞ 1. **Reproduction:** It is the process by which genetic material is passed from one generation to another generation and thus maintains continuation of species, i.e. the mechanism by which thread of life is sustained.
2. **Puberty:** Puberty is the age at which all internal reproductive organs reach the maturity.
3. **Menopause:** It is the period which occurs between the age of 45 to 55 years and marking the end of child-bearing period. Or it means permanent cessation of menses.
4. **Ovulation:** The process of maturation of graafian follicle and liberation of ovum is termed ovulation.
5. **Fertilization:** Fertilization is the process of fusion of spermatozoa with the ovum which normally takes place in ampulla part of the fallopian tube.
6. **Menstruation/menstrual cycle:** The periodic discharge of blood, ovum, mucus and cellular debris from uterus to vagina at about 28 days interval is called menstruation.

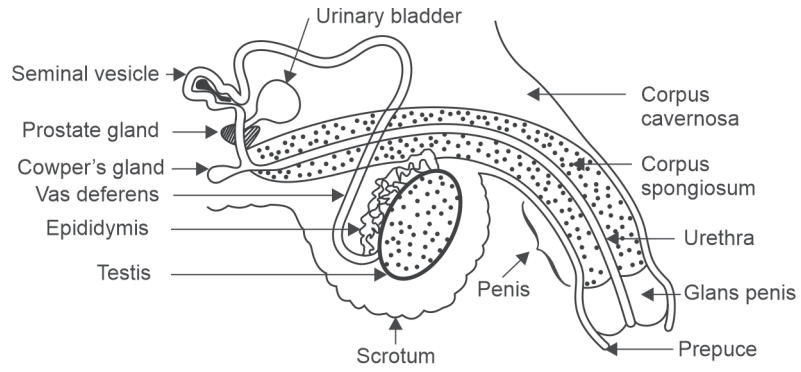
2 Name the organs/parts of the male reproductive system.

☞ **Parts of Male Reproductive System** **(S.22)**

1. Testes (2)
2. Epididymis (2)
3. Vas deferens/deferent ducts (2)
4. Ejaculatory ducts (2)
5. Penis (1)
6. Urethra (1)
7. Accessory sex glands
   (i) Seminal vesicles (2)
   (ii) Prostate gland (1)
   (iii) Cowper's glands (bulbourethral glands) (2).

3 Draw and label a diagram of male reproductive system.

☞



The male reproductive system

4 Write a note on testis.

☞ **Testes**

These are two oval-shaped bodies one on each side in the scrotum.

- The scrotum helps in regulation of body temperature for testis. The muscles of scrotum either contract or relax in response to cold and warmth in order to maintain optimum temperature for formation of spermatozoa. The process of spermatogenesis is better when the temperature of testes is less than 3°C than normal body temperature.
- Each testis is covered by 3 layers:
  - (i) Tunica vaginalis (outer)
  - (ii) Tunica albuginea (middle)
  - (iii) Tunica vasculosa (inner)
- Internally, each testis consists of about 5000 convoluted tubules called seminiferous tubules.
- Spermatozoa are formed in the walls of these seminiferous tubules. The seminiferous tubules unite at upper end of testis and form a network-like structure called epididymis.

Functions of Testes

1. Testes produce spermatozoa by the process of spermatogenesis.
2. Testes secrete the hormone testosterone.

5 Describe various accessory sex glands in male.

☞ **Accessory Sex Glands in Male**

(a) **Seminal vesicle:** These are two sac-like glands present at the base of urinary bladder. These ducts join with vas deferens and form ejaculatory duct.

- **Functions**
  - (i) It provides nourishment to the sperms.
  - (ii) It increases mobility of sperms.

(b) **Prostate glands:** It is the largest accessory gland which surrounds the anterior part of urethra.

- **Functions**
  - (i) Its secretions activate the sperms and provide nourishment to the sperms.
  - (ii) Its secretions neutralise the acidity of urine.
  - (iii) It secretes a fluid containing proteolytic enzymes which helps in liquefication of seminal fluid.

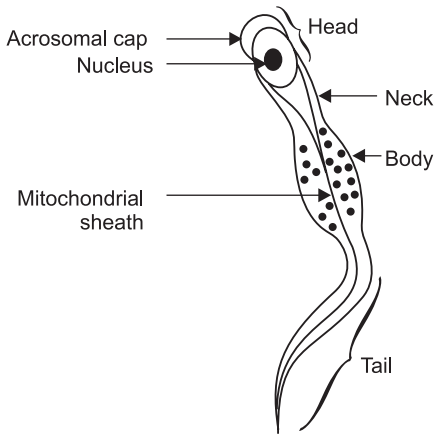
(c) **Cowper's glands:** These are two pea-shaped glands situated at the base of the penis. There ducts open into the bulb of urethra.

- **Functions**
  - (i) These glands secrete an alkaline substance that protects the sperms by neutralising acid environment of urethra.
  - (ii) The mucus secreted by these glands lubricates passage of urethra.
  - (iii) During sexual excitement the Cowper's gland secretes a clear viscous fluid which further lubricates urethra.

6 Explain the structure of sperm/spermatozoon with the help of a diagram.

☞ **Spermatozoon/Sperm**

Spermatozoon is a motile living male gamate produced by seminiferous tubule of the testes by the process of spermatogenesis.



The sperm

Structure

The total length of spermatozoon is 55 to 65 μ. The spermatozoa has four main parts.

1. **Head:** Head of the sperm is flat and consists of nucleus. The nucleus is covered at anterior end by acrosomal cap. 'Acrosomal cap' produces an enzyme 'hyaluronidase' which dissolves the egg membrane so that penetration of sperm into ovum takes place.
2. **Neck:** It connects the head to the middle piece, i.e. to the body. It is short and weak. It contains centriole.
3. **Body:** The body has rings of fibrils with sheath and represents mitochondria.
4. **Tail:** Tail of sperm has two parts:
   (i) **Principal piece:** It is the longest portion of the tail having length of 42 to 50 μ. It is without mitochondrial sheath.
   (ii) **Tail piece:** It is a short, slender and about 5 to 10 μ in length. It has typical appearance of flagellum and consists of microtubules surrounded by plasmalemma that covers the entire sperm.

7 Write a note on seminal fluid or semen.

☞ **Semen**

Semen is a fluid ejaculated from urethra of male during coitus, i.e. sexual stimulation. Semen is a thick whitish fluid which is very viscous in nature. It is slightly alkaline and has pH of about 7.4.

Composition of Semen

Semen is composed of:

(i) Spermatozoa in testes
(ii) A viscous fluid from seminal vesicles
(iii) Secretion of prostate gland
(iv) Secretion of Cowper's gland
(v) Mucus secreted by glands.

Functions of Semen

(i) Semen contains spermatozoa which are to be introduced into female vagina during coitus.
(ii) After ejaculation of semen, the individual satisfies full sexual pleasure.

8 Define puberty. What are the changes involved in male during puberty?

☞ **Puberty**

Puberty is the age of maturity at which all the reproductive organs reach to the maturity.

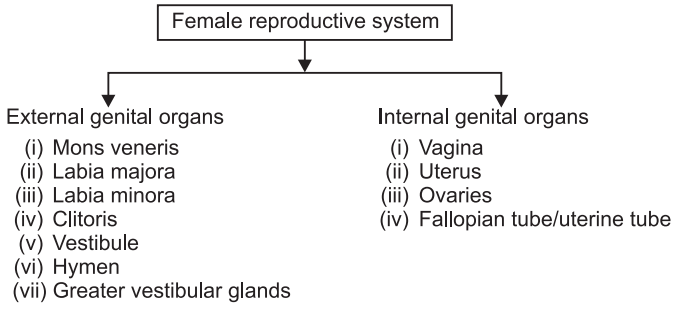
- In case of male, puberty occurs between the ages of 10 and 14 years.
- The hormone testosterone secreted in this stage influences the development of body to sexual maturity.

The Changes which Occur at Puberty in Males

1. Growth of muscles and marked increase in height and body weight.
2. Enlargement of larynx and deeping of voice breaks.
3. Growth of hairs on face, chest, abdomen and pubis.
4. Enlargement of penis, scrotum and prostate gland.
5. Maturation of seminiferous tubules and production of spermatozoa.
6. Ejaculation of seminal fluid.

9 Name the parts/organs of female reproductive system.

☞



10 Write in short about uterus.

☞ **Uterus**

Uterus is a thick muscular pear-shaped bag situated between urinary bladder and rectum. It measures about 8 cm in length, 5 cm in breadth and 2 cm in thickness. It consists of three parts:

(i) **Fundus:** It is an upper dome-shaped part of uterus.

(ii) **Body:** It is middle part of uterus.

(iii) **Cervix:** It is lower part of uterus which opens into vagina by external os.

The walls of uterus consist of three layers:

(i) Perimetrium

(ii) Myometrium

(iii) Endometrium.

Functions

(i) It provides space for growth and development of embryo.

(ii) It plays an active role in menstruation.

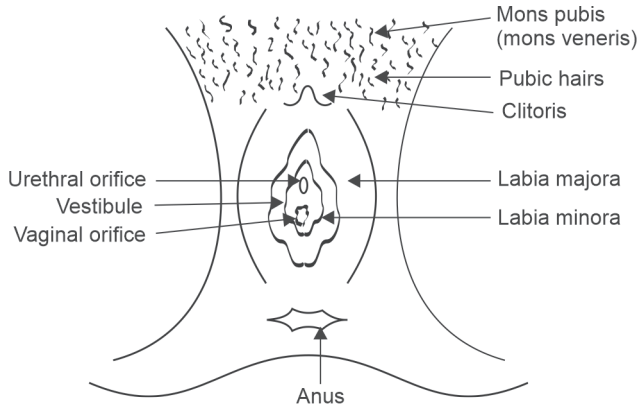
(iii) It receives fertilized ovum and allows for implantation.

(iv) It expels the foetus by contraction.

(v) It receives the sperms during coitus.

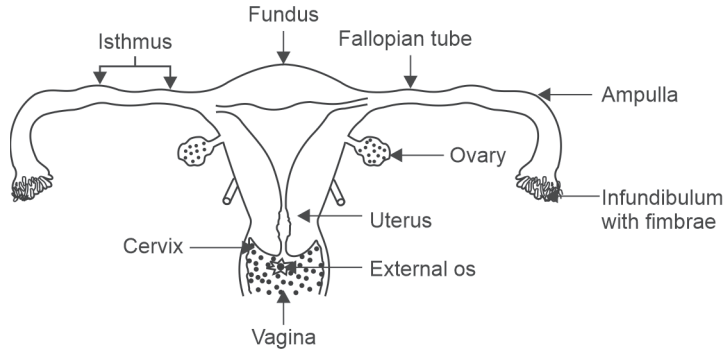
11 Draw and label a diagram of female external reproductive system.

☞



The female external reproductive system

12 Draw and label a diagram of female internal reproductive system.



The female internal reproductive system

13 Write a note on ovaries.

Ovaries

Ovaries are two female sex organs situated near the kidney on either side of uterus. Each ovary is attached to the uterus by an ovarian ligament.

Functions of Ovaries **(W.23)**

1. Ovaries help in formation, development and liberation of ovum.
2. It helps in production of oestrogen by graafian follicles.
3. It helps in production of progesterone by corpus callosum.

14 Define puberty. Explain physiological changes occurring in female during puberty.

Puberty

It is the age at which all internal reproductive organs reach to the maturity.

- Puberty usually occurs at the age of 10 to 14 years in girls.
- It is marked by 'onset of menstruation'.

Physiological Changes Observed in Female during Puberty

(i) Onset of menstruation and ovulation.
(ii) Enlargement of vagina and breast.
(iii) Growth of axillary and pubic hairs.

(iv) Maturation of ovaries, uterus and uterine tubes.
(v) Increase in rate of growth in height and widening of the pelvis.
(vi) Increased deposition of fat in subcutaneous tissue.
(vii) Mental and emotional maturity.

15 Write in brief about 'menopause'.

☞ **Menopause**

It is a period which occurs between the age of 45 and 55 years and marking the end of child-bearing period.

- Menopause means permanent cessation of menses.
- Menopause is caused by changes in concentration of sex hormones.
- Ovaries become less responsive to FSH and LH stimulation. Hence, ovulation and menstrual cycle becomes irregular and stops immediately.

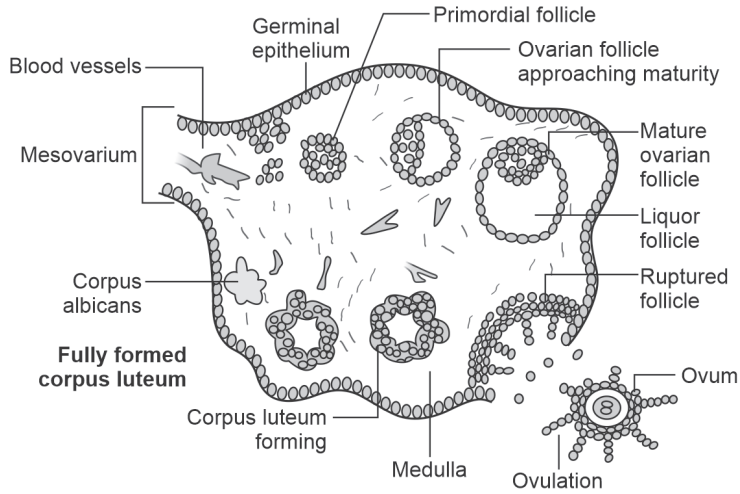
Changes involved in Female during Menopause

(i) Breast shrinks.
(ii) Axillary and pubic hairs become sparse.
(iii) Atropy of sex hormones.
(iv) Episodes of uncharacteristic behaviour.
(v) Sweating.
(vi) Palpitation (rapid forceful heartbeat).
(vii) Discomfort and disturbances of normal sleep pattern.

16 Explain the terms.

☞ 1. **Amenorrhoea:** It means an absence of menses, i.e. menstrual fluid.
2. **Dysmenorrhoea:** It means painful menstruation in women comes during first day of the menstruation period often within an hour the start of bleeding.
3. **Leucorrhoea:** Excessive discharge of fluid from the cervix of the uterus, vagina and associated glands with appearance of discharge of WBCs.
4. **Galactorrhoea:** It means excessive flow of milk from the breast, i.e. mammary glands.
5. **Migraine:** It means recurring paroxysmal headache mostly occurs unilateral, associated with nausea, vomiting and visual disturbances in female during menstrual cycle.

17 Describe microscopic structure of ovary with the help of diagram. (W.23)



Microscopic structure of ovary

Explanation

1. **The germinal epithelium:** It is the outer layer of simple epithelium that covers the surface of ovary and is continuous with mesothelium that covers mesovarium.
2. **The tunical albugenia:** It is a capsule below germinal epithelium.
3. **The cortex:** It surrounds the medulla. It contains ovarian follicle in various stages of maturity, each contains an ovum. Before puberty it contains immature follicles (primordial follicles), which the female has from birth. During the childbearing years (after puberty), one ovarian follicle matures (graafian follicle) and ruptures and releases ovum into the peritonial cavity and occurs during each menstrual cycle. The ruptured follicle develops into the corpus luteum which in turn becomes corpus albicans.
4. **Medulla:** It lies in the centre and consists of fibrous tissue, blood vessels and nerves.

18 Define menstrual cycle. Describe the phases of "menstrual cycle"/menstruation. (S.23,24, W.22)

Menstrual cycle: It is a series of changes in endometrium of a female, every 26 to 30 days throughout the child-bearing period.

The phases of menstrual cycle are divided into:

1. **Menstrual phase (04 days):**
   - It is characterized by periodic discharge of 25–65 ml of blood, tissue fluid, mucus and epithelial cells.
   - It is caused by sudden reduction in oestrogen and progesterone and lasts for approximately 4–5 days.
   - During menstrual phase, ovarian cycle is also in operation and primary follicle begins its development.
   - At birth, each ovary contains 200,000 follicles each consisting of primary ovum surrounded by single epithelium.
   - Towards the end of menstrual phase, many primary follicles developed into secondary follicle which consist of secondary ova.
2. **Proliferative phase (10 days):**
   - It is characterized by release of oestrogen.
   - During this, endometrium gets proliferated and it gets renewed in this period.
   - Also, graafian follicle is maturing and this phase is terminated when ovulation occurs and oestrogen production is inhibited.
3. **Secretory phase (14 days):**
   - Immediately after ovulation, the cells lining of ovarian follicle are stimulated by LH to develop corpus luteum which further produces progesterone.
   - Under the influence of progesterone, the endometrium becomes oedematous and secretory glands produce an increased amount of watery mucus which is also called luteal phase.
   - If the implantation of fertilized ovum occurs, then endometrium grows further.
   - Then the menstrual cycle is interrupted during the period of lactation. If ovum is not fertilized, the cycle enters in the next phase.

19 Differentiate between spermatogenesis and oogenesis.

☞

	Spermatogenesis	Oogenesis
1.	It occurs inside the testis.	It occurs inside the ovary.
2.	All stages are completed inside the testis.	Major part of oogenesis occurs inside ovary but last stage occurs inside oviduct.
3.	Spermatogenia develop from germinal epithelium lining of the seminiferous tubules.	Oogonia develop from germinal epithelium overlying the ovary.
4.	All spermatogonia divides to form spermatozoa.	Only some oogonia give rise to oocytes.
5.	Growth phase is short.	Growth phase is prolonged.
6.	A spermatocyte forms four spermatozoa.	A oocyte forms only one egg or ovum.
7.	Reserve food is little in the sperms.	Ovum collects a lot of reserve food and other biochemicals.
8.	It produces motile male gametes.	It forms non-motile female gametes.

20 What is pregnancy? Explain various stages of pregnancy.

☞ **Pregnancy:** Pregnancy is the time during which one or more offspring develops inside a woman.

- **Common symptoms and discomforts of pregnancy:**
  1. Tiredness
  2. Constipation
  3. Pelvic girdle pain
  4. Back pain
  5. Increased urinary frequency
  6. Haemorrhoids (piles)
  7. Heart burn, nausea
  8. Breast tenderness
  9. Pregnancy-related stretch marks
- **Stages of pregnancy (physiology of pregnancy):** Fertilization is the event where the egg cell fuses with male gamete, spermatozoon to produce zygote, which is then implanted into the uterus.

  Fertilization (conception) is sometimes used as the initiation of pregnancy.

  (a) First trimester (week 1 to week 12)
  (b) Second trimester (week 3 to week 28)
  (c) Third trimester (week 29 to week 40)

(a) **First trimester:** In this stage, woman undergoes many changes. Hormonal changes affect almost every organ system in female body. Menstruation period stopping is a clear sign of pregnancy of woman.

Other signs include—extreme tiredness, swollen breasts, nipples might also stickout, morning sickness, distaste of certain foods, mood swings, constipation, need to pass urine more often, headache, heartburn, weight gain or loss.

(b) **Second trimester:** In this stage woman's abdomen is expanding as the baby continues to grow.

Other changes during this stage—body aches stretch marks on abdomen, breast, thighs or buttocks, darkening of skin around nipples, patches of darker skin usually over the cheeks, forehead, nose or upper lip, numb or tingling hands, itching on the abdomen, palms and sole of feet, swelling of ankles, fingers and face.

(c) **Third trimester:** In this stage some new body changes noticed, i.e. shortness of breath, heartburn, haemorrhoids, tender breast which may leak a watery pre-milk called colostrum. The baby dropping or moving lower in the abdomen, which can be the sign of real or false labour.

21 What is parturition? Give the mechanism and control of parturition.

☞ Parturition

Parturition is the process of expelling of the fully formed baby from the mother's uterus after pregnancy period. Parturition is the process of giving birth.

- Mechanism and control of parturition: Parturition is induced by a complex neuroendocrine mechanism which is triggered by fully formed foetus and the placenta called foetal ejection complex.

  Parturition is controlled by two hormones.

  (a) Oxytocin: It causes powerful contractions of myometrium during parturition and pushes the young baby gradually outside.

  (b) Relaxin: It causes widening of pelvis by relaxing the pubic symphysis of the pelvic girdle.

Parturition is also called childbirth or process of bringing out a child from the uterus or womb.

OBJECTIVE QUESTIONS WITH ANSWERS IN BOLD LETTERS

1. In adult males, sperms are produced in the **testis**.
2. Menopause means permanent **cessation of the menses**
3. Each testis consists of **seminiferous tubules**.
4. Menopause period occurs in women in between ages of **45 and 55 years**.
5. Menstruation/menstrual cycle is about **28 days'** cycle.
6. In adult males, **Leydig cells** produce testosterone.
7. The hormone produced by a corpus luteum after ovulation is **progesterone**.
8. **Scrotum** helps to regulate temperature of testis.
9. **Urethra** is the name of tube through which both urine and semen leave a man's body.
10. **Hymen** is the membrane that covers the opening of the vagina.
11. The process of spermatogenesis is better when the temperature of testis is **less than 3°C** than normal body temperature.
12. Fertilization usually takes place in the **fallopian tube**.
13. **Prostate gland** is the largest accessory gland of the male reproductive system.
14. The onset of reproductive maturity is known as **puberty**.
15. Cowper's gland is also known as **bulbourethral gland**.
16. Colostrum is a thin fluid which is rich in **proteins**.
17. Nourishment to the developing cells in the testes is provided by **Sertoli cells**.
18. **Spermatogenesis** is the process of formation of sperms in the testis.
19. Proliferation of uterine wall is maximum when the blood contains high levels of **estrogens**.
20. Fructose and prostaglandins are present in the secretion of **seminal vesicles**.
21. The fold of skin covering the penis is called **prepuce**.
22. Location and secretion of Leydig's cell is **testis, testosterone**.

23. Puberty is marked by **onset of menstruation**.
24. Puberty usually occurs at the age of **10 to 14 years**.
25. The nutritive medium for the ejaculated sperms is given by the **seminal fluid**.
26. Amenorrhoea means **absence of menses**.
27. The menstrual cycle in a normal adult woman is **28 days**.
28. **Fimbriae** help in collection of ovum after ovulation.
29. In human beings the median tube where the uterus opens independently is called **vagina**.
30. Parturition is controlled by two hormones, namely **oxytocin and relaxin**.

Board Examination Papers
Summer Examination 2022
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following. **30 Marks**

a. Define skeleton. Name the bones of axial and appendicular Skeleton.
b. Describe the process of blood coagulation. Name the factors which accelerate and retard blood clotting.
c. Describe the structure and functions of skin with a neat labelled diagram.
d. Name the valves and chambers of human heart. Explain cardiac cycle.
e. Draw a neat labelled sketch of LS of kidney and explain its structure.
f. Define reflex action. Describe the basic components of reflex arc with labelled diagram.
g. Name the organs of digestive system. Give the composition and functions of gastric juice.

Q2. Answer any TEN of the following. **30 Marks**

a. Name four fundamental tissues of body. Differentiate between smooth and skeletal muscles.
b. Define the terms:
   (i) Cardiac output
   (ii) Stroke volume
   (iii) Blood pressure
c. Draw a neat sketch of human cell and label:
   (i) Nucleus
   (ii) Golgi apparatus
   (iii) Mitochondria
   (iv) Cytoplasm
   (v) Lysosomes
   (vi) Endoplasmic reticulum
d. Write six functions of liver.

e. Define hormones. Name hormones of anterior pituitary gland.
f. Classify leukocytes with their functions.
g. Draw a neat labelled diagram of lymph node and state its two functions.
h. Explain the physiology of respiration.
i. Write the effect of stimulation of sympathetic system on:
   (i) Heart
   (ii) Eye
   (iii) Small intestine
j. Explain the role of insulin and glucagon in the body.
k. Name different parts of male reproductive system with their functions.

Q3. Answer ALL questions of the following. 20 Marks

a. Name three layers of heart.
b. The blood vessel which carry deoxygenated blood from heart to lungs is _____.
c. The right lung has _____ white left lung has _____ lobes.
d. Intrinsic factor is necessary for absorption of _____.
e. _____ is hormone secreted by testes.
f. Name the bones involved in elbow joint.
g. Neurotransmitter released at neuromuscular junction is _____.
h. Peripheral nervous system consists of _____ pairs of cranial nerves and _____ pairs of spinal nerves.
i. Name the cranial nerve responsible for equilibrium and hearing.
j. In which part of female reproductive system fertilization of ovum takes place?
k. The study of physical structures of body is _____.
   (i) Anatomy (ii) Physiology
   (iii) Histology (iv) Cytology
l. The term "medial" means _____.
   (i) Away from surface of body
   (ii) Near to head
   (iii) Away from the head
   (iv) Near to midline

m. Which of the following is not a connective tissue?
(i) Blood (ii) Bone
(iii) Cardiac muscle (iv) Adipose tissue

n. The exchange of gases between air and lungs is called _____.
(i) Internal respiration (ii) Cellular respiration
(iii) External respiration (iv) Bronchodilation

o. Organ of Corti helps in _____.
(i) Balancing (ii) Hearing
(iii) Vision (iv) All of the above

p. Taste cells on tongue that receive the stimulation of taste are _____.
(i) Olfactory receptor (ii) Gustatory receptors
(iii) Baroreceptor (iv) Photoreceptor

q. _____ focuses light in retina.
(i) Sclera (ii) Iris
(iii) Cornea (iv) Ciliary muscles

r. Following is an example of hinge joint.
(i) Shoulder joint ((ii) Hip joint
(iii) Knee joint (iv) All joints in body

s. The functional unit of contractile system in striated muscle is known as _____.
(i) M-line (ii) Actin
(iii) Sarcomere (iv) Myofibril

t. The reason why right kidney is slightly lower than the left kidney is _____.
(i) Right kidney is bigger than the left
(ii) Right kidney is smaller than the left
(iii) Considerable space occupied by liver on right side
(iv) Considerable space occupied by heart

Summer Examination 2022
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following. **30 Marks**

a. Define skeleton. Name the bones of the axial and appendicular skeleton.

Ans: Skeleton: It is the bony framework of the body.

Bones of axial skeleton: This includes bones of the skull, vertebral column and rib cage.

Bones of skull: Skull has two sets of bones: Eight cranial bones and 14 facial bones.

The eight cranial bones include:

- Two parietal bones
- Two temporal bones
- One frontal bone.
- One occipital bone.
- One ethmoid bone.
- One sphenoid bone.

The 14 facial bones include:

- Two maxilla bones .
- Two zygomatic bones
- One mandible bone.
- Two nasal bones
- Two palatine bones
- Two nasal concha bones
- Two lacrimal bones
- One vomer bone

Bones of the vertebral column, or spine,

- 24 vertebrae, sacrum and coccyx
- 7 cervical vertebrae
- 12 thoracic vertebrae
- 5 lumbar vertebrae

- Sacrum
- Coccyx

Rib cage: Sternum (breast bone) and 12 pairs of ribs

Bones of appendicular skeleton: This includes bones of pectoral girdle, upper limb, pelvic girdle and lower limb

Pectoral girdle: Clavicle (2)

Scapula (2)

The bones of upper limb are:

- Humerus (2)
- Radius (2)
- Ulna (2)
- Carpals (16)
- Metacarpals (10)
- Phalanges (28)

Pelvic girdle: Innominate, or hip bones (2)

Bones of the lower limb

- Femur (2)
- Tibia (2)
- Fibula (2)
- Patella (2)
- Tarsals (14)
- Metatarsals (10)
- Phalanges (28)

b. Describe the process of blood coagulation. Name the factors which accelerate and retard blood clotting.

Ans: When the blood vessel is damaged, loss of blood is stopped by the following ways.

1. **Vasoconstriction:** Serotonin is released from damaged blood vessels that cause vasoconstriction. When platelets come in contact with a damaged blood vessel, they adhere to it.
2. **Platelet plug formation:** The adhered platelets attract more platelets which form platelet plug. This forms a temporary seal.
3. **Coagulation (blood clotting):** The thromboplastin (prothrombinase) released by damaged tissue cells by extrinsic or intrinsic pathway. In presence of calcium ions, it converts prothrombin to thrombin. Thrombin acts on fibrinogen and converts it to insoluble fibrin. The fibrin mesh traps blood cells. This is known as clotting.

Prothrombin + Calcium + Thromboplastin → Thrombin
(inactive) (from damaged tissue) (active)
Thrombin acts on
↓
Fibrinogen → Fibrin
(soluble) (insoluble)
Fibrin + Blood Cells → Clot

Factors accelerating clotting are:

(a) During menstruation and parturition,
(b) Injury to the walls of the blood vessels,
(c) The venom of viper snakes
(d) Higher temperature (above 46°C)
(e) Presence of calcium salts

Factors retarding clotting are

(a) Clinical conditions like hemophilia, liver disease, afibrinogenemia, Christmas disease, etc.
(b) Removal calcium ions from the blood by addition of sodium or potassium or citrate ions.
(c) Calcium deficiency in blood
(d) Lower temperature: However, lower temperature causes contraction of blood vessels.
(e) Deficiency of vitamin K

c. Describe the structure and functions of skin with a neat labeled diagram.

Ans: Structure of Skin:

There are two main layers—epidermis and dermis.

A. Epidermis: It is the most superficial layer composed of stratified keratinized squamous epithelium, which varies in thickness in different parts of the body. It is thickest on the palms and soles. There are no blood vessels in the epidermis. There are several layers of cells in the epidermis which extends from the deepest germinative layer to the surface stratum corneum. The cells on the surface are flat non-nucleated and dead cells and have protein keratin. The cells from the germinative layer undergo change as they come towards the surface.

Stratum basale: It is composed of a single layer of cuboidal or columnar keratinocytes. Some cells that are stem cells undergo cell division to continually produce new keratinocytes. The nuclei in these layers are large.

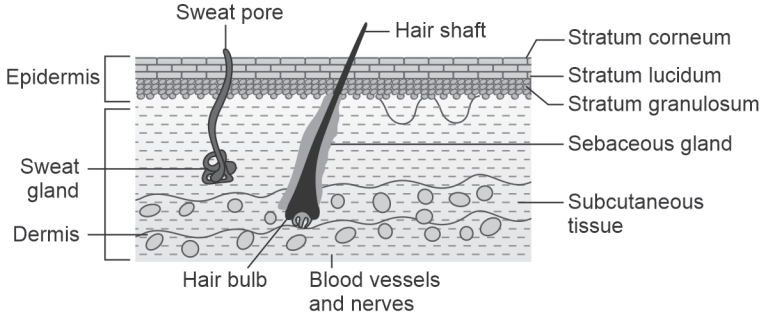
Stratum spinosum: Keratinocytes are arranged in 8–10 layers. Cells in the more superficial layers become flattened.

Stratum granulosum: This consists of 3–5 layers of flattened cells. The nuclei and other organelles begin to degenerate as they move away from the dermal blood vessels.

Stratum lucidum: It is present only in the thick skin of areas such as the fingertips, palms and soles. It consists of four 4–6 layers of flattened clear dead keratinocytes containing keratin.

Stratum corneum: It consists of 25–30 layers of flattened dead cells. The cells on the surface are flat, non-nucleated and dead cells and have protein keratin. The cells continue to shed and be replaced by cells from deeper strata. It forms a protective layer.

B. Dermis: It is tough and elastic. It is made up of connective tissue: The collagen and elastic fibers. Fibroblasts, macrophages and masts cells are found in dermis. There are blood vessels, lymph vessels, sensory nerve ending, sweat glands, hair, arrector pili muscles and sebaceous glands in the dermis.



Structure of skin

Functions of skin

(i) **Protection:** It forms the waterproof layer and protects the inner delicate structures. It acts as the barrier against the invasion of the microbes, chemicals and dehydration. The melanin pigment protects against the harmful UV rays.

(ii) **Regulation of body temperature:** The temperature is constant at 36.8°C. When the metabolic rate of the body increases, the body temperature increases and vice versa. To ensure constant body temperature a balance between heat production and heat loss is maintained by the skin.

(iii) **Formation of Vitamin D:** 7-dehydroxycholesterol is present in the skin. UV light from the sun converts it to vitamin D.

(iv) **Sensation:** There are different sensations like touch, pain, pressure, etc., are felt due to the presence of sensory receptors in the skin.

(v) **Absorption:** Some drugs and chemicals are absorbed through the skin.

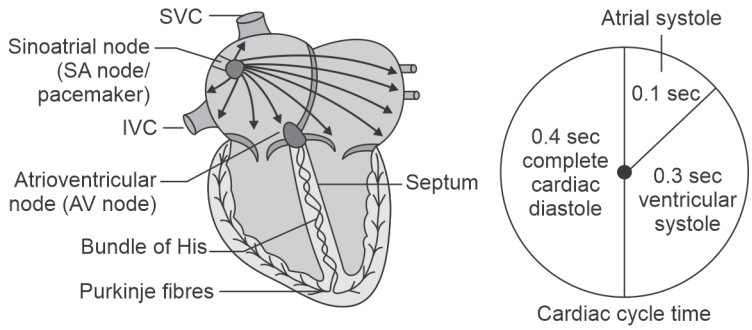
(vi) **Excretion:** Skin is a minor excretory organ and excretes NaCl, urea and substances like garlic.

d. Name the valves and chambers of the human heart. Explain cardiac cycle.

Ans: Valves of the heart: The right AV valve or tricuspid valve and left AV valve or bicuspid valve or mitral valve

Chambers of the heart: Left atrium and right atrium, left ventricle and right ventricle

Cardiac cycle: The events which occur in the heart during the circulation of blood during each heartbeat is called cardiac cycle OR the series of events during one heartbeat is known as cardiac cycle.



Cardic cycle

Events in cardiac cycle:

(i) Atrial systole (0.1 sec)

(ii) Ventricular systole (0.3 sec)

(iii) Complete cardiac diastole (0.4 sec): Total 0.8 secs.

Description of cardiac cycle

The superior and inferior vena cava transports the deoxygenated blood into the right atrium. At the same time, four pulmonary veins transport oxygenated blood into the left atrium. The heart action starts in the special cells of

myocardium called SA node or sino-atrial node. It is situated near the opening of the superior vena cava in the right atrium. These impulses from the SA node spread over the atria, atria contracts, the AV valves open and blood flows to the ventricles (atrial systole-0.1 sec). When the wave of contraction reaches AV node, it is stimulated and emits impulses which spread over AV bundle, bundle branches and Purkinje fibres resulting in contraction of ventricles pumping the blood into pulmonary artery and the aorta. (Ventricular systole 0.3 sec). After the contraction of the ventricles there is complete cardiac diastole (0.4 sec) when both atria and ventricles relax. After this the next cycle begins.

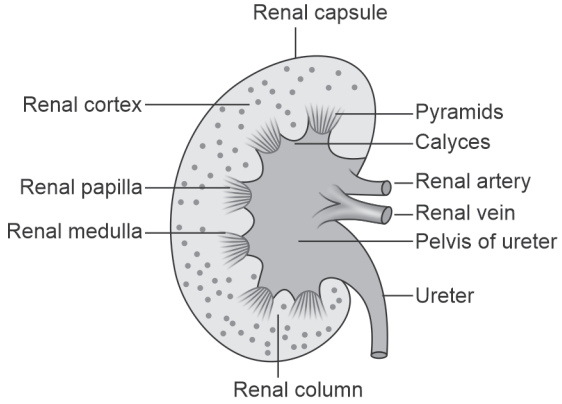
e. Draw a well-labeled sketch of LS of kidney and explain the structure.

Ans: Structure of kidney: There are three areas of tissues that are seen in the LS of kidney.

The outer fibrous capsule surrounding the kidney.

The cortex, a reddish brown layer below the capsule and outside the pyramids.

The medulla, the innermost layer consisting of conical-shaped striations, the renal pyramids.The renal papilla is at the apex of the pyramids. The papilla opens into a minor calyx. The minor calyces unite to form the major calyx. Major calyces unite to form the renal pelvis.The renal pelvis is the funnel-shaped structure that collects the urine. The renal pelvis continues as a ureter. The hilum is the concave medial border of the kidney where the renal blood vessel, lymph vessel, ureter and nerves enter.

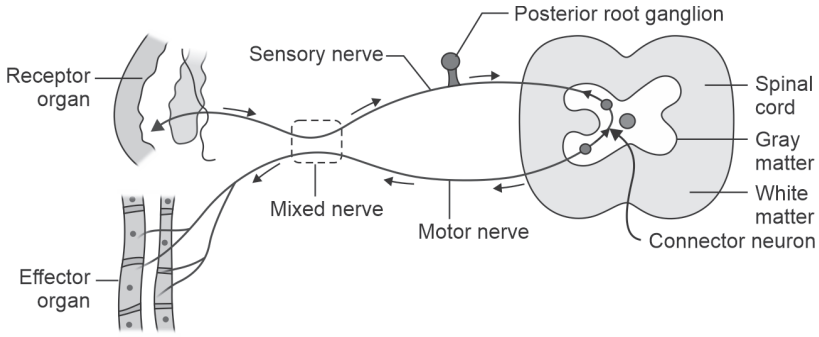


LS of kidney

f. Define reflex action. Describe the basic components of the reflex arc with a labeled diagram.

Ans: Reflex action: A reflex action is an involuntary and immediate motor response to a sensory stimulus.

Component of reflex arc: It consists of structures which are involved in the production of a reflex action.
These structures are:
A sensory receptor present in skin which receives the sensory impulses.
A sensory nerve which transmits sensory impulses from sensory organ to posterior root of spinal cord.
A connector neuron which receives sensory impulses interprets it and generates motor impulses.
A motor nerve which transmits motor impulses to the motor (effector) organ.
An effector organ like muscle which receives motor impulses, gets excited and shows response to the impulses.



Structure of simple reflex arc

g. Name the organs of the digestive system. Give the composition and functions of gastric juice.

Ans: Organs of digestive system:

(a) **Alimentary tract:** Mouth, pharynx, oesophagus, stomach, small intestine, large intestine, rectum and anal canal.

(b) **Accessory organs:** Teeth, tongue, 3 pairs of salivary glands, pancreas, liver and biliary duct

Composition of gastric juice: Water, mineral salts, mucus, hydrochloric acid, enzymes such as pepsinogen, intrinsic factor.

Functions of Gastric Juice:

1. Water liquefies the food.
2. HCl acidifies the food and stops the action of salivary amylase.
3. HCl kills the microbes
4. Pepsinogen is activated to pepsin by HCl. This digests protein to peptones and peptides.
5. Intrinsic factor helps in absorption of vitamin B_{12} from small intestine.
6. Mucus prevents mechanical injury to the stomach wall.

Q2. Answer any TEN of the following. 30 Marks

a. Name four fundamental tissues of the body. Differentiate between smooth and skeletal muscles.

Ans: Fundamental tissues are: Epithelial, connective, muscle and nervous tissue.

Differences between smooth muscle and skeletal muscle:

Skeletal muscle	Smooth muscle
It is also known as striated muscle.	It is known as non-striated muscle.
It is less extensible.	It is more extensible.
The fibres (cell) are cylindrical and have many nuclei.	The cells are spindle shaped with only one central nucleus.
They are under the control of our will (voluntary).	They are not under the control of our will (involuntary).
The fibrous tissue enclosing muscle extends beyond the fibres to become the tendon which attaches the muscle to the bone or skin.	The bundles of fibres form the whole sheets of muscle.
There is a distinct sarcolemma.	There is no distinct sarcolemma.

b. Define the terms:

Ans: (i) **Cardiac output:** The amount of blood ejected from each ventricle every minute.

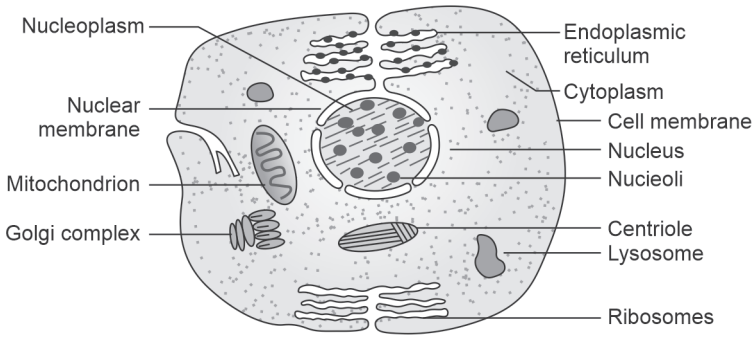
Cardiac output = Stroke volume × heart rate

(ii) **Stroke volume:** The amount of blood expelled by each contraction of the ventricles.

(iii) **Blood pressure:** It is lateral pressure exerted by blood on the arterial wall.

c. Draw a neat sketch of human cell and label:

(i) Nucleus, (ii) Golgi apparatus, (iii) Mitochondria, (iv) Cytoplasm, (v) Lysosomes (vi) Endoplasmic reticulum



Cell

d. Write six functions of the liver.

Ans: Functions of the liver:

1. **Carbohydrates metabolism OR Glycogenic function:** The hepatic cells by the action of enzymes convert glucose into glycogen and it is then stored in the liver.
2. **Metabolism of fat:** Whenever energy is needed, the saturated stored fat is converted to a form in which it can be used to provide energy.
3. **Protein metabolism OR Formation of urea:** Hepatic cells by the action of the enzyme cause deamination of amino acids, i.e. amine group is set free which forms urea.
4. **Destruction of RBCs and defence against microbes:** Carried out by phagocytic macrophages (Kupffer cells) in the sinusoids.
5. **Detoxification of drugs and toxic substances:** The toxic substances entering the body after absorption through the alimentary canal are destroyed in the liver.
6. **Inactivation of hormones:** Hormones like insulin, glucagon, cortisol, aldosterone, thyroid and sex hormones are inactivated by the liver.

7. **Secretion of bile:** The constituents of bile secreted by hepatocytes from the mixed arterial and venous blood in the sinusoids.
8. **Production of heat:** It uses a considerable amount of energy, has a high metabolic rate and hence produces a great amount of heat. It is the main heat-producing organ.
9. **Formation of RBCs in foetal life:** Formation of heparin, a natural anticoagulant in the blood.
10. Storage of glycogen, fat-soluble vitamins like A, D, E, and K, iron, copper, and vitamin B_{12}.

e. Define hormones. Name hormones of anterior pituitary gland.

Ans: Hormone is a chemical messenger secreted by endocrine gland into the bloodstream, carried away at a distance where it influences cellular activity.

Hormones secreted by anterior lobe:

1. Growth hormone
2. Thyrotropic hormone/thyroid stimulating hormone (TSH)
3. Adrenocorticotropic hormone (ACTH)
4. Gonadotrophic hormones
5. Follicle stimulating hormone (FSH)
6. Luteinising hormone (LH)/interstitial cell-stimulating hormone (ICSH)
7. Lactogenic hormone (prolactin)

f. Classify leukocytes with their functions.

Ans: Leukocytes are classified as:

Granulocytes	Agranulocytes
1. Neutrophils	1. Monocytes
2. Eosinophils	2. Lymphocytes
3. Basophils	

Functions:

Neutrophils: Phagocytosis: Destruction of bacteria and engulfing of foreign material.

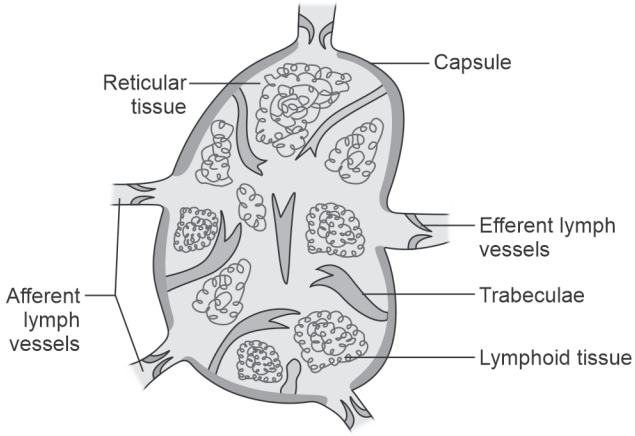
Eosinophils: Phagocytoses antigen–antibody complex, parasitic invasion; overcomes effects of histamine involved in inflammation during allergic reactions.

Basophils: Liberate heparin, histamine and serotonin at inflammation sites in allergic reactions, that intensify overall inflammatory response.

Monocytes: Phagocytosis
Lymphocytes: These develop into plasma cells which secrete antibodies.

g. Draw a neat labelled diagram of the lymph node and state its two functions.

Ans:



Functions:

1. **Filtration:** Foreign substances are trapped by reticular fibres. Macrophages and lymphocytes destroy these foreign substances. Filtered lymph then leaves the other end of the lymph node.
2. **Proliferation:** T-lymphocytes and b-lymphocytes undergo multiplication in lymph nodes.

Nodes

h. Explain the physiology of respiration.

Ans: Respiration is a process of supply of oxygen present in the atmosphere into the body and excretion for carbon dioxide. The normal human has 12–15 breaths per minute. Each breath consists of inspiration, expiration and pause.

Inspiration: The simultaneous contraction of intercostal muscles and diaphragm increases the capacity of thoracic cavity. This reduces the pressure in the lungs.

To equalise the pressure the air from the atmosphere enters the lungs. The process of inspiration is active as it needs energy for muscle contraction. It lasts for 2 seconds.

Expiration: Relaxation of intercostal muscles and diaphragm results in decrease in the space in the lungs. As a result, the pressure inside the lungs increases as compared to atmospheric pressure. The air from the lungs is expelled from the lungs. This process is passive as it does not require energy. The expiration lasts for 3 sec.

After expiration there is pause and then the next cycle begins.

i. Write the effect of stimulation of sympathetic system on:

Ans: 1. **Heart:** Increases rate and force of the contraction.
2. **Eye:** Dilates pupil causing mydriasis.
3. **Small intestine:** Reduces peristalsis (intestinal motility), thereby slows down digestion process.

j. Explain the role of insulin and glucagon in the body.

Ans: Role of insulin: It decreases blood sugar level.

1. It increases the uptake of glucose by the cells.
2. Increases the conversion of glucose to glycogen in the liver and skeletal muscles.
3. It increases the uptake of amino acids by the cells.
4. It promotes the synthesis of fatty acids and storage of fats in adipose tissue.
5. Decreases glycogenolysis.
6. Prevents breakdown of protein, fat and gluconeogenesis.

Role of glucagon:

1. Its function is to increase blood sugar level.
2. Whenever the blood sugar level falls below the normal, the glycogen stored in the liver is broken down to glucose by the hormone glucagon.
3. Stimulates gluconeogenesis.

Thus these two hormones help to maintain the blood sugar level.

k. Name the different parts of male reproductive system with their functions.

Ans: Parts of male reproductive system: Scrotum, testes, seminal vesicles, ejaculatory duct, prostate gland, urethra and penis.

Testes: It produces sperms and testosterone. Epididymis is the site of sperm maturation.

Scrotum: It protects testes and provides a closed climate control system for sperm production.

Deferent ducts (vas deferens): Helps in storage of sperm and also carries sperm from epididymis to the urethra.

Spermatic cords: Its function is to suspend the testis inside the scrotum.

Seminal vesicles: Stores the sperms and secretes seminal fluid that makes sperm active.

Ejaculatory ducts: Carrying seminal fluid and sperms to the urethra.

Prostate gland: It secretes a thin milky fluid that makes up about 30% of the semen.

Urethra: It carries the semen.

Penis: To introduce sperm into the vagina.

Q3. Answer ALL questions of the following. 20 Marks

a. Name three layers of heart.

Ans: Pericardium, myocardium and endocardium.

b. The blood vessel which carries deoxygenated blood from heart to lungs is pulmonary artery**.**

c. The right lung has 3 lobes **while the left lung has** 2 lobes**.**

d. Intrinsic factor is necessary for absorption of vitamin B_{12}**.**

e. Testosterone **is a hormone secreted by testes.**

f. Name the bones involved in the elbow joint.

Ans: Humerus, radius and ulna

g. Neurotransmitter released at the neuromuscular junction is acetylcholine**.**

h. Peripheral nervous system consists of 12 pairs **of cranial nerves and** 31 pairs **of spinal nerves.**

i. Name the cranial nerve responsible for equilibrium and hearing.

Ans: Auditory nerve OR vestibule-cochlear nerve

j. In which part of the female reproductive system fertilization of ovum takes place?

Ans: Fallopian tubes

k. The study of physical structure of body is _____.

(i) Anatomy (iii) Histology
(ii) Physiology (iv) Cytology

Ans: (i) Anatomy

l. The term"medial" means _____.

(i) Away from surface of body
(ii) Near to head
(iii) Away from the head
(iv) Near to midline

Ans: (iv) Near to midline

m. Which of the following is not a connective tissue?

(i) Blood **(iii) Cardiac muscle**
(ii) Bone **(iv) Adipose tissues**

Ans: (iii) Cardiac muscle

n. The exchange of gases between air and lungs is called _____.

(i) Internal respiration **(iii) External respiration**
(ii) Cellular respiration **(iv) Bronchodilation**

Ans: (iii) External respiration

o. Organ of Corti helps in _____.

(i) Balancing **(iii) Vision**
(ii) Hearing **(iv) All of the above**

Ans: (ii) Hearing

p. Taste cells on tongue that receive the stimulation of taste are _____.

(i) Olfactory receptor
(ii) Gustatory receptors
(iii) Baroreceptor
(iv) Photoreceptor

Ans: (ii) Gustatory receptors

q. _____ focuses light in retina.

(i) Sclera **(iii) Cornea**
(ii) Iris **(iv) Ciliary muscles**

Ans: (iv) Ciliary muscles

r. Following is an example of hinge joint.

(i) Shoulder joint **(iii) Knee joint**
(ii) Hip joint **(iv) All joints in body**

Ans: (iii) Knee joint

s. The functional unit of contractile system in striated muscle is known as _____

(i) M-line **(iii) Sarcomere**
(ii) Actin **(iv) Myofibril**

Ans: (iii) Sarcomere

t. The reasons why right kidney is slightly lower than the left kidney is _____

(i) Right kidney is bigger than the left
(ii) Right kidney is smaller than the left
(iii) Considerable space occupied by liver on the right side
(iv) Considerable space occupied by heart

Ans: (iii) Considerable space occupied by liver on the right side.

Winter Examination 2022
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following. **30 Marks**

a. What is CSF? Give composition and functions of CSF.
b. Describe internal structure of heart with a well-labelled diagram.
c. What is anemia? Give its types and write its causes.
d. Define and classify joints with suitable examples. Explain any two joint disorders.
e. What is oedema? Describe the physiology of urine formation.
f. Give and explain the functions of liver.
g. Discuss physiology of hearing. What are auditory ossicles?

Q2. Answer any TEN of the following. **30 Marks**

a. Define cell. Draw a well-labelled diagram of the cell.
b. What is spleen? Describe its structure and functions.
c. What is reflex action? Give structure of reflex arc.
d. Define the following terms and give their normal values:
   (i) Lung capacity
   (ii) Vital capacity
   (iii) Tidal volume
e. Describe the composition of blood.
f. What is blood pressure? How is it recorded clinically?
g. What is menstrual cycle? Describe phases of menstrual cycle.
h. Name any two endocrine glands with their location. Why pituitary gland is known as "master gland"?
i. Draw and explain the structure of neuron.
j. Draw a well-labelled diagram of gall bladder. Give its functions.
k. Give the difference between endocrine and exocrine glands with examples.

Q3. Answer ALL questions of the following. **20 Marks**

a. Name the muscles of respiration.
b. _____ is the largest part of brain.

c. The collar bone is called _____.
d. Define micturition.
e. The cell produced by fusion of male and female gamates is called _____.
f. Name the bones in the shoulder joint.
g. Define systole and diastole.
h. Write the effect of sympathetic stimulation on salivary gland.
i. Define menopause.
j. Trachea is also called _____.
k. Name the enzyme which is present in tears.
l. Name the arteries supplying blood to kidney and spleen.
m. _____ neurotransmitter causes skeletal muscle contraction.
n. Name the enzyme which converts fats to fatty acid and glycerol.
o. Keratinized epithelium is found on dry surfaces lines_____.
   (i) Lining of mouth (iii) Pharynx
   (ii) Hair (iv) Conjunctiva of eye
p. Human body is divided into _____ cavities.
   (i) Two (ii) Three (iii) Four (iv) Five
q. _____ is essential for the synthesis of pigment Rhodopsin.
   (i) Vitamin C (iii) Vitamin B
   (ii) Vitamin A (iv) Vitamin D
r. Superior means _____.
   (i) Nearer to median plane
   (ii) Away from median plane
   (iii) Nearer to the head
   (iv) Nearer to lower end
s. Colour pigmentation of the skin is due to _____.
   (i) Protein (iii) Keratin
   (ii) Carbohydrate (iv) Melanin
t. _____ is responsible for muscle contraction.
   (i) Calcium (iii) Potassium
   (ii) Chloride (iv) Phosphorus

Winter Examination 2022
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following: **30 Marks**

a. What is CSF? Give composition and functions of CSF.

Ans: Cerebrospinal fluid (CSF): Cerebrospinal fluid is fluid secreted by choroid plexuses within the four ventricles and moves around the brain and spinal cord.

Composition of CSF:

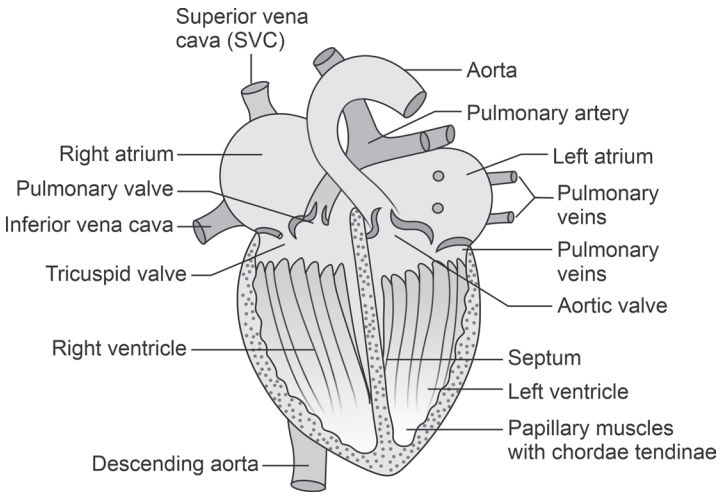
- Water
- Mineral salts
- Glucose
- Plasma proteins: Small amounts of albumin and globulin.
- Urea in small amounts
- A few leukocytes.

Functions of CSF:

- It supports and protects the brain and spinal cord.
- It maintains a uniform pressure around these delicate structures.
- It acts as a cushion and shock absorber between the brain and the skull.
- It keeps the brain and spinal cord moist and there may be interchange of substances between CSF and nerve cells, such as nutrients and waste products.

b. Describe internal structure of heart with a well-labelled diagram.

Ans: Internal Structure of Heart:



- The heart is a four-chambered organ consisting of two upper chambers called right atrium and left atrium and two lower chambers consisting of right ventricle and left ventricle. The two thin-walled atria are separated by inter-atrial septum and ventricles are separated by inter-ventricular septum.
- The ventricles are thick walled because they have to pump the blood with force. The left ventricle is the chamber of the heart with the thickest wall.
- The valves between atria and ventricles ensure that the flow of blood is in one direction only. The valve separating the right atrium from right ventricle is called right atrioventricular valve or tricuspid valve and consists of three cusps or flaps. The left atrioventricular valve is called bicuspid or mitral valve and consists of two cusps or flaps.
- Thick thread-like cords of fibrous tissue which connects the valve flaps to the walls of ventricles with papillary muscles are called chordae tendinae. These prevents valves from opening during ventricular contraction.
- The pulmonary artery arises from the right ventricle and the aorta arises from the left ventricle. The place where pulmonary artery and aorta leave the ventricles is guarded by semi-lunar valves (pulmonary valve and aortic valve). These valves prevent the backflow of blood.

c. What is anaemia? Give its type and write its causes.

Ans: Anaemia:

In anaemia, there is not enough haemoglobin available to carry sufficient O_2 from lungs to the tissues.

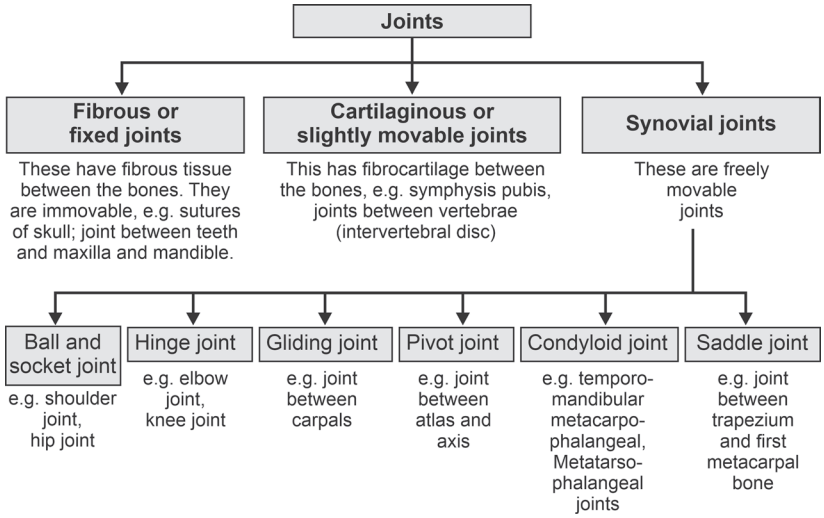
Types (Classification) based on the cause:

1. **Iron deficiency anaemia**—due to deficiency of iron
2. **Megaloblastic anaemia**—due to deficiency of vitamin B_{12} or folic acid.
3. **Hypoplastic/aplastic anaemia**—due to reduced/no bone marrow function.
4. **Haemolytic anaemia**—may be either congenital or acquired.
   a. **Congenital** includes sickle cell anaemia or Thalassemia: Major and minor
   b. **Acquired:** This is due to chemicals, drugs, autoimmunity or mismatched blood transfusion, malaria, ionising radiation, burns, etc.
5. **Normocytic (haemorrhagic) anaemia**—due to blood loss

d. Define and classify joints with suitable examples. Explain any two joint disorders.

Ans: Joints: A joint is a site at which any two or more bones articulate or come together.

Classifications of Joints:



Disorders of joint:

1. **Inflammatory joint diseases:**
   a. **Rheumatoid arthritis:** It is a chronic progressive autoimmune disease mainly affecting synovial joints. It is a disease which affects heart, blood vessels and skin. It is more common in females, may be post-viral infection.
   b. **Other types of polyarthritis:** Polyarthritis means inflammation of more than one joint. It is also autoimmune disease like rheumatoid arthritis, but the RA factor is absent. Here joints of axial skeleton are involved.
   c. **Infective arthritis:** Joint infection due to septicemia or injury.
2. **Traumatic injury to the joints:** Sprains, strains and dislocations. If a ligament is stretched or torn, the injury is called a sprain. A strain occurs when the muscle tendon unit is stretched or torn. Joint dislocation occurs when bones in a joint are displaced.
3. **Osteoarthritis:** It is a degenerative non-inflammatory disease that results in pain and restricted movement of affected joints. It is due to age, obesity, hereditary or female gender.
4. **Gout:** This is more common in males. It is caused by deposition of sodium urate crystals in joints and tendons which causes inflammation.

e. What is oedema? Describe the physiology of urine formation.

Ans: Oedema: Oedema is excessive accumulation of tissue fluid causing swelling.

Physiology of Urine Formation:

There are three processes in urine formation:

1. Glomerular ultrafiltration
2. Selective reabsorption
3. Tubular secretion

1. **Ultrafiltration/glomerular filtration:** Filtration takes place through the semi-permeable walls of the glomerulus and glomerular capsule or Bowman's capsule. Water and small molecules pass through it. The afferent renal artery brings blood to the glomerulus and the efferent artery carries the

blood away from it. As the diameter of afferent artery is more than the efferent artery, a hydrostatic pressure is generated in the glomerulus (55 mm Hg). This pressure is opposed by osmotic (30 mmHg) and filtrate hydrostatic pressure in capsule (15 mm Hg). The net filtration pressure is 55 – (30 + 15) = 10 mm of Hg. All constituents of blood are filtered except blood cells and plasma proteins.

2. **Selective reabsorption:** This is the process by which composition and volume of filtrate are changed during its passage through the tubule. The constituents required by the body are reabsorbed. Components like glucose, vitamins, amino acids get completely re-absorbed into the blood. These are called high threshold substances. Low threshold substances like urea, uric acid are absorbed slightly. Some substances like creatinine are not reabsorbed at all.
3. **Tubular secretion:** Substances not required and the foreign material which have not got cleared during filtration due to short time, are secreted into the distal convoluted tubule and excreted in the urine. Tubular secretion of hydrogen ions is important for maintaining pH. H ions are secreted in combination with bicarbonate as carbonic acid, with ammonia as ammonium chloride and with hydrogen phosphate as dihydrogen phosphate.

f. Give and explain the functions of liver.

Ans: Functions of liver:

1. Secretion of bile: Bile salts are helpful in digestion and absorption of fats by its emulsification.
2. Glycogenic function: The hepatic cells by the action of enzymes convert glucose into glycogen and it is then stored in the liver.
3. Formation of urea: Hepatic cells by the action of the enzyme cause deamination of amino acid, i.e. amine group is set free which forms urea.
4. Metabolism of fat: Whenever energy is needed, the saturated stored fat is converted to a form in which it can be used to provide energy.
5. Formation of RBCs in foetal life.
6. Destruction of RBCs forming bile pigments and iron.
7. Formation of plasma protein.
8. Formation of heparin, a natural anticoagulant in the blood.

9. Storage of iron and vitamin B_{12}.
10. Maintenance of body temperature: As several chemical reactions occur in the liver, heat is generated which is helpful in maintaining body temperature.
11. Excretion of toxic substances: The toxic substances entering the body through alimentary canal are destroyed in liver.

g. Discuss physiology of hearing. What are auditory ossicles?

Ans: Physiology of hearing:

The auricle collects the sound waves and through external acoustic meatus directs them to tympanic membrane. Tympanic membrane vibrations are transmitted and amplified through middle ear by movement of auditory ossicles. The foot plate of stapes rocks to and fro into the oval window, setting the fluid wave in perilymph of scala vestibuli. Most of the pressure of this wave is transmitted to cochlear duct. This causes wave in endolymph resulting in stimulation of the auditory receptors in the hair cells in spiral organ in cochlear duct. The nerve impulses generated pass to the brain through the cochlear portion of the eighth cranial nerves.

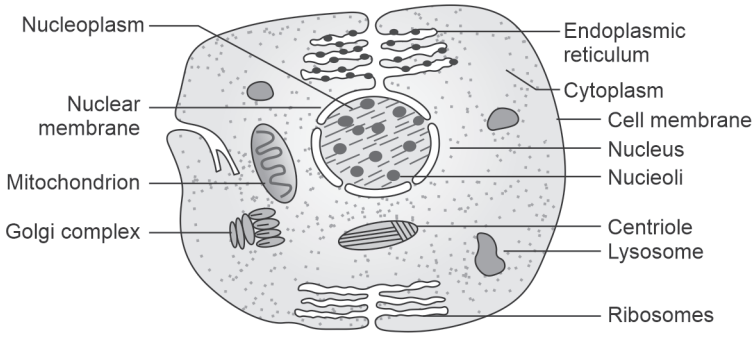
Auditory ossicles: Auditory ossicles are three very small bones present in tympanic cavity of the ear. They are named according to their shape, namely

a. Malleus (hammer)
b. Incus (anvil)
c. Stapes (stirrup).

Q2. Answer any TEN of the following: 30 Marks

a. Define cell. Draw a well-labelled diagram of the cell.

Ans: Cell: The cell is defined as the structural and functional unit of body.



b. What is spleen? Describe its structure and functions.

Ans: Spleen: Spleen is the largest lymph organ. It is dark purple in colour and located in the abdominal cavity between the stomach and diaphragm.

Structure

- It is purplish in colour and weighs about 200 gm.
- It is oval in shape and has hilum through which passes the splenic artery, splenic vein and efferent lymph vessels.
- It has fibrous tissue capsule which dips inside forming trabeculae.
- It has two different types of tissues known as red pulp which has blood and white pulp which has lymphatic tissue containing lymphocytes and macrophages.

Functions of spleen

- Phagocytosis: Destruction of old and abnormal RBCs, WBCs, platelets, and microbes.
- Storage of blood: It stores up to 350 ml of blood.
- Immunity: It contains T and B lymphocytes which are activated by presence of antigens, i.e. infections.
- Spleen produces lymphocytes, some specific antibodies, and antitoxins.
- Erythropoiesis: It is an important site of foetal blood cell production and can do this in adults at the time of need.

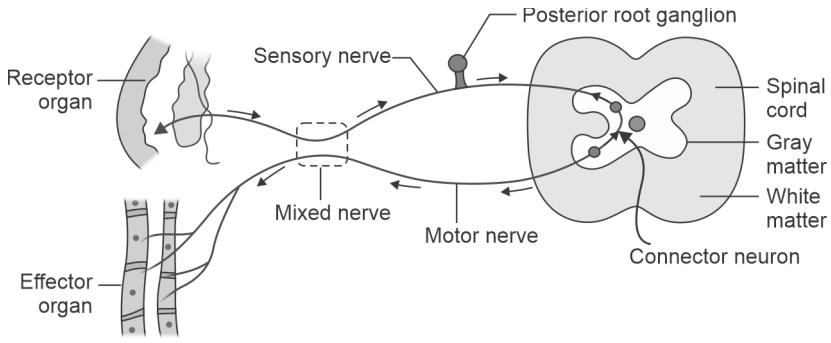
c. What is reflex action? Give structure of reflex arc.

Ans: Reflex action: It is an involuntary and immediate motor response given by spinal cord to a sensory stimulus. Examples—the sudden withdrawal of hand if fingers touch something hot.

Structure of reflex arc

A simple reflex arc has the following points:

1. Sense organ
2. Sensory neurons which pass from sensory organ to the spinal cord
3. Connector neuron in the spinal cord
4. Motor neuron in the spinal cord
5. Effector organ like the muscle.



Structure of simple reflex arc

d. Define the following terms and give the normal values.

(i) Lung capacity
(ii) Vital capacity
(iii) Tidal volume

Ans: 1. Lung capacity: It is the total amount of air that lungs can hold and equals vital capacity + residual volume. The normal value is 4.5 to 6 lit or 4500–6000 ml.
2. Vital capacity: This is the maximum volume of air which can be moved into and out of the lungs during forceful breathing. Normal value is about 3–5 L.
3. Tidal volume: It is the volume of air moved in and out of lungs during normal breathing. Normal value is 500 ml.

e. Describe the composition of blood.

Ans: Composition of blood: It is composed of liquid matrix plasma (55%) and different cells suspended in it (45%).

1. Plasma consists of water—90–92%, plasma proteins, inorganic salts, nutrients, waste material, hormones and gases.
2. Blood cells are of 3 types:
   a. Red blood cells (erythrocytes)
   b. White blood cells (leukocytes): These are of 2 types
      i. Granulocytes:
         1. Neutrophils
         2. Eosinophils
         3. Basophils
      ii. Agranulocytes
         1. Monocytes
         2. Lymphocytes
   c. Platelets (thrombocytes)

f. What is blood pressure? How is it recorded clinically?

Ans: Blood pressure:

It is defined as the force or pressure exerted by blood on the artery walls. The normal value of blood pressure is 120/80 mm of Hg.

Clinical recording: The blood pressure is measured clinically by auscultatory method using an instrument called sphygmomanometer. The sphygmomanometer consists of cuff, mercury column, air pump and release button for it. The inflatable cuff of sphygmomanometer is wrapped around the arm. A stethoscope is placed at the anti-cubital fossa over the brachial artery. The cuff is inflated until the pressure is above the expected systolic blood pressure. The brachial artery is occluded by the cuff, no sound is heard by the stethoscope. The pressure in the cuff is then released slowly. The point at which systolic pressure in the artery exceeds the cuff pressure, a spurt of blood passes through. This is heard as a tapping sound. The pressure at which the sound is first heard is called systolic blood pressure. As the cuff pressure is further lowered, the sounds become louder, then dull and finally stop. The last sound corresponds to the diastolic pressure. The sounds are heard due to the turbulent blood flow in the brachial artery.

g. What is menstrual cycle? Describe phases of menstrual cycle.

Ans: Menstrual cycle: Series of events occurring regularly in endometrium of females every 26–30 days, during reproductive years. Consists of series of changes that take place simultaneously in ovaries and uterine walls, stimulated by changes in blood level of hormones. Days of cycle are numbered from the beginning of menstruation.

Phases of menstrual cycle:

1. Proliferative phase (10 days)
2. Secretory phase (14 days).
3. Menstruation (4 days)

1. Proliferative phase: One of the follicles from both ovaries, develop and become dominant follicle, starts secreting estrogens. This follicle matures into Graafian follicle (diameter more than 20 mm). Estrogens stimulate repair

of endometrium. Cells of stratum basalis undergo mitosis and produce new stratum functionalis. Thickness of endometrium doubles: 5–10 mm LH causes rupture of mature follicle and ovulation. That is the end of this phase.

2. **Secretory phase:** Under influence of LH ruptured follicle transforms into corpus luteum that secretes progesterone, estrogens. Promotes growth and coiling of endometrial glands, vascularisation of superficial endometrium and thickening of endometrium to 12–18 mm. Under influence of progesterone, secretory glands produce a large amount of mucus. There is similar increase in secretion of watery mucus by glands of uterine tubes and cervical glands of vagina. If oocyte is not fertilised, degeneration of corpus luteum within 2 weeks into corpus albicans. Levels of progesterone and estrogens decrease, that causes menstruation and cycle continues. This phase lasts for 14 days, i.e. from 15 to 28 days.
3. **Menstrual phase:** It is characterised by periodic discharge of 25–65 ml of blood, mucus, tissue fluid and epithelial cells. This is caused by sudden reduction in estrogen and progesterone. This phase lasts for 4–5 days.

h. Name any two endocrine glands and their location. Why is pituitary gland known as "master gland"?

Ans:

Sr. no	Glands	Location
1.	Pituitary gland	Situated in hypophyseal fossa of sphenoid bone at the base of brain.
2.	Thyroid gland	Situated in the neck in front of larynx and trachea and beside the thyroid cartilage
3.	Parathyroid glands	Two on each side of the thyroid gland in the neck on the posterior side.

Contd.

Contd.

Sr. no	Glands	Location
4.	Pancreas (islets of Langerhans)	In the curvature of duodenum in the abdominal cavity.
5.	Adrenal glands	They are situated on upper pole of each kidney
6.	Pineal glands	Situated near corpus callosum in the brain
7.	Testes in male	Present in scrotum
8.	Ovaries in female	One on each side of the uterus

Pituitary gland known as "Master gland": Because

The secretions from all endocrine glands are controlled by hormones of the pituitary gland, hence pituitary gland called master gland.

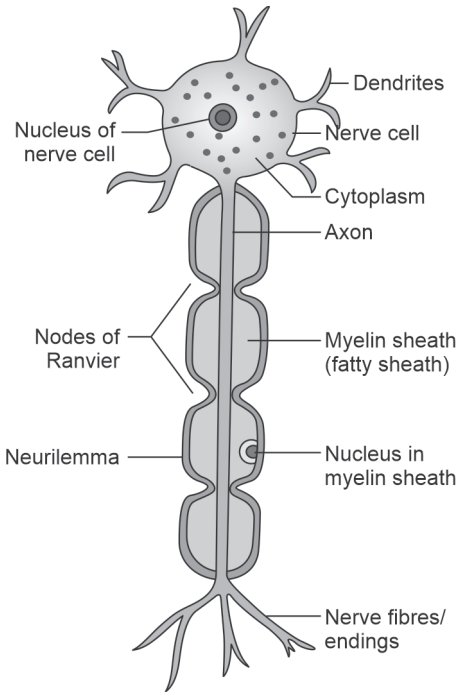
i. Draw and explain the structure of neuron.

Ans: Depending on the structure, neurons are of two types:

1. Myelinated or medullated.
2. Non-myelinated or non-medullated

Structure of Neuron: A typical neuron consists of:

1. **Dendrites:** These are the processes which are short, and they carry impulses towards the nerve cell. Each neuron contains several dendrites.
2. **Axon:** The axon is a long process of nerve cell which carries impulse away from neuron. The axon consists of:
   a. Axolemma or neurilemma: It maintains the shape of axons.
   b. Myelin sheath: It is a sheath of fatty material which surrounds most axons and gives white appearance. The myelin sheath is absent at intervals along the length of the axon and near its branched end, these intervals are called 'nodes of Ranvier'. They help in rapid transmission of nerve impulse in the myelinated neuron.

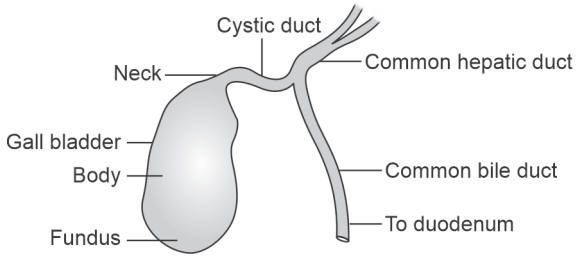


Structure of Neurone

j. Draw a well-labelled diagram of gall bladder. Give its functions.

Ans: The gall bladder is a pear-shaped sac attached to the posterior surface of liver by connective tissue.

It consists of a fundus, body and a neck which is continuous with the cystic duct. Its structure is similar to the GIT with additional oblique muscles. The mucus membrane shows small rugae when empty.



Gall bladder

Functions of Gall Bladder

1. It is reservoir of bile.
2. It concentrates the bile by absorption of water through the wall of gallbladder.
3. Secretion of mucus into the bile
4. Release of the stored bile

k. Give the differences between endocrine and exocrine glands with examples.

S. no.	Endocrine glands	Exocrine glands
1.	These glands are ductless glands	These glands have ducts
2.	These glands pour their secretions directly into the blood.	These glands pour their secretions into the lumen of the organs or to the outer surface of the body.
3.	Secretion of endocrine gland is called hormone.	Secretion of exocrine gland is called juice or enzyme.
4.	They produce their effect on distant organs.	They produce their effect where they secrete their secretion.
5.	Their glands are mostly involved in homeostatic activity.	Their glands are mostly involved in metabolic activities.
6.	For example, adrenal glands, testes, thyroid	For example, sweat glands, gastric glands, sebaceous glands.

Q3. Answer ALL the following questions: 20 Marks

a. Name the muscles of respiration.

Ans: Diaphragm and intercostal muscles (external and internal)

b. Cerebrum **is the largest part of brain.**

c. The collar bone is called clavicle

d. Define micturition.

Ans: Micturition is the process of expelling or excreting urine from the urinary bladder of human body to the exterior. Micturition is also known as urination.

e. The cell produced by fusion of male and female gametes is called diploid zygote**.**

f. Name the bones in the shoulder joint.

Ans: Clavicle, scapula, humerus.

g. Define systole and diastole.

Ans: Systole: Contraction of the heart muscle.
Diastole: Relaxation of the heart muscle.

h. Write the effect of sympathetic stimulation on salivary gland.

Ans: Sympathetic stimulation is the secretion of noradrenaline which is responsible for inhibition of secretion of the saliva.

i. Define menopause.

Ans: It is the natural decline in oestrogen and progesterone in women and marks the end of childbearing period. It occurs between the ages of 45 and 55 years.

j. Trachea is also called windpipe**.**

k. Name the enzyme which is present in tears.

Ans: Lysozyme

l. Name the arteries supplying blood to kidney and spleen.

Ans: Right and left renal arteries, splenic artery.

m. Acetylcholine (ACh) neurotransmitter causes skeletal muscle contraction.

n. Name the enzyme which converts fats to fatty acid and glycerol.

Ans: Lipases

o. Keratinised epithelium is found on dry surfaces like _____.

(i) Lining of mouth (iii) Pharynx
(ii) Hair (iv) Conjunctiva of eye

Ans: (ii) Hair

p. Human body is divided into _____ cavities.

i. Two (ii) Three (iii) Four (iv) Five

Ans: (iii) Four

q. _____ is essential for the synthesis of pigment rhodopsin.

(i) Vitamin C (iii) Vitamin B
(ii) Vitamin A (iv) Vitamin D

Ans: (ii) Vitamin A

r. Superior means

(i) Nearer to median
(ii) Away from median plane
(iii) Nearer to the head
(iv) Nearer to lower end

Ans: (iii) Nearer to the head

s. Colour pigmentation of the skin is due to _____

(i) Protein
(ii) Carbohydrate
(iii) Keratin
(iv) Melanin

Ans: (iv) Melanin

t. _____ is responsible for muscle contraction.

(i) Calcium
(ii) Chloride
(iii) Potassium
(iv) Phosphorus

Ans: (i) Calcium

Summer Examination 2023
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following: **30 Marks**

a. Describe the process of blood clotting.
b. Explain conducting system of the heart with neat diagram.
c. Write the composition and functions of gastric juice. Name the three phases of gastric juice secretion.
d. Explain the functions of cerebrum. Name the functional areas of cerebrum with diagram.
e. Describe the process of urine formation.
f. Write the functions of skin.
g. Classify bones. Explain anatomical features of synovial joint with diagram.

Q2. Attempt any TEN of the following: **30 Marks**

a. Write anatomy and functions of the mitochondria.
b. Give an account of simple epithelium.
c. Describe the functions of lymphatic system.
d. Name the parts of respiratory system. Write applications of a peak flow meter.
e. Create a flow diagram that describes the sequence of events that causes contraction of ventricles and ejection of blood flow from heart.
f. Write physiology of carbohydrate digestion.
g. Differentiate between sympathetic and parasympathetic nervous system.
h. Name the three layers of eye. Draw a well-labelled vertical section of an eyeball.
i. Name the hormones secreted by pancreas. Explain physiological role of insulin.
j. Describe phases of menstrual cycle.
k. Enlist the endocrine glands with their location in the body.

Q3. Attempt ALL the following questions: 20 Marks

a. State the meaning of coronal plane.
b. Mention the tissue that lines blood vessels.
c. List the bones forming ankle joint.
d. Define cardiac output.
e. State the meaning of myopathy.
f. Write two functions of CSF.
g. Classify tissues.
h. Define tidal volume.
i. List indications of blood transfusion.
j. Write normal values of RBC count.
k. Which statement is correct?
   (i) The knee is proximal to hip
   (ii) The hip is proximal to knee
   (iii) The shoulder is distal to elbow
   (iv) The knee is distal to ankle
l. Sperm maturation occurs in the:
   (i) Seminiferous tubule
   (ii) Epididymis
   (iii) Vas deferens
   (iv) Urethra
m. The hormone responsible for puberty in females is:
   (i) Prolactin
   (ii) Follicle stimulating hormone
   (iii) Oxytocin
   (iv) All of the above
n. The largest bone in the body is:
   (i) Humerous (iii) Tibia
   (ii) Femur (iv) Sternum
o. Classify WBC into its two types.
p. The largest blood vessel of body is _____.
q. The part of respiratory system mostly affected by COVID-19 is:
   (i) Nasal cavity (iii) Pharynx
   (ii) Alveoli (iv) Trachea
r. What does liver do to help digestion?
s. Coughing and sneezing are controlled by which part of brain?
t. Name the functional unit of kidney.

Summer Examination 2023
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following: **30 Marks**

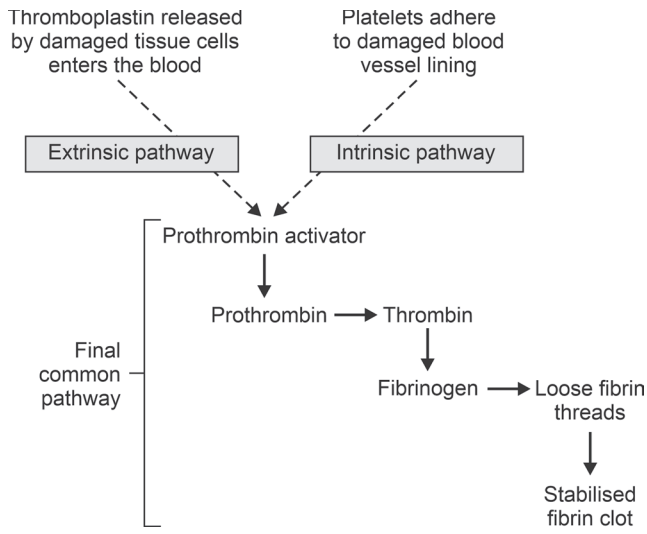
a. Describe the process of blood clotting.

Ans: Blood Clotting

Blood clotting is a protective process to stop the loss of blood. When blood vessel damaged after injury, a blood loss stops by a sequence of overlapping processes—in which platelets play a crucial role—lead to repair. Coagulation can start as soon as 15 seconds after injury, depending on how much the vessel wall is injured.

The conversion of blood to semisolid mass is known as blood coagulation which occurs in the following ways.

1. **Vasoconstriction:** Very first platelets come in contact with the damaged blood vessels, their surfaces become sticky, and they adhere to the damaged walls. Then they release serotonin that causes vasoconstriction, reducing or stopping blood flow through it.
2. **Platelet plug formation:** The adhered platelets attract more platelets which form platelet plug. This forms a temporary seal. Platelet plug formation is usually complete within 6 minutes of injury.
3. **Coagulation (blood clotting):** Coagulation takes place by conversion of various coagulation factors (as given in table) to their active form and a series of cascade to a clot. Both intrinsic and extrinsic pathway are operated on their own as per the situation and both are responsible to activate the X factor. This then stimulates the conversion of prothrombin to thrombin with the help of platelet phospholipid and calcium. Thrombin helps to convert the fibrinogen to insoluble fibrin which forms a mesh-like structure, where more blood cells are get trapped to form a clot. The cascade of coagulation process is given as follows:



Stages of blood clotting (coagulation)

Blood coagulation factors:

I	Fibrinogen
II	Prothrombin
III	Tissue factor (thromboplastin)
IV	Calcium (Ca^{2+})
V	Labile factor, proaccelerin, Ac-globulin
VII	Stable factor, proconvertin
VIII	Antihaemophilic globulin (AHG), antihaemophilic factor A
IX	Christmas factor, plasma thromboplastin component (PTA), antihaemophilic factor B
X	Stuart-Prower factor
XI	Plasma thromboplastin antecedent (PTA), anti-haemophilic factor C
XII	Hageman factor
XIII	Fibrin stabilising factor

b. Explain conducting system of the heart with neat diagram.

Ans: Conducting system of the heart: The cardiac conduction system consists of nodes and specialised conduction cells:

Sinoatrial node—action potential generation

↓

Atrioventricular node—action potential slightly delayed

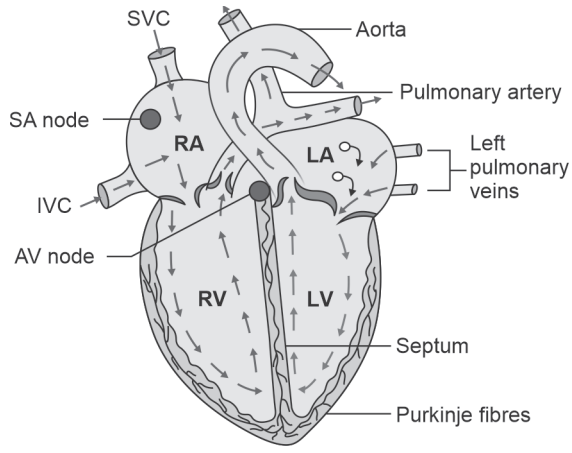
↓

Atrioventricular bundle (bundle of His)—wave further transmitted to

↓

Purkinje fibres—impulses transmitted to ventricles

1. **Sinoatrial node (pacemaker):** The sinoatrial (SA) node is a group of specialised cells, located in the upper wall of the right atrium near the superior vena cava. These cells can spontaneously generate electrical impulses. The wave of excitation created by the SA node spreads to the atria, resulting in atrial contraction (atrial systole).
2. **Atrioventricular node:** The impulses then reach atrioventricular node—located within the atrioventricular septum, near the opening of the coronary sinus. The AV node acts to delay the impulses, to ensure the atria have enough time to fully eject blood into the ventricles.
3. **Atrioventricular bundle:** The atrioventricular bundle (bundle of His) is a continuation of the specialised tissue of the AV node. It helps to transmit the electrical impulse from the AV node to the Purkinje fibres. It descends down the interventricular septum, then divides into two bundles: Right and left.
4. **Purkinje fibres:** They are a network of specialised cells located in the subendocardial surface of the ventricular walls and helps in ventricular contraction. The blood flows from the right and left ventricles to the pulmonary artery and aorta respectively.



Conducting system of heart

c. Write the composition and functions of gastric juice. Name the three phases of gastric juice secretion.

Ans: Composition and functions of gastric juice

Composition of gastric juice	**Functions of gastric juice**
Water	Liquefies the food
Mineral salts	Helps in buffering action
Mucus	Prevents mechanical injury to the stomach wall
Hydrochloric acid	Acidifies food and stops the action of salivary amylase. Kills the microbes. Provides acidic pH for active pepsin Pepsinogen
Enzyme	Helps in digestion of proteins to peptones and peptides
Intrinsic factor	Helps in absorption of vitamin B_{12} from small intestine

Phases of gastric secretion

1. Cephalic phase
2. Gastric phase
3. Intestinal phase

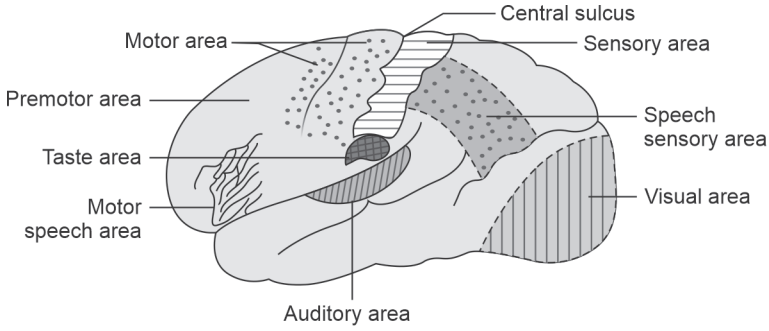
d. Explain the functions of cerebrum. Name the functional areas of cerebrum with diagram.

Ans: Functions of cerebrum

1. Mental activities involving memory, intelligence, sense of responsibility, thinking, will power, personality, moral sense, and learning.
2. Sensory functions like sense of smell, taste, touch, hearing, sight, pain and temperature
3. Initiation and control of skeletal muscle contraction (movement)

Names of functional areas of cerebrum

1. Speech area
2. Visual area
3. Auditory area
4. Taste area
5. Sensory area
6. Motor area



The cerebrum showing the functional areas

e. Describe the process of urine formation.

Ans: Process of urine formation

There are three processes in urine formation which takes place in the nephron in kidneys:

1. Glomerular filtration/ultra filtration
2. Selective reabsorption
3. Tubular secretion.

1. Glomerular filtration: Filtration takes place through the semipermeable walls of the glomerulus. Although some are later reabsorbed, tiny molecules like water and other substances can easily pass through. Big molecules such

as blood cells, plasma proteins, and other big molecules cannot pass through the capillaries and stay there instead. With the notable exceptions of plasma proteins and blood cells, the filtrate in the glomerulus shares a lot in common with plasma in terms of composition.

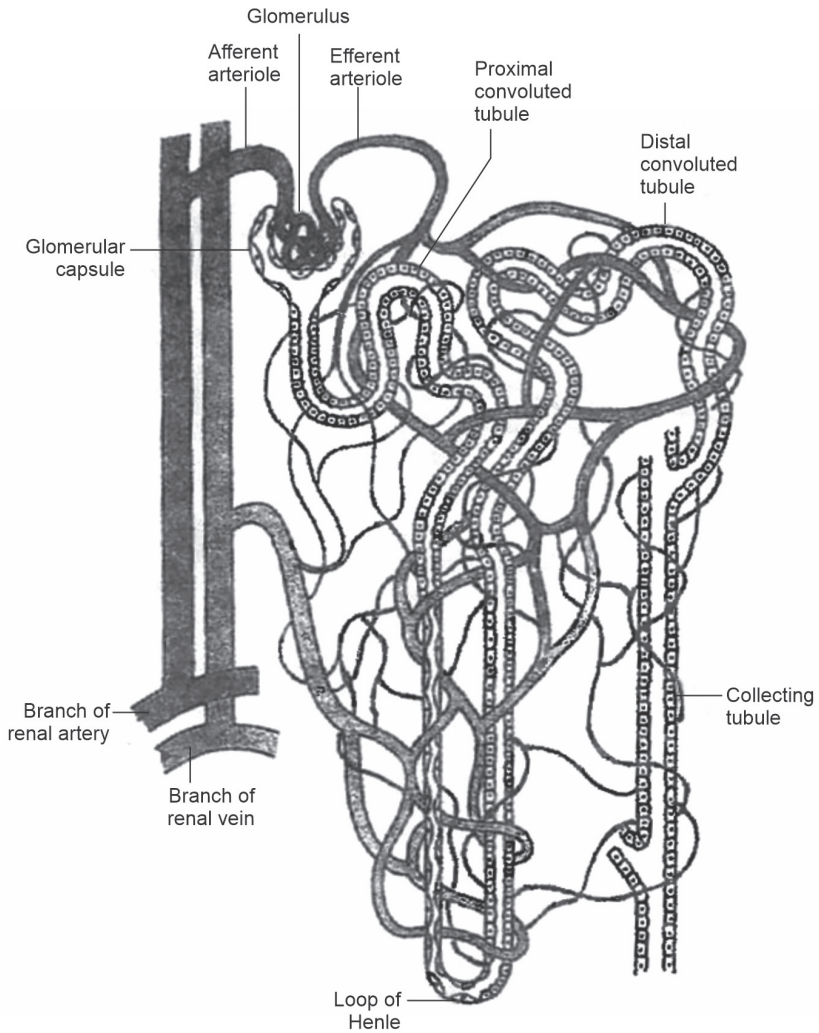
Filtration takes place because there is a difference between the blood pressure in the glomerulus and the pressure of the filtrate in the glomerular capsule. Because the efferent arteriole is narrower than the afferent arteriole, a capillary hydrostatic pressure is greater which is opposed by blood osmotic pressure and the filtrate hydrostatic pressure in the glomerular capsule.

The glomerular filtration rate (GFR) is the amount of filtrate that both kidneys produce each minute. The GFR of an adult in good health is around 125 mL/min, meaning that the two kidneys produce 180 litres of filtrate per day. Less than 1%, or 1–1.5 litres, of the filtrate is eventually expelled as urine, with the remainder being reabsorbed almost entirely from the renal tubules. The selective reabsorption of some filtrate elements and tubular secretion of others are what cause the variations in volume and concentration.

2. **Selective reabsorption:** It is the process by which composition and volume of filtrate are changed during its passage through the tubule. The constituents required by the body are reabsorbed. Components like glucose, amino acids, vitamins are completely reabsorbed into the blood. These are called high-threshold substances. Low-threshold substances like urea, uric acid is absorbed slightly. Some substances, e.g. creatinine, are not at all absorbed.

   Various hormones influence the selective reabsorption like parathyroid hormone increases the blood calcium level and calcitonin lower it. Antidiuretic hormone, ADH increases the permeability of the distal convoluted tubules and collecting tubules, increasing water reabsorption. Aldosterone secreted by the adrenal cortex, this hormone increases the reabsorption of sodium and water, and the excretion of potassium. Atrial natriuretic peptide decreases reabsorption of sodium and water from the proximal convoluted tubules and collecting ducts.

3. **Tubular secretion:** As blood passes through the glomerulus, filtering takes place. Because blood spends so little time in the glomerulus, it may not be completely filtered of unnecessary and alien substances, such as medications like aspirin and penicillin. Such chemicals are eliminated via secretion into the filtrate within the convoluted tubules from the peritubular capillaries. Hydrogen ion (H^+) production from the tubules is crucial for preserving a normal blood pH.



Nephron (uriniferous tubule)

f. Write the functions of skin.

Ans: Functions of skin

1. **Protection:** It forms the waterproof layer and protects the inner delicate structures. It acts as the barrier against the invasion of the microbes, chemicals and dehydration. The melanin pigment protects against the harmful UV rays.
2. **Regulation of body temperature:** The human body temperature is constant at 36.8°C. When the metabolic rate of the body increases, the body temperature increases and vice versa. To ensure consistent body temperature, a balance between heat production and heat loss is maintained by the skin.
3. **Formation of vitamin D:** 7-dehydroxycholesterol is present in the skin. UV light from the sun converts it to vitamin D.
4. **Sensation:** There are different sensations like touch, pain, pressure, etc. are felt due to the presence of sensory receptors in the skin.
5. **Absorption:** Some drugs and chemicals are absorbed through the skin.
6. **Excretion:** Skin is a minor excretory organ and excretes NaCl, urea and substances like alcohol.
7. **Blood reservoir:** The dermis houses an extensive network of blood vessels that carry 8–10% of the total blood flow in a resting adult. For this reason, the skin acts as a blood reservoir.

g. Classify bones. Explain anatomical features of synovial joint with diagram.

Ans: Classification of Bone

Bones are classified according to their shape.

1. Long bones: These are elongated bones found mostly in the limbs. They have a shaft and two extremities, e.g. humerus, femur, radius, etc.
2. Short bones: These are box-shaped bones, e.g. carpals, tarsals, etc.
3. Flat bones: These are curved thin bones, e.g. skull bones
4. Irregular bones: These have complex shape/irregular shape, e.g. vertebrae

5. Sesamoid bones: These bones form within a tendon, e.g. patella

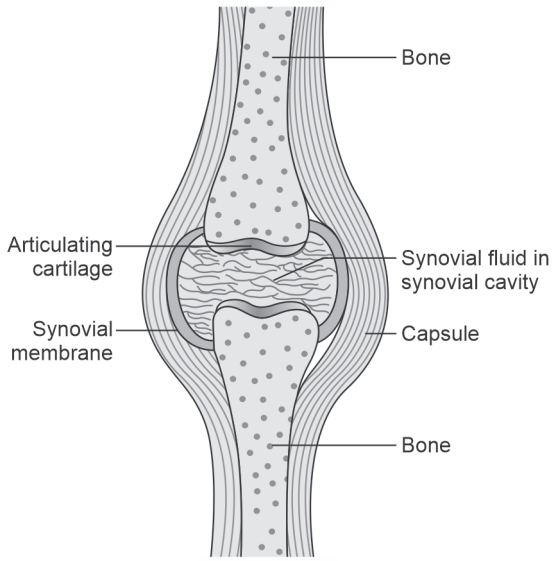
Synovial joint: A synovial joint has anatomical features as synovial membrane, synovial cavity, cartilage, and synovial capsule.

A space or capsule between the articulating bones is a distinguishing feature of synovial joints. A sleeve of fibrous tissue and a little quantity of fluid hold the ends of the bones together tightly. The body's synovial joints are the most mobile. The ends of bones are present in a synovial cavity. They are covered in smooth cartilage and are protected by a capsule. The capsule is lined with a synovial membrane that produces synovial fluid which helps in lubrication.

Articular or hyaline cartilage: Hyaline cartilage covers the portions of the bones that are in touch with one another. This offers a friction-free articular surface, is robust enough to withstand compression pressures, and can support the weight of the body. Age causes the cartilage lining, which in youth can be up to 7 mm thick, to thin down and become less compressible. Other joint structures are put under more stress as a result. Since cartilage lacks a blood supply, synovial fluid serves as its only source of nutrition.

Capsule or capsular ligament: A sleeve of fibrous tissue encircles and covers the joint, holding the bones together. It is robust enough to keep it from getting hurt yet sufficiently loose to allow for freedom of movement.

Synovial membrane: All non-weight-bearing surfaces inside the joint are covered by this epithelial layer, which also lines the capsule. Synovial fluid is secreted by it.



A typical synovial joint

Q2. Answer any TEN of the following: 30 Marks

a. Write anatomy and functions of the mitochondria.

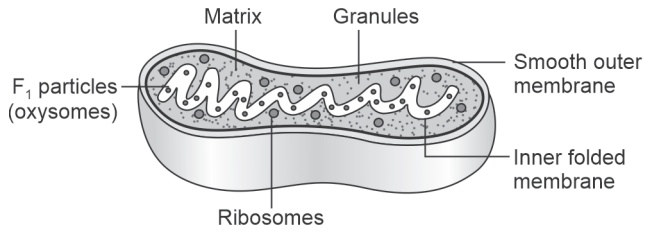
Ans: Mitochondria

Structure:

- They are sausage-shaped structure present in cytoplasm.
- It has a double unit membrane where the inner membrane contains folds known as cristae, forms shelves on which oxidative enzymes are present.
- The fluid-filled cavity is known as matrix.
- They contain a special type of DNA, which is self-replicative.

Function:

- It is known as powerhouse of cell.
- They are involved in cellular respiration, the process by which chemical energy is made available in the cell. When nutrients and oxygen come in contact with the enzyme, they combine to form CO_2, water and energy.
- This is in the form of ATP (aerobic oxidation).
- This ATP is used by the cell to do cellular functions.



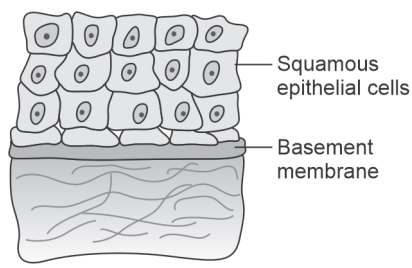
Mitochondria

b. Give an account of simple epithelium.

Ans: Simple Epithelium

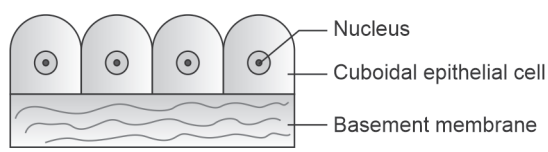
Simple epithelial tissues consist of single layer of cells. It can be classified into 4 subtypes:

1. **Squamous/pavement epithelium:** Composed of single layer of flattened cells, fit like flat stones, and forms a smooth membrane. This tissue provides a thin smooth, inactive lining for heart, blood vessels, alveoli of lungs and lymph vessels. In lungs, blood vessels and lymph vessels, it is called endothelium and in heart it is called endocardium.



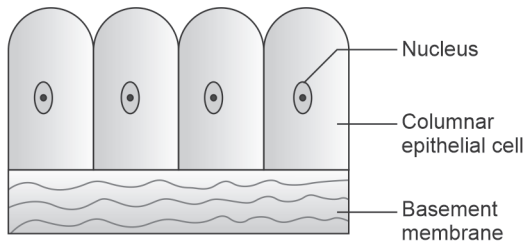
Squamous epithelium

2. **Cuboidal epithelium:** Composed of cube-shaped cells and forms the basement membrane. Involved in secretion and absorption. Present in some simple secretive glands. Forms basement membrane in tubules of kidney.



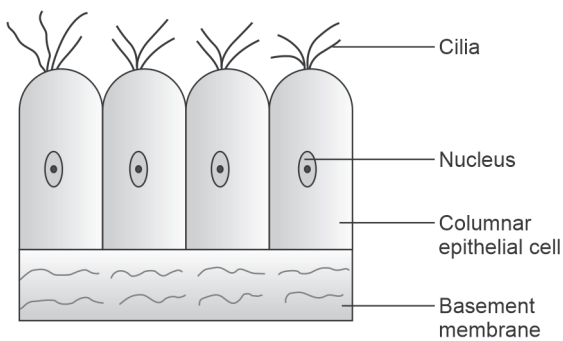
Cuboidal epithelium

3. **Columnar epithelium:** Formed by single layer of rectangular shaped cells and situated on a basement membrane. Found lining the organs of alimentary tract and special columnar cells called 'goblet cells', in GIT secretes sticky substances called mucus. Function—absorption.



Columnar epithelium

4. **Ciliated epithelium:** This is formed by columnar cells with fine hair-like protoplasmic processes called cilia, capable of wave-like movements. They move the contents in a particular direction. Found at the lining of most of the respiratory passages and uterine tubes. In respiratory passages, it propels mucous towards throat and in the uterine tube, it propels ova towards the uterus.



Ciliated epithelium

c. Describe the functions of lymphatic system.

Ans: Functions of lymphatic system

1. It collects and returns tissue fluids from the intercellular spaces to the blood.
2. It plays an important role in returning plasma proteins to the blood.
3. Lymphatic node produces and transports lymphocytes to the circulatory system.
4. Antibodies formation by lymph node to protect body against infection.
5. It absorbs and transport fatty acids and fats from the digestive system.
6. Lymph nodes play an important role in defence mechanism by way of filtration of lymph and trapping microorganism.

d. Name the parts of respiratory system. Write applications of a peak flow meter.

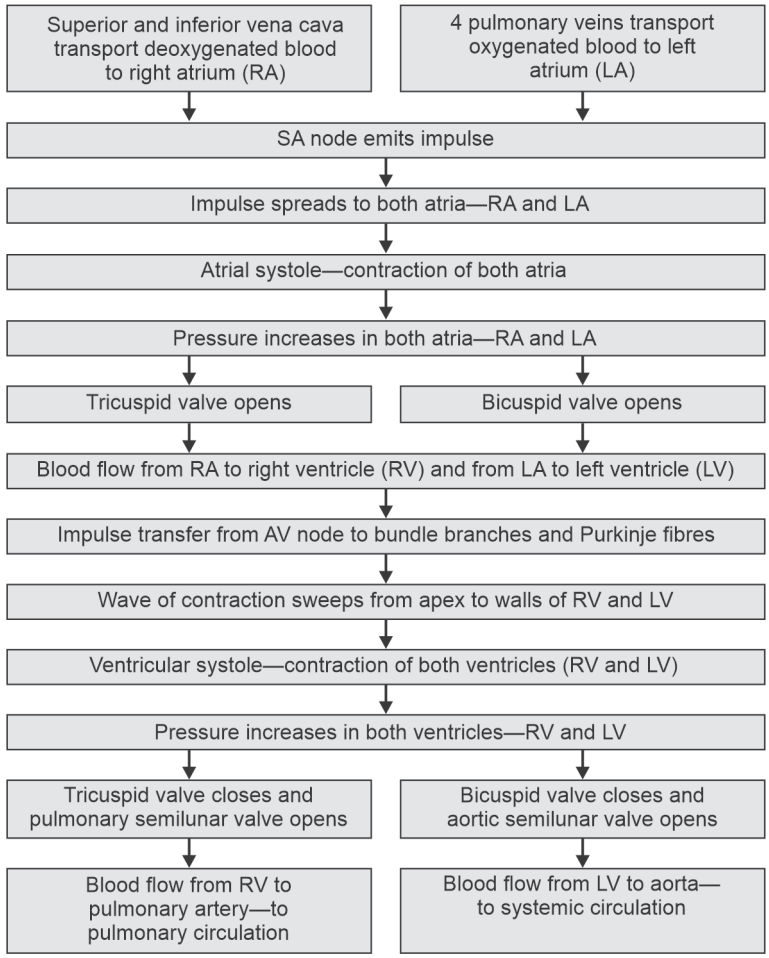
Ans: Parts of respiratory system:

Nose, pharynx, larynx, trachea, bronchi (two), bronchioles, alveoli, and two lungs covered with pleura. Muscles of respiration: Intercostal muscles and diaphragm.

Applications of a peak flow meter:

- Peak flow meter is a portable device that measures peak expiratory flow rate (PEFR).
- It is useful in detecting changes in airway function.
- It is used to monitor asthma, effects of air pollutant and COPD.
- It evaluates how efficiently lungs can exhale air.

e. Create a flow diagram that describes the sequence of events that causes contraction of ventricles and ejection of blood flow from heart.



f. Write physiology of carbohydrate digestion.

Ans: Carbohydrate digestion:

1. Digestion of carbohydrate involves formation of simple and absorbable sugars from carbohydrates by action of enzymes. It takes place in mouth and small intestine.
2. Salivary amylase converts polysaccharides to disaccharides.
3. Pancreatic amylase converts polysaccharides to disaccharides.

4. Sucrase converts sucrose to glucose and fructose.
5. Maltase converts maltose to glucose.
6. Lactase converts lactose to glucose and galactose.

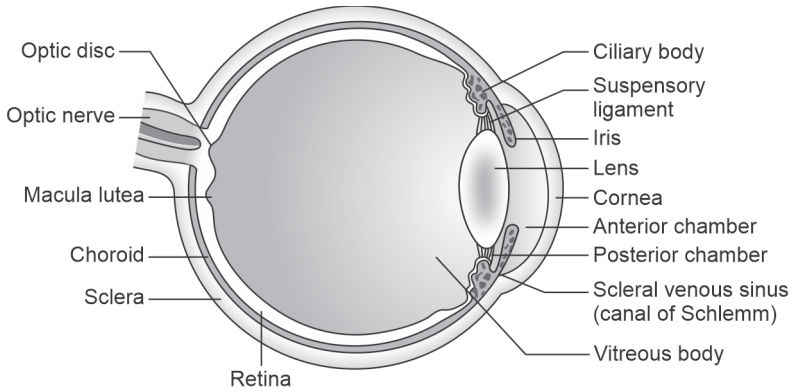
S.no	Organ	Secretion	Enzyme	Action
1.	Mouth	Saliva	Salivary	Starch → Polysaccharides
2.	Small intestine	Pancreatic juice	Amylase	Polysaccharides → Disaccharides
3.	Small intestine	Intestinal juice	Sucrase Lactase Maltase	Sucrose → Glucose + Fructose Lactose → Glucose + Galactose Maltose → Glucose + Glucose

g. Differentiate between sympathetic and parasympathetic nervous system.

Sympathetic nervous system	Parasympathetic nervous system
This system enables the individual to stressful conditions (fight or flight).	This system acts as a pace-maker for the body allowing restoration processes to occur quietly and peacefully.
It is also called thoraco-lumbar outflow.	It is also called cranio-sacral outflow.
The preganglionic nerve fibre is short while the post-ganglionic fibre which ends in effector organ is long.	The preganglionic nerve fibre is long while the post-ganglionic fibre is short.
The post-ganglionic nerve fibre secretes neurotransmitter called adrenaline or noradrenaline.	The post-ganglionic nerve fibre secretes neurotransmitter called acetylcholine.
It is also known as adrenergic nervous system.	It is also known as cholinergic nervous system.
It has alfa and beta receptors.	It has muscarinic and nicotinic receptors.
It is involved in expenditure of energy.	It deals with restoration of body energy.

h. Name the three layers of the eye. Draw well-labelled vertical section of an eyeball.

Ans: The sclera, choroid, and retina are the three layers of the eyeball wall. Vertical section of an eyeball is given as follows:



Vertical section of an eyeball/eye

i. Name the hormones secreted by pancreas. Explain physiological role of insulin.

Ans: Hormones secreted by pancreas: Insulin, glucagon, somatostatin, and pancreatic polypeptide.

Physiological role of insulin: The main function of insulin is to lower blood glucose level, this can be achieved by

1. Increases the uptake of glucose by the cells.
2. Increases the conversion of glucose to glycogen in the liver and skeletal muscles.
3. It increases the uptake of amino acids by the cells.
4. It promotes the synthesis of fatty acids and storage of fats in adipose tissue.
5. Decreases glycogenolysis.
6. Prevents breakdown of protein, fat and gluconeogenesis

j. Describe the phases of menstrual cycle.

Ans: Phases of menstrual cycle:

1. Menstrual phase (bleeding phase): 4 days

- Takes 3–4 days.
- Bleeding through vagina takes place.
- Destruction of endometrium and blood vessels.
- Menstrual flow consists of 50–100 ml blood, mucus, endometrial strips, WBCs and unfertilised ovum.
- Indicates failure of fertilisation. Corpus luteum degenerate and sudden reduction in oestrogen and progesterone.

2. Proliferative phase—9 to 10 days

- In this phase proliferation of endometrium takes place and it gets renewed in this period.
- FSH stimulates ovarian follicle, produces oestrogen which causes proliferation of endometrium.
- Endometrial thickness increases up to 2 mm.
- Also known as follicular phase—development and maturation of graafian follicle. Lasts up to 13th day.
- This phase ends when ovulation occurs and oestrogen production declines.

3. Ovulatory phase—1 day

- Graafian follicle of one ovary rupture to release ovum.
- Body temperature increases.
- Graafian follicle is converted into corpus luteum which increases progesterone.
- Increased progesterone level maintains endometrium and helps for implantation.
- Takes place on 14th day.

4. Secretory phase—about 14 days

- Under influence of progesterone secretory glands produce large amount of mucus.

  There is similar increase in secretion of watery mucus by glands of uterine tubes and cervical glands of vagina.
- If ovum is fertilised, endometrium and corpus luteum remain intact.
- If ovum is not fertilised, degeneration of corpus luteum takes place within 2 weeks.
- Levels of progesterone and oestrogens decrease, that causes menstruation and cycle continues.
- This phase is most constant part of cycle lasts for 14 days, i.e. from 15 to 28 days.

k. Enlist the endocrine glands with their location in the body.

S.no.	Endocrine gland	Location
1.	Pituitary gland	Situated in hypophyseal fossa (sella turcica portion) of sphenoid bone at the base of the brain.
2.	Thyroid gland	Situated in the neck in front of trachea and besides thyroid cartilage
3.	Parathyroid gland	These are small glands two on each side of thyroid gland in neck on posterior side
4.	Adrenal gland	Two adrenals situated on the upper pole of each kidney
5.	Islets of Langerhans	Irregularly distributed throughout pancreas
6.	Ovaries (2) in females	One on each side of uterus and below uterine tubes
7.	Testes (2) in males	Present in scrotum
8.	Thymus gland	In chest, between lungs and near heart
9.	Pineal glands	Near the corpus callosum in the brain

Q3. Attempt ALL the following questions: 20 Marks

a. State the meaning of coronal plane.

Ans: The coronal/frontal plane is that which divides human body into an anterior and posterior portion.

b. Mention the tissue that lines blood vessels.

Ans: Epithelial tissue.

c. List the bones forming ankle joint.

Ans: Talus, tibia and fibula.

d. Define cardiac output.

Ans: Cardiac output is determined by the stroke volume and heart rate and is measured in liters per minute.
Cardiac output: Heart rate × Stroke volume

e. State the meaning of myopathy.

Ans: A disease of muscle tissue.

f. Write two functions of CSF.

Ans: Functions of CSF

1. It acts as a shock absorber.
2. Provides protection and support to brain and spinal cord from mechanical shocks.
3. It keeps the brain and spinal cord moist.
4. Helps in interchange of substances between CSF and nerve cells, such as nutrients and waste products.

g. Classify tissues.

Ans: Classification of tissues

- Connective tissue
- Epithelial tissue
- Muscle tissue
- Nervous tissue

h. Define tidal volume.

Ans: Tidal volume: It is the volume of air moved in and out of lungs during normal breathing. Normal value is 500 ml.

i. List indications of blood transfusion.

Ans: Indications of blood transfusion:

- Haemorrhage
- Haemophilia
- Severe anaemia
- Supply necessary blood components like platelets, RBC or clotting factors.
  – During major surgeries where blood loss is expected.

j. Write normal values of RBC count.

Ans: Normal values of RBC count.

i. Male: 4.5 to 5.5 millions/mm^3 of blood.
ii. Female: 4 to 4.5 millions/mm^3 of blood.

k. Which statement is correct?

(i) The knee joint is proximal to hip
(ii) The hip is proximal to knee
(iii) The shoulder is distal to elbow
(iv) The knee is distal to ankle

Ans: (ii) The hip is proximal to knee.

l. Sperm maturations occurs in the _____.

(i) Seminiferous tubule
(ii) Epididymis
(iii) Vas deferens
(iv) Urethra

Ans: (ii) Epididymis

m. Hormones responsible for puberty in females:

(i) Prolactin
(ii) Follicle stimulating hormone
(iii) Oxytocin
(iv) All of the above

Ans: (ii) Follicle stimulating hormone

n. The largest bone in the body is:

(i) Humerus **(iii) Tibia**
(ii) Femur **(iv) Sternum**

Ans: (ii) Femur

o. Classify WBC into its two types.

Ans: 1. Granulocytes
2. Agranulocytes

p. The largest blood vessel of body is _____.

Ans: Dorsal aorta OR aorta OR arch of aorta OR arc of aorta

q. The part of respiratory system mostly affected by COVID-19 is _____.

(i) Nasal cavity **(iii) Pharynx**
(ii) Alveoli **(iv) Trachea**

Ans: (ii) Alveoli

r. What does liver do to help digestion?

Ans: Production and secretion of bile.
Metabolism of key nutrient.
Detoxification.

s. Coughing and sneezing is controlled by which part of brain?

Ans: Medulla oblongata

t. Name the functional unit of kidney.

Ans: Nephron

Winter Examination 2023
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Attempt any SIX of the following: **30 Marks**

a. Describe the structure and functions of skin.
b. Explain how circulation of blood takes place through heart chambers with neat labelled diagram of LS of human heart.
c. Define blood. Write classification and functions of leucocytes.
d. Give the functions of liver.
e. Explain mechanism of urine formation. Write any five functions of kidney.
f. Sketch and label central nervous system and explain various functions of medulla oblongata.
g. Classify bones. Differentiate between male and female pelvis.

Q2. Attempt any TEN of the following: **30 Marks**

a. Give the composition and functions of saliva.
b. What are the functions of lymphatic system? Draw a well-labelled diagram of 'lymph node'.
c. Why pancreas is called exo-endocrine gland?
d. Draw a neat labelled sketch of human cell.
e. Give the composition and functions of CSF.
f. Enlist different types of blood cells with their normal values.
g. Explain the structure and functions of ovary.
h. Define and give normal values of:
   (i) Vital capacity
   (ii) Tidal volume
   (iii) Residual volume
i. Define hormones. Explain the role of hormones secreted by adenohypophysis.
j. Define blood pressure. Explain all factors that modify blood pressure.
k. Name fundamental tissues of body. Classify simple epithelium with their locations.

Q3. Attempt ALL of the following: 20 Marks

a. The exchange of gases takes place in _____ of the respiratory system.
b. Name any two cranial nerves.
c. Name the largest cell in the human body.
d. Mechanical and chemical processes which break down ingested food into small molecules is called _____.
e. Structure of the body away from the midline is called _____.
f. The fluid that enters the glomerulus is:
(i) Serum (ii) Blood (iii) Water (iv) Mucus
g. Name the bones of auditory ossicles.
h. The function of the thoracic cage is:
(i) Protect the stomach
(ii) Protect the kidneys
(iii) Protect the heart and lungs
(iv) Protect the brain and spinal cord
i. Which of the following is not property of muscle?
(i) Elasticity
(ii) Degradability
(iii) Contractility
(iv) Excitability
j. Define cardiac cycle.
k. Testosterone hormone is secreted by _____ cells.
l. Which statement is correct in case of cone cells in retina?
(i) Stimulated in dim light and do not produce colour vision
(ii) Responsible for colour vision
(iii) Stimulated in bright light which do not produce colour vision.
(iv) Stimulated in dim light which produce colour vision.
m. Define the term anatomy.
n. Give an example of ball and socket joint.
o. Acetylcholine in the nerve ending is broken down by an enzyme _____.
p. What is ECG?
q. Which receptor is present in the nose?
(i) Photoreceptors
(ii) Gustatory receptors
(iii) Olfactory receptors
(iv) Phonoreceptors

r. Choose the correct sequence of respiratory organs in human
   (i) Pharynx - Larynx - Bronchi - Trachea - Alveolus
   (ii) Pharynx - Larynx - Trachea - Bronchi - Alveolus
   (iii) Pharynx - Bronchi - Larynx - Trachea - Alveolus
   (iv) Pharynx - Trachea - Bronchi - Larynx - Alveolus
s. Name various types of cartilages in body.
t. Posture, balance and equilibrium of body is regulated by which part of the brain?

Winter Examination 2023
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following: **30 Marks**

a. Describe the structure and function of skin.

Ans: Structure of skin: The skin is the largest organ of the body, accounting for about 15% of the total adult body weight. The skin is composed of three layers: The epidermis, the dermis, and subcutaneous tissue (hypodermis).

A. Epidermis: It is the most superficial layer composed of stratified keratinized squamous epithelium, which varies in thickness in different parts of the body. It is the thickest on the palms and soles. There are no blood vessels in the epidermis. There are several layers of cells in the epidermis which extends from the deepest germinative layer to the surface stratum corneum. The cells on the surface are flat non-nucleated and dead cells and have protein keratin. The cells from the germinative layer undergo change as they come towards the surface.

a. Stratum basale: It is composed of a single layer of cuboidal or columnar keratinocytes. Some cells that are stem cells undergo cell division to continually produce new keratinocytes. The nuclei in these layers are large.

b. Stratum spinosum: Keratinocytes are arranged in 8–10 layers. Cells in the more superficial layers become flattened.

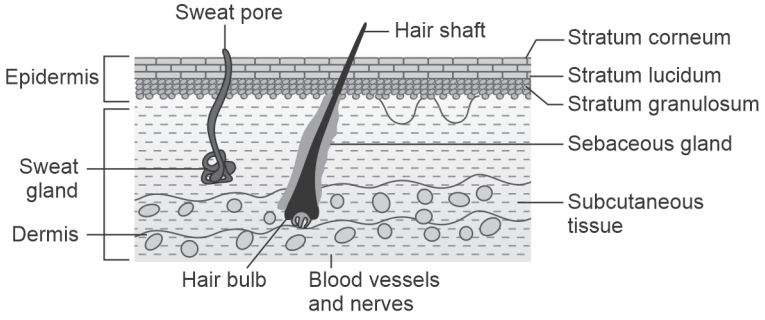
c. Stratum granulosum: This consists of 3–5 layers of flattened cells. The nuclei and other organelles begin to degenerate as they move away from the dermal blood vessels.

d. Stratum lucidum: It is present only in the thick skin of areas such as the fingertips, palms and soles. It consists of 4–6 layers of flattened clear dead keratinocytes containing keratin.

e. **Stratum corneum:** It consists of 25–30 layers of flattened dead cells. The cells on the surface are flat non-nucleated, dead cells and have protein keratin. The cells continue to shed and be replaced by cells from deeper layers. It forms a protective layer.

B. Dermis: It is tough and elastic. It is made up of connective tissue (the collagen and elastic fibres). Fibroblasts, macrophages, and masts cells are found in dermis. There are blood vessels, lymph vessels, sensory nerve ending, sweat glands, hair, arrector pili muscles and sebaceous glands in the dermis.

C. Subcutaneous tissue: The deepest layer of skin is made of connective tissue and fat. Subcutaneous tissue is well-vascularized. The hypodermis produces fat cells (adipocytes), which store energy.



Functions of skin:

A. Protection: It forms the waterproof layer and protects the inner delicate structures. It acts as barrier against the invasion of the microbes, chemicals and dehydration. The melanin pigment protects against the harmful UV rays.

B. Regulation of body temperature: When the metabolic rate of the body increases, the body temperature increases and vice versa. To ensure constant body temperature, a balance between heat production and heat loss is maintained by the skin.

C. Formation of vitamin D: 7-dehydrocholesterol is lipid-based substance present in the skin. UV light from the sun converts it to vitamin D.

D. Sensation: There are different sensations like touch, pain, pressure, etc. are felt due to the presence of sensory receptors in the skin.

E. Absorption: Some drugs and chemicals are absorbed through the skin.

F. Excretion: Skin is a minor excretory organ and excretes NaCl, urea and aromatic substances like garlic and other spices.

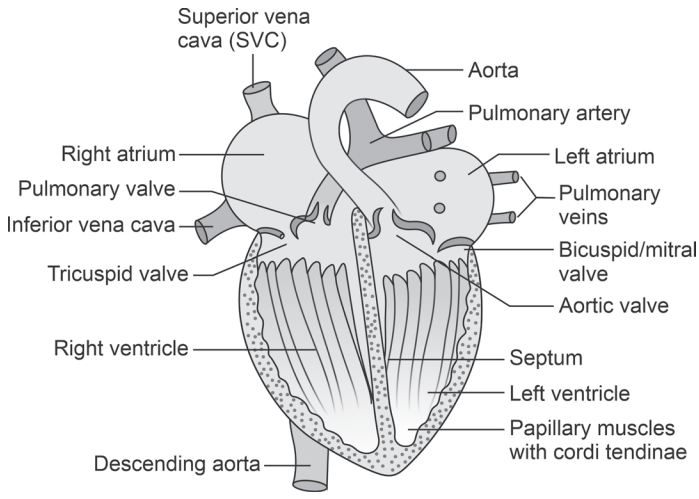
b. Explain how circulation of blood takes place through heart chambers with neat, labelled diagram of LS of human heart.

Ans: Circulation of blood on right side of heart:

- The superior vena cava and inferior vena cava receive deoxygenated blood from various parts of the body through different veins.
- This deoxygenated blood is poured into the right atrium of heart.
- The blood from right atrium enters the right ventricle through tricuspid valve, which prevents back flow of blood from ventricle into atrium.
- The deoxygenated blood from right ventricle is forced into pulmonary artery through pulmonary valve.
- The pulmonary arteries divide into two branches, each enters the right and left lungs.
- In the lungs, the red blood cells (RBCs) release carbon dioxide and absorb oxygen.

Circulation of blood on left side of heart:

- This oxygenated blood from the right and left lungs is collected by four pulmonary veins and poured into left atrium.
- From left atrium this blood enters into left ventricle through bicuspid valve which prevents backflow of blood into left atrium.
- This oxygenated blood from left ventricle is forced into the aorta through aortic valve which prevents backflow of blood into left ventricle.



LS of human heart

c. Define blood. Write classification and functions of leucocytes.

Ans: Blood is a fluid connective tissue circulated in the body and consists of blood cells, suspended in intercellular fluid called plasma.

Leukocytes are also called white blood cells (WBCs) and classified into 2 groups:

(1) Granulocytes	**(2) Agranulocytes**
1. Eosinophils	1. Monocytes
2. Basophils	2. Lymphocytes
3. Neutrophils	

Functions of Leukocytes:

- **Neutrophils:** Phagocytosis (destruction of bacteria) and also remove cell debris.

  Eosinophils: Phagocytize antigen–antibody complex, parasitic invasion; overcomes effects of histamine involved in inflammation during allergic reactions.
- **Basophils:** Liberate heparin, histamine and serotonin at inflammation site in allergic reactions, that intensify overall inflammatory response.
- **Lymphocytes:** T cells control immune system response and directly attack infected and tumour cells. B cells develop into plasma cells which secrete antibodies to invade viruses, bacteria.

Monocytes: Phagocytosis. Monocytes use plasma membrane to engulf and break down dead cells or harmful foreign particles and bacteria.

d. Give the functions of liver.

Ans: Functions of liver:

1. **Carbohydrate metabolism (glycogenic function):** The hepatic cells by the action of enzymes convert glucose into glycogen and it is then stored in the liver.
2. **Metabolism of fat:** Whenever energy is needed, the saturated stored fat is converted to a form in which it can be used to provide energy.
3. **Protein metabolism (formation of urea):** Hepatic cell by the action of the enzyme causes deamination of amino acid, i.e. amine group is set free which forms urea.
4. **Metabolism of drugs and noxious substances:** Ethanol and most drugs.
5. Formation of plasma protein and blood clotting factors.
6. Formation of heparin, a natural anticoagulant in the blood.
7. Formation of RBCs in foetal life.
8. Destruction of RBCs forming bile pigments and iron.
9. Storage: (i) Glycogen, (ii) Fat soluble vitamins, (iii) Iron and copper, (iv) Vitamin B_{12}.
10. **Maintenance of body temperature (heat production):** As several chemical reactions occur in the liver, heat is generated which is helpful in maintaining body temperature.
11. **Secretion of bile**
12. **Synthesis of vitamin A from carotene**
13. **Excretion of toxic substance:** The toxic substances entering the body through alimentary canal are destroyed in liver.
14. **Inactivation of hormones:** Insulin, glucagon, cortisol, aldosterone, thyroid and sex hormones.

e. Explain mechanism of urine formation. Write any five functions of kidney.

Ans: Mechanism of urine formation:

There are three processes in the mechanism of urine formation which takes place in the nephron in kidneys.

1. **Glomerular filtration/ultra filtration:** Filtration takes place through the semi-permeable walls of the glomerulus and glomerular capsule or Bowman's capsule. Water and small

molecules pass through it. The afferent renal artery brings blood to the glomerulus and the efferent artery carries the blood away from it. As the diameter of afferent artery is more than the efferent artery, a hydrostatic pressure is generated in the glomerulus (55 mm Hg). This pressure is opposed by osmotic (30 mmHg) and filtrate hydrostatic pressure in capsule (15 mmHg). The net filtration pressure is 55 – (30 + 15) = 10 mmHg. All constituents of blood are filtered except blood cells and plasma proteins. The GFR, i.e. glomerular filtration rate is about 125 ml per min, i.e. 180 liters of dilute filtrate is formed in each day, by the 2 kidneys.

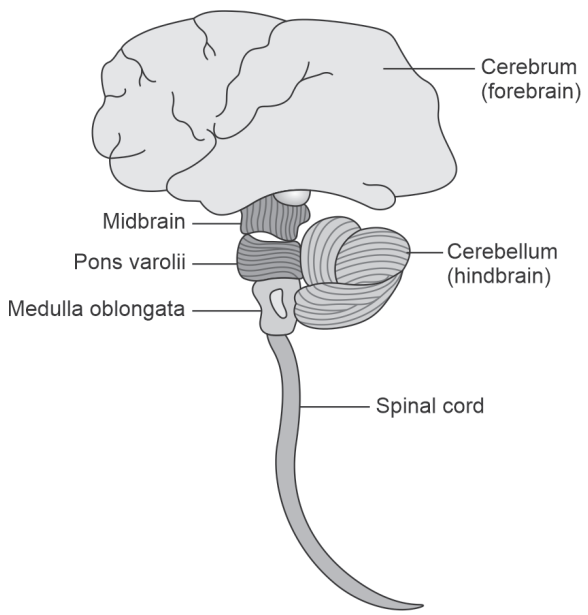
2. **Selective reabsorption:** This is the process by which composition and volume of filtrate are changed during its passage through the tubule. The constituents required by the body are reabsorbed. Components like glucose, vitamins, and amino acids get completely reabsorbed into the blood. These are called high threshold substances. Low threshold substances like urea, uric acid is absorbed slightly. Some substances like creatinine are not reabsorbed at all.
3. **Tubular secretion:** Substances not required and the foreign material which have not got cleared during filtration due to short time, are secreted into the distal convoluted tubule and excreted in the urine. Tubular secretion of hydrogen ions is important for maintaining pH. H ions are secreted in combination with bicarbonate as carbonic acid, with ammonia as ammonium chloride and with hydrogen phosphate as dihydrogen phosphate.

Functions of kidney:

1. Formation of urine.
2. Regulate the osmotic pressure of the body fluids.
3. Regulate the concentrations of numerous ions in blood plasma, including Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, bicarbonate (HCO_3^-), phosphate, and sulphate.
4. Removes metabolic waste products from the blood and excrete them in urine.
5. Regulate the volume of the ECF by controlling Na^+ and water excretion.
6. Remove many chemicals and drugs from the blood and excrete them in urine.

7. Hormone secretion: Renin, erythropoietin
8. Degrade several polypeptide hormones, including insulin, glucagon, and parathyroid hormone.
9. It helps to regulate arterial blood pressure by adjusting Na^+ excretion and producing various substances (e.g. renin) that can affect blood pressure.
10. Play an essential role in acid–base balance. Maintain pH of body fluids.

f. Sketch and label central nervous system and explain various functions of medulla oblongata.



Central nervous system

Functions of medulla oblongata

The vital centres consisting of group of cells associated with autonomic reflex activity lie in medulla oblongata. They are:

- **Cardiac centre:** The cardiac centre controls the rate and force of cardiac contraction and blood pressure.
- **Respiratory centre:** The respiratory centre controls the rate and depth of respiration. Nerve impulses pass to the phrenic and intercostal muscles which stimulate the contraction of diaphragm and intercostal muscles, thus initiating inspiration.

- **Vasomotor centre:** This controls the diameter of blood vessels especially small arteries and arterioles.
- **Reflex centre:** When irritating substances are present in stomach or respiratory tract, nerve impulse passes on to the medulla oblongata stimulating the reflex centre which initiate reflex actions like vomiting, sneezing, and coughing.

g. Classify bones. Differentiate between male and female pelvis.

Ans: Depending upon shape and size bones are classified as:

1. **Long bones:** These consist of an elongated shaft with two extremities. The shaft consists of a cylindrical compact bone and extremities are formed by a thin outer shell of compact tissue with an interior network of spongy or cancellous bone containing red bone marrow, e.g. femur, tibia, fibula.
2. **Short bones:** These are roughly box-like bones having no shaft but consist of smaller masses of spongy bones covered by a thin layer of compact bone, e.g. wrist, carpal and tarsal bones.
3. **Flat bones:** In this type, a thin layer of cancellous bone is sandwiched in between two layers of compact bones, e.g. sternum, scapula, bones of the skull.
4. **Irregular bones:** These bones cannot place in any of the above categories and their shape is not fixed, e.g. vertebrae and most bones of face.
5. **Sesamoid bones:** These are small bones which are developed in the tendons around certain joints, e.g. patella bone.

Differentiate between male and female pelvis:

S. No.	Female pelvis	Male pelvis
1.	Bones are lighter and thin	Bones are heavier and thick
2.	Cavity is shallow and oval	Cavity is deep and funnel shaped
3.	Sacrum is more concave anteriorly, making true pelvis broader.	Sacrum is less concave, making true pelvis narrower at the outlet.
4.	The angle made at the symphysis pubis is wider.	The angle of pubic arch is narrower.
5.	Acetabulum faces more lateral	Acetabulum faces anteriorly

Q2. Answer any TEN of the following: 30 Marks

a. Give the composition and functions of saliva.

Ans: Composition of Saliva:

- Water
- Mineral salts
- Enzyme: Salivary amylase (ptyalin)
- Mucus
- Lysozyme
- Immunoglobulin
- Blood clotting factors

Functions of Saliva

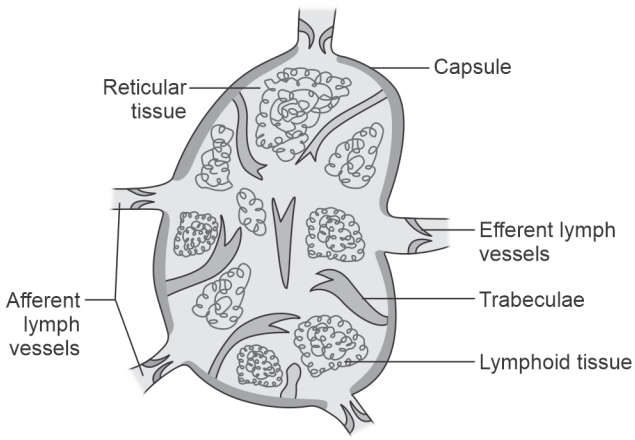
- Cleaning: Saliva helps in cleaning mouth and teeth which prevents growth of bacteria.
- Moistening and lubricating: Saliva lubricates, moistens soft part of mouth, keeping it pliable (flexible) for speech.
- Excretion: Various organic substances like urea and inorganic substances like mercury, lead and several drugs like metronidazole are excreted in saliva.
- Salivary amylase acts on starch, reduces them to disaccharides.
- Lubrication of food.
- Non-specific defense mechanism (lysosomes and immunoglobulin).
- Sense of taste by lubrication of food.

b. What are the functions of lymphatic system? Draw a well-labelled diagram of 'lymph node'.

Ans: Functions of lymphatic system

1. Lymph node protects the body against infections by filtering and destroying bacteria.
2. Lymph nodes are the sites where lymphocytes are produced.
3. Lymphatics drain excess fluid from tissues back to circulation.
4. Lymphatics carry waste products from tissues to blood.

Diagram of Lymph Node:



c. Why is pancreas called exo-endocrine gland?

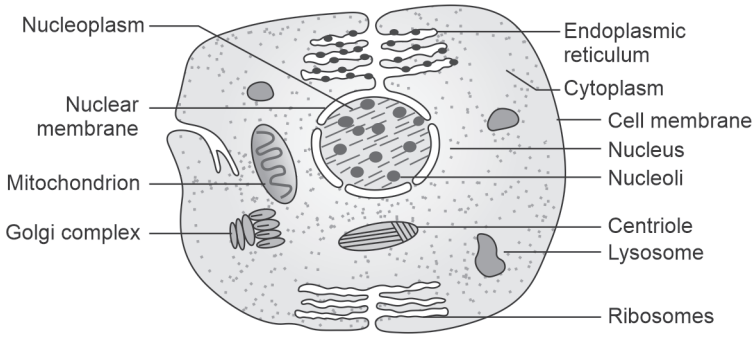
Ans: Pancreas called exo-endocrine gland:

1. Exocrine glands secrete their substances through ducts onto your body's surfaces.
2. Endocrine glands secrete their substances directly into your bloodstream.
3. Pancreas is functionally divided into exocrine and endocrine part.
4. *Exocrine* part of pancreas pours its secretion into duodenum and endocrine part pours its secretion into bloodstream.
5. *Exocrine* portion of pancreas is made up of pancreatic cells, arranged in clusters and secrete digestive juices into the duodenum.
6. Endocrine part is made up of islets of Langerhans, which secretes their secretions directly into the blood.

Since pancreas secretes both digestive juices and hormones and has exocrine and endocrine parts, it is known as an exo-endocrine gland.

d. Draw a neat, labelled sketch of human cell.

Diagram of Cell



e. Give the composition and functions of CSF.

Ans: Composition of CSF:

- Water
- Mineral salts
- Glucose
- Plasma proteins—small amounts of albumin and globulin creatinine in small amount
- Urea
- A few leucocytes

Functions:

- Provides support, protects the delicate structure of brain, spinal cord.
- As shock absorber cushion to brain and spinal cord.
- Maintain uniform pressure around brain and spinal cord.
- Provides chemical protection to brain and spinal cord.
- Provides nutrients and carries away metabolic waste.

f. Enlist different types of blood cells with their normal values.

Ans:

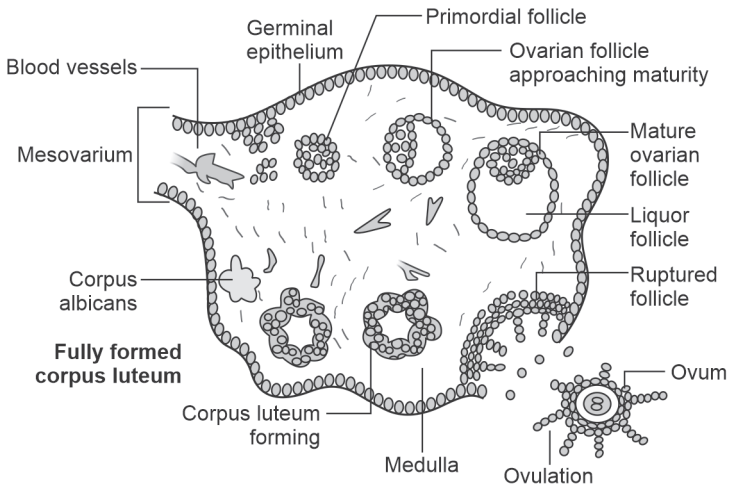
- Erythrocytes (RBC)
  = Men—4.5 to 5 million per mm^3 of blood
  Women—4 to 4.5 million per mm^3 of blood.
- Leukocytes (WBC) = 6000 to 11000 per mm^3 of blood
  (Neutrophils: 40–60%, Lymphocytes: 20–40%, Monocyte: 2–8%, Eosinophil: 1–4%, Basophil: Up to 1%)
- Thrombocytes (platelets) = 3 to 5 lacs per mm^3 of blood

g. Explain the structure and functions of ovary.

Ans: Structure of ovary:

- One ovary lies on each side of uterus.
- Ovary is in close connection with *fimbriae of infundibulum*.
- It is made up of *germinal epithelium, tunica albuginea, stroma, ovarian follicles, graafian follicle and corpus luteum*.
- The *graafian follicle* is the mature follicle filled with fluid and is ready for rupture and release of secondary oocytes.
- Remnants of graafian follicle after release of secondary oocytes is called corpus luteum, it produces progesterone, estrogens, relaxin, and inhibin.

Diagram of Ovary:



Section of ovary

Functions of ovary:

- To produce and store ovum/egg.
- To produce hormones that control the menstrual cycle and pregnancy.
- To produce the ovum and secrete female sex hormones like oestrogen and progesterone.
- Fertilization of ovum.
- An ovary carries genetic material.

h. Define and give normal values of:

(i) Vital capacity
(ii) Tidal volume
(iii) Residual volume

Ans: (i) Vital capacity: It is the maximum amount of air which can expel from the lungs after a maximum inhalation (effort). It is equal to the sum of inspiratory reserve volume, tidal volume, and expiratory reserve volume.
Normal value: 3–5 liters

(ii) Tidal volume: Amount of air inspired and expired during normal quiet breathing is volume of one breath.
Normal value: 500 ml

(iii) Residual volume: After normal expiration a considerable amount of air remains in lungs (even after expiratory reserve volume is expelled) and this volume of air called residual volume.
Normal value: 1200 ml

i. Define hormones. Explain the role of hormones secreted by adenohypophysis.

Ans: Hormones: A hormone is a chemical message transmitted in the blood that is secreted by an endocrine gland.

Role of hormones by adenohypophysis OR anterior pituitary gland

- Growth hormone: Responsible for overall growth of body and body parts.
- Adrenocorticotropic hormone (ACTH): Responsible for secretion of glucocorticoids, by the adrenal cortex.
- Melanocyte stimulating hormone (MSH): Causes darkening of skin.
- Thyroid stimulating hormone (TSH): Secrete thyroxine (T4) and triiodothyronine (T3)
- Follicle stimulating hormone (FSH) and luteinizing hormone (LH) which play important roles in sexual functions.
- Prolactin causes development of breast and milk secretion.

j. Define blood pressure. Explain all factors that modify blood pressure.

Ans: Blood pressure: The hydrostatic pressure exerted by blood on the walls of blood vessels is called blood pressure. It is the result of cardiac output and peripheral resistance.

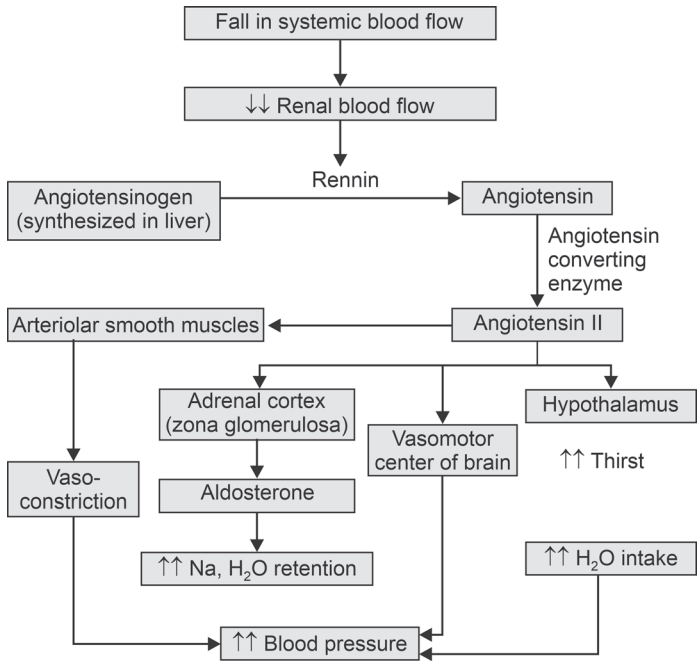
OR

It is the lateral pressure produced by the blood on the walls of blood vessels.

Factors modifying blood pressure:

- **Peripheral vascular resistance (systemic vascular resistance, SVR):** Blood pressure is most inversely proportional to viscosity of blood. PVR also depends upon viscosity of blood, total length, and average radius of blood vessels. Blood viscosity depends upon RBC to plasma volume ratio.
- **Cardiac output (5–6 L/min):** Amount of blood ejected per minute by both ventricles.
- **Baroreceptors:** Baroreceptors are found on some large systemic arteries' walls. Mechanism of nerve for arterial pressure control is baroreceptors reflex. These are stimulated when stretched. As blood pressure increases, baroreceptors are stretched and the rate of impulse transmission drastically decreases. This results in vasodilation of veins and arterioles.
- **Chemoreceptors:** Chemoreceptors are associated with baroreceptors. These are in close contact with arterial blood. If there is full blood pressure, these receptors send signals to vasomotor centers and excite to elevate arterial pressure back to normal.
- **Renin angiotensin system:** When blood pressure falls than normal in renal arteries, the sympathetic stimulation stimulates to secrete rennin. This interacts with angiotensinogen protein for its conversion into angiotensinogen I. Angiotensinogen converting enzyme converts angiotensinogen I into angiotensinogen II a potent vasoconstrictor. This angiotensinogen II constricts arteriolar smooth muscles causes increase in peripheral resistance, hence increase in blood pressure. Also, angiotensinogen II stimulates adrenal cortex to release aldosterone, acts on kidney to increase Na^{++} reabsorption, increase passive water reabsorption, increase blood volume; regulation of blood pressure takes place. Angiotensinogen II stimulates vasomotor center of brain to increase blood pressure. Angiotensinogen II stimulates thirst area of hypothalamus to increase sensation of thirst, thereby increase water intake.

OR



- **Hormonal regulation:** Major hormones involved in blood pressure regulation are: Aldosterone, epinephrine, norepinephrine, anti-diuretic hormone, atrial natriuretic peptide (ANP), parathyroid hormone and calcitonin.
- **Aldosterone:** Increase Na^{++} absorption by kidneys, promote K^{+} excretion. Na^{++} absorption—increase water reabsorption—increase extracellular fluid volume—increase blood volume—increase blood pressure.
- **Epinephrine and norepinephrine:** Secreted by adrenal medulla. Increase cardiac output, increase rate, force of contraction. Arteriole vasoconstriction in abdominal organs, vasodilation in cardiac and skeletal muscles to help in regulation of blood pressure.
- **Anti-diuretic hormone/vasopressin:** Produced by hypothalamus and released by posterior pituitary. It causes vasoconstrictions and decreases water loss through urine, leading to an increase in blood pressure.

k. Name fundamental tissues of body. Classify simple epithelium with their locations.

Ans: Fundamental tissues are:

1. Epithelial tissue
2. Connective tissue
3. Muscular tissue
4. Nervous tissue

Classification and location of simple epithelium

i. **Simple squamous epithelium:** Lines of heart, air sac of lungs, glomerular capsule of kidney

ii. **Simple cuboidal epithelium:** Cover surface of ovary, lens of eye, kidney tubules, ducts of glands (like thyroid, pancreas, etc.)

iii. **Simple columnar epithelium:** Lines of GI tract, bronchioles of respiratory tract, uterine, gall bladder, central canal of spine, etc.

iv. **Ciliated (pseudostratified) columnar epithelium:** Lining the uterine tubes, respiratory passages, etc.

Q3. Attempt ALL the following questions: 20 Marks

a. The exchange of gases takes place in alveoli **of the respiratory system.**

b. Name any two cranial nerves.

Ans: Olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear (auditory), glossopharyngeal, vagus, spinal accessory.

c. Name the largest cell in the human body.

Ans: The ovum or egg cell.

d. Mechanical and chemical processes which break down ingested food into small molecules is called digestion.

e. Structure of the body away from the midline is called lateral.

f. The fluid that enters the glomerulus is:

(i) Serum **(iii) Water**
(ii) Blood **(iv) Mucus**

Ans: (ii) Blood

g. Name the bones of auditory ossicles.

Ans: Malleus, incus, stapes.

h. The function of the thoracic cage is:

(i) Protect the stomach
(ii) Protect the kidneys
(iii) Protect the heart and lungs
(iv) Protect the brain and spinal cord

Ans: Protect the heart and lungs

i. Which of the following is not property of muscle?

(i) Elasticity **(iii) Contractility**
(ii) Degradability **(iv) Excitability**

Ans: (ii) Degradability

j. Define cardiac cycle.

Ans: The sequence of co-ordinated events which takes place during each heartbeat.

k. Testosterone hormone is secreted by leydig cells.

l. Which statement is correct in case of cone cells in retina?

(i) Stimulated in dim light and do not produce colour vision.
(ii) Responsible for colour vision
(iii) Stimulated in bright light which do not produce colour vision.
(iv) Stimulated in dim light which produce colour vision.

Ans: (ii) Responsible for colour vision

m. Define the term anatomy.

Ans: The study of the structures of living things.

n. Give an example of ball and socket joint.

Ans: 1. Hip joint (femur and pelvic joint)
2. Shoulder joint (humerus and pectoral girdle joint)

o. Acetylcholine in the nerve ending is broken down by an enzyme cholinesterase or acetyl cholinesterase.

p. What is ECG?

Ans: ECG means electrocardiogram: An electrocardiogram (ECG) records the electrical signal from the heart to check for different heart conditions.

q. Which receptor is present in the nose?

(i) Photoreceptors
(ii) Gustatory receptors

(iii) Olfactory receptors
(iv) Photoreceptors

Ans: (iii) Olfactory receptors

r. Choose the correct sequence of respiratory organs in human:

(i) Pharynx – Larynx - Bronchi – Trachea - Alveolus
(ii) Pharynx – Larynx – Trachea – Bronchi – Alveolus
(iii) Pharynx – Bronchi – Larynx – Trachea – Alveolus
(iv) Pharynx – Trachea – Bronchi – Larynx – Alveolus

Ans: (ii) Pharynx – Larynx – Trachea – Bronchi – Alveolus

s. Name various types of cartilages in body.

Ans: Hyaline cartilage, elastic cartilage and fibrocartilage

t. Posture, balance and equilibrium of body is regulated by which part of the brain?

Ans: Cerebellum or vestibular apparatus.

Summer Examination 2024
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Answer any SIX of the following: 30 marks

a. Describe the internal structure of the heart with a diagram.
b. Define joint and classify. Name the bones of axial skeleton.
c. Define blood. Describe its composition and function.
d. Give composition and functions of saliva and write any six functions of liver.
e. Describe the physiology of urine formation. Draw well-labelled diagram of nephron.
f. Draw a sagittal section of eye and explain its part.
g. Describe the structure of spinal cord with neat and labelled diagram.

Q2. Attempt any TEN of the following: 30 marks

a. Explain nervous tissue.
b. Which part of the cell is called powerhouse of cell? Why?
c. Define anemia. Explain its types.
d. Define the terms:
   (i) Cardiac output
   (ii) Blood pressure
   (iii) Stroke volume
e. Explain structure and function of lymph node.
f. Write composition and function of pancreatic juice.
g. Define the term
   (i) Tidal volume
   (ii) Residual volume
   (iii) Vital capacity
h. Describe menstrual cycle.
i. Which gland is called endocrine and exocrine? Why?
j. Define hormone. Enlist all the endocrine glands with their hormones in the body.
k. Write the effect of parasympathetic stimulation on:
   (i) Eye
   (ii) Salivary gland
   (iii) Urinary bladder

Q3. Attempt ALL of the following: 20 Marks

a. Name the 2nd cranial nerve
b. Name the blood vessel which carry oxygenated blood from the lungs to heart.
c. Name the muscles of respiration.
d. Which hormone is secreted by testis?
e. Name the four fundamental tastes.
f. Which neurotransmitter is responsible for muscle contraction?
g. Name the bones of elbow joint.
h. What are heart sounds?
i. Define anatomy and physiology.
j. Name the fundamental tissues of the body.
k. Structural and functional unit of kidney is _____.
l. Name the bones of cranium.
m. The fertilization in female takes place in _____.
   (i) Uterus (iii) Fallopian tube
   (ii) Vagina (iv) Ovary
n. Which of the following is a property of skeletal muscle
   (i) Muscle tone
   (ii) Muscle contraction
   (iii) Muscle fatigue
   (iv) All of the above
o. Organ of Corti helps in _____.
   (i) Hearing (iii) Vision
   (ii) Balancing (iv) All of the above
p. Exchange of gases at the cellular level in lungs and tissue is described as _____.
   (i) Inspiration
   (ii) Internal respiration
   (iii) External respiration
   (iv) All of the above
q. _____ is the innermost nervous coat of the eye.
r. Which of the following function belongs to bile juice?
   (i) Laxative action (iii) Buffer action
   (ii) Fat digestion (iv) All of the above
s. The term 'proximal' refers _____.
   (i) Towards the front of body
   (ii) Towards the back of body
   (iii) The upper part nearest to the point of attachment
   (iv) In the midline
t. Write any two functions of CSF.

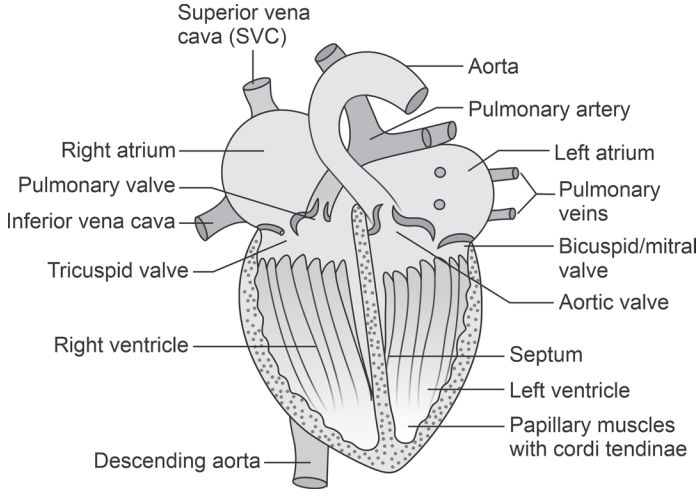
Summer Examination 2024
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Attempt any SIX of the following: **30 Marks**

a. Describe internal structure of the heart with a diagram.

Ans: Internal structure of the heart:



- The interior of heart is divided into right and left side by a vertical septum known as interventricular septum.
- Each side is further divided into upper and lower chambers by the valves.
- The upper chambers are called atrias or auricles and lower chambers are called ventricles.
- Hence the heart has got four chambers: (i) Right atrium, (ii) right ventricle, (iii) left atrium, (iv) left ventricle
- The two largest veins of the body, namely superior vena cava (SVC) and inferior vena cava (IVC) collect deoxygenated blood from the superior and inferior part of the body and empty their contents into the right atrium of the heart.

- Two pairs of pulmonary veins collect the blood from two lungs and pour their contents into the left atrium.
- The pulmonary artery originating from right ventricle which further divides into right and left pulmonary branches carrying the blood towards the lungs.
- Aorta is the largest artery originating from left ventricle which further divides into a number of arteries and arterioles supplying oxygenated blood to different parts of the body: Valves of the heart.
- The heart has four main valves, namely:
  - **(i) Tricuspid valve:** This valve is present separating right atrium from the right ventricle. Hence it is also called right atrioventricular valve. Opening of this valve is guarded by three cusps.
    Function: This valve prevents backflow of blood from right ventricle to right atrium
  - **(ii) Bicuspid valve:** This valve is present separating left atrium from the left ventricle. Hence, it is also called left atrioventricular valve. This valve is also known as mitral valve. The opening of this valve is guarded by two cusps.
    Function: This valve prevents backflow of blood from left ventricle to left atrium.
  - **(iii) Pulmonary valve:** This valve is present between pulmonary artery and right ventricle.
    Function: This valve prevents the backflow of blood from pulmonary artery to the right ventricle.
  - **(iv) Aortic valve:** This valve is present between aorta and left ventricle.
    Function: This valve prevents the backflow of blood from aorta to left ventricle.
    Three layers of heart: Pericardium, myocardium, endocardium

b. Define joint and classify. Name the bones of axial skeleton.

Ans: Joint: The place where two or more bones join together is called a joint or articulation.

Types of Joint/Classification of Joint/Types of Articulation: According to range of movement, the joints are classified as:

A. Fixed joint/immovable/fibrous joint

B. Slightly movable/cartilaginous joint

C. Freely movable synovial joints

(i) Ball and socket joint
(ii) Hinge joint
(iii) Double hinge joint
(iv) Gliding joint
(v) Pivot/axial joint
(vi) Saddle joint

Bones of axial skeleton: It includes bones of skull, vertebral column and thoracic cage.

A. Skull:

Cranium: Frontal (1), Parietal (2), Occipital (1), Temporal (2), Sphenoid (1), Ethmoid (1)

Face: Zygomatic (3), Maxilla (1), Nasal (2), Lacrimal (2), Vomer (1), Palatine (2) Inferior conchae (2), Mandible (1)

B. Vertebral column (vertebra): Cervical (7), Thoracic (12), Lumbar (5), Sacral (5 fused), Coccyx (4 fused)

C. Thoracic cage: Sternum (1), Rib (12 pairs)

c. Define blood. Describe its composition and function.

Ans: Blood is red coloured, viscous fluid connective tissue circulated in body and mainly composed of blood cells and plasma.

1. Plasma (55%)

A. Water: 91 to 92%
B. Solids: 8 to 9%
   (a) Inorganic constituents, e.g. sodium, potassium, calcium
   (b) Organic constituents
      (i) Proteins, e.g. albumin, globulin, prothrombin, fibrinogen
      (ii) Non-protein nitrogenous substances, e.g. urea, uric acid, creatinine
      (iii) Nutrients, e.g. glucose amino acids, vitamins, glycerol
      (iv) Hormones and enzymes
      (v) Gaseous: O, CO, nitrogen
      (vi) Antibodies and antitoxins
      (vii) Fats: Neutral fats, phospholipids
      (vii) Colouring matter: Bilirubin
      (ix) Other substances: Internal secretions

2. Blood (45%)

(i) RBCs (erythrocytes)
(ii) WBCs (leukocytes)

Granulocytes (75%): Neutrophils (70%), basophils (1%), eosinophils (4%)

Agranulocytes (25%): Lymphocytes (20%), monocytes (5%)

iii. Platelets (thrombocytes)

Functions of Blood:

1. Blood helps to transport the gases from lungs to the tissues (O) and from tissues to the lungs (CO)
2. Blood helps to transport the absorbed digested materials to the tissues of the body.
3. Blood acts as a vehicle through which many substances are transported to their places of activity.
4. Blood helps to drain out waste materials present in the body.
5. Blood acts as a great defensive mechanism.
6. Blood helps to regulate body temperatures
7. Blood maintains acid–base balance of the body.
8. Blood has coagulation property due to which it prevents loss of blood from the body.

d. Give composition and function of saliva and write any six functions of liver.

Ans: Saliva: Saliva is a mixed secretion of the three pairs of salivary glands (parotid, submandibular, sublingual glands) which gives moistening to the mouth, also cleans the teeth, tongue and helps in the process of mastication.

Composition of Saliva

(i) Water: 10%
(ii) Ptyalin: Salivary enzyme
(iii) Mucin: Thick lubricant
(iv) Calcium salts: In small amounts.

Functions of Saliva

(i) Saliva constantly keeps the mouth cavity clean and moist
(ii) Saliva moistens and lubricates the food material so that it forms a soft mass (bolus) which is suitable for swallowing.

Functions of Liver:

(i) The hepatic cells of liver secrete the bile which is necessary for digestion and absorption of fats.
(ii) Liver acts as a storage of glycogen.
(iii) The liver helps in the formation of urea which is then carried to the kidney and thrown out in the form of urine.
(iv) Liver helps in metabolism of fats.

(v) Liver helps in production of heat which helps in maintaining body temperature.
(vi) Liver performs detoxication function.
(vii) Liver helps in storage of iron in the form of protein compound called ferritin.
(viii) Liver helps in storage of vitamins A, D, E, K and B_{12}.
(ix) Functions of liver related to blood:
(a) Formation of RBCs in foetal life.
(b) Destruction of RBCs and formation of bile pigments.
(c) Formation of plasma proteins such as albumin, globulin, prothrombin, fibrinogen.
(d) Formation of heparin which is a natural anticoagulant present in the blood.

e. Describe the physiology of urine formation. Draw a well-labelled diagram of nephron.

Ans: Formation of urine involves three main stages:

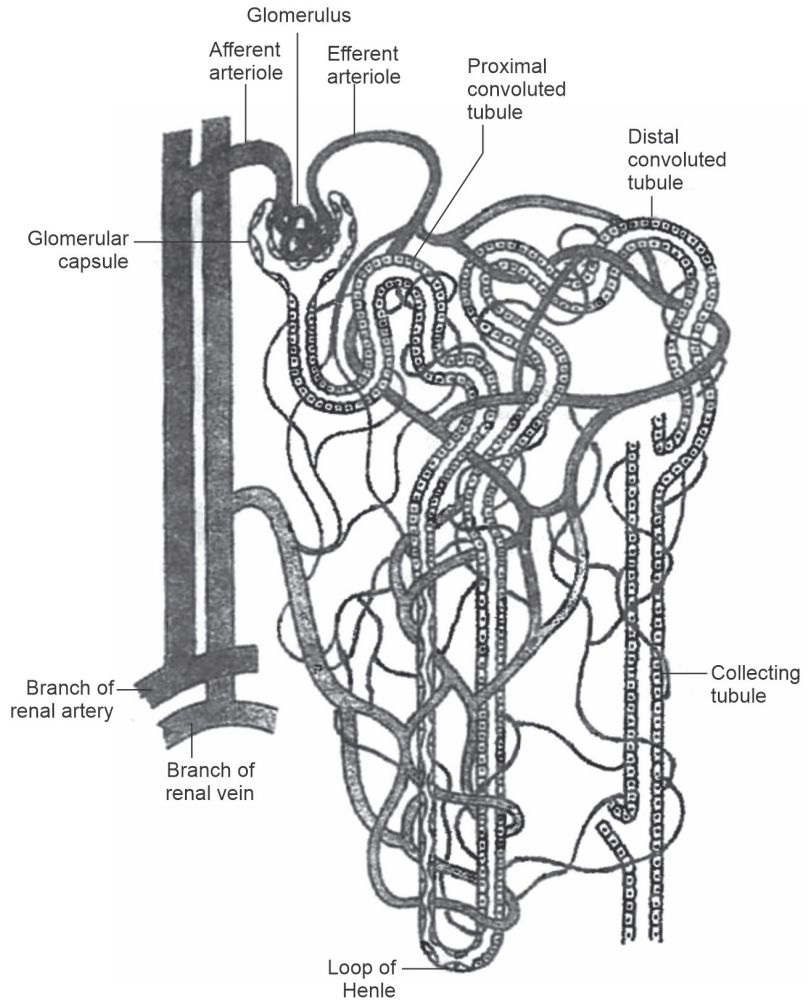
1. Ultrafiltration (glomerular filtration)
- The filtration of blood under pressure is called ultrafiltration.
- It occurs in glomerulus, hence named glomerular filtration.
- The blood containing waste material is carried into the glomerulus by afferent arterioles.
- The walls of glomerular capsule act as a filter and blood is filtered under pressure of about 10 mm Hg.
- About 125 ml of blood is filtered out per minute as a glomerular filtrate.
- GFR: Glomerular filtration rate.
  – Definition: The blood filtered through glomerulus in 1 hour is called glomerular filtration rate.
  – About 1 litre of blood is filtered in 1 hour. Thus GFR is 10% (100 ml).

2. Selective reabsorption (active reabsorption): The process by which only useful substances are absorbed from the glomerular filtrate into the blood capillaries is called selective reabsorption.
- **High threshold substances:** The substances which are essential to the body and are selectively reabsorbed back into the blood circulation are called high threshold substances, e.g. glucose, amino acids, vitamins, water.
- **Low threshold substances:** The substances which are reabsorbed only up to a slight extent are called low threshold substances, e.g. urea, uric acid.

- **Non-threshold substances/no threshold substances:** Suhstances which are not reabsorbed at all from the glomerular filtrate are called non-threshold substances, e.g creatinine, hippuric acid.

3. **Active secretion:**

Definition: The process of transport of substances from blood into the filtrate again is called active secretion. The substances which are not filtered by glomerular capsule carried in the capillaries of the efferent arteriole and they are clear by active secretion into the urine, in this way process of urine formation completes.



Nephron (uriniferous)

f. Draw a sagittal section of eye and explain its parts.

Ans: Parts of Eye

1. **Cornea:** It is an anterior transparent epithelial membrane slightly curved or convex and is continuous with sclera. Cornea is sometimes called 'window of eye'.
   – Cornea has no blood supply but it is nourished from aqueous humour.

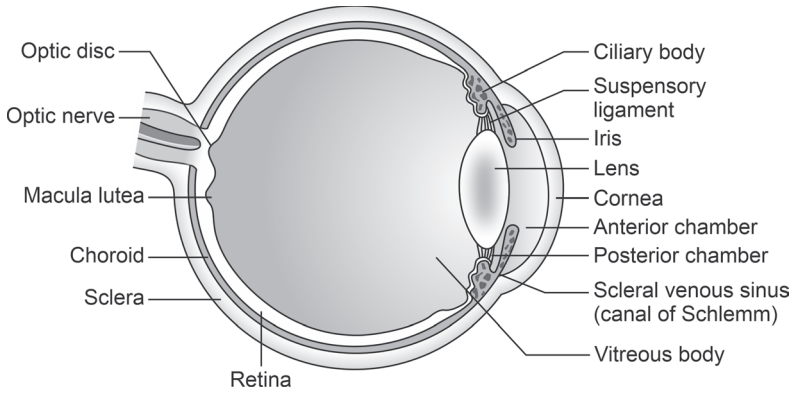
   Function: It allows the light to enter the interior of the eye because of transparent nature.
2. **Iris:** Iris is circular body and is an anterior extension of ciliary body present, behind the cornea. It is a pigmented membrane which surrounds the pupil of eye. Iris is attached to the ciliary process and is present between cornea and lens. It consists of radiating and circular muscles along with pigment cells.

   Functions:
   (i) The muscles of iris contract and relax causing dilation and constriction of pupil. It regulates the amount of light entering the posterior part of the eye.
   (ii) It helps to control the size of the pupil.
3. **Pupil:** The central aperture of the iris is known as pupil.
   - The pupil varies depending upon the intensity of light.
   - In bright light the circular muscle fibres contract and constrict the pupil.
   - In dim light, the radiating muscle fibres contract and produce dialation of pupils.

   Function: The pupil helps to control the amount of light enter.
4. **Aqueous humour:** It is a fluid present in between cornea and iris (anterior chamber).
   - It is secreted by the ciliary bodies.

   Functions:
   (i) It keeps the parts of eye moist.
   (i) It gives nourishment to the cornea.
5. **The lens:** Lens is an elastic circular biconvex, transparent body present behind the thickness of the pupil. It is made up of protein fibres and suspended by ligaments. Lens is controlled by ciliary muscles.

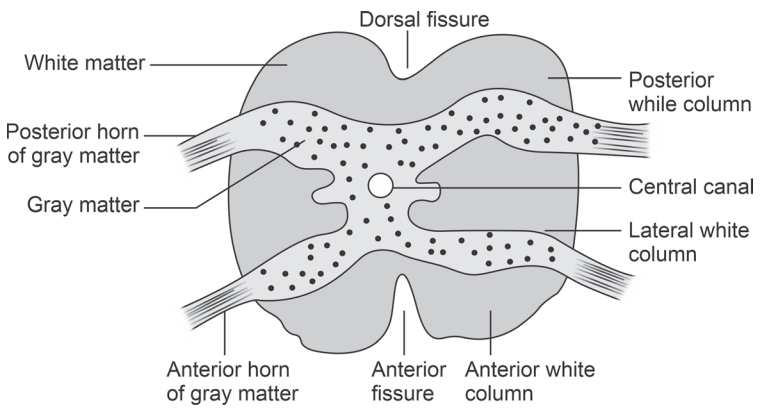
   Functions: To focus the rays of light entering the eye through the pupil on the retina.



Vertical section of an eyeball/eye

g. Describe the structure of spinal cord with neat and labelled diagram.

Ans: Spinal cord extends from medulla oblongata. Spinal cord is an elongated and almost cylindrical part of the CNS. Spinal cord is surrounded by dura mater, arachnoid and pia mater. It is about 45 cm long and is about thickness of little finger. The spinal cord emerges out from an opening in the cranium known as foramen magnum.



TS of spinal cord

Q2. Attempt any TEN of the following: **30 Marks**

a. Explain nervous tissue.

Ans: Nervous tissue is a specialized type of tissue that forms the nervous system, which includes the brain, spinal cord, and

nerves. It is composed of two main types of cells: Neurons and neuroglia.

Neurons are the primary functional cells of the nervous system and are responsible for transmitting electrical signals throughout the body. They have a cell body, dendrites that receive signals from other neurons, and an axon that transmits signals to other cells.

Neuroglia, also known as glial cells, provides support and protection for neurons. They help maintain the structure of the nervous tissue, regulate the environment around neurons, and play a role in immune responses in the nervous system.

Nervous tissue is highly specialized and has unique properties that allow for rapid communication and coordination of bodily functions. It is essential for sensory perception, motor function, cognition, and overall homeostasis in the body. Damage to nervous tissue can result in neurological disorders and impairments in sensory, motor, and cognitive functions.

Description of neuron: Each neuron consists of: (a) Nerve cell, (b) Axon, (c) Dendrites.

(a) **Nerve cells:** They form grey matter of nervous system. The nerve cells in group are called ganglia.

Functions:

(i) It stimulates impulses.

(ii) It helps in generation and transmission of impulses.

(b) **Dendrites:** The branches of the nerve cell are called dendrites.

Function: They receive the impulses from synapse towards the nerve cell.

(c) **Axon:** The elongated main fibre originated from the nerve cell is called axon. It forms white matter of the nervous system. (i) Axolemma: It is a membrane which covers and protects axon and contains axoplasm. (i) Myelin sheath: It is a sheath of fatty material which surrounds axons. The points where myelin sheath is absent are known as nodes of Ranvier. Functions of myelin sheath: (a) It protects the axon from injury. (b) It contributes to rapid transmission of nerve impulses along myelinated fibres. (c) It acts as an insulator. (d) It speeds the flow of nerve impulses through them.

b. Which part of the cell is called powerhouse of cell? Why?

Ans: Mitochondria are known as the powerhouse of the cell because they are responsible for producing the majority of the cell's

energy in the form of adenosine triphosphate (ATP). ATP is the primary energy currency of cells and is required for various cellular processes such as muscle contraction, active transport, and synthesis of macromolecules.

The process by which mitochondria generate ATP is called cellular respiration. It involves the breakdown of glucose and other molecules through a series of biochemical reactions that occur within the mitochondria. This process occurs in multiple steps, including glycolysis, the citric acid cycle, and oxidative phosphorylation.

During cellular respiration, glucose is broken down into carbon dioxide and water, releasing energy in the form of ATP. Therefore, due to their central role in generating ATP, mitochondria are often referred to as the powerhouse of the cell.

c. Define anemia. Explain its types.

Ans: Anemia: Anemia is a medical condition characterized by a decrease in the number of red blood cells or a decrease in the amount of hemoglobin in the blood.

There are several types of anemia:

1. **Iron-deficiency anemia:** This is the most common type of anemia. It occurs when the body does not have enough iron to produce hemoglobin. Iron is essential for the production of red blood cells, and inadequate iron levels can lead to decreased hemoglobin synthesis.
2. **Vitamin-deficiency anemia:** Deficiencies in vitamins such as vitamin B_{12} and folate (vitamin B_9) can lead to anemia. These vitamins are necessary for red blood cell production, and their deficiency can impair the formation of healthy red blood cells.
3. **Hemolytic anemia:** In this type of anemia, red blood cells are destroyed more rapidly than they can be produced. This can occur due to various factors, including inherited conditions, autoimmune disorders, or certain infections.
4. **Aplastic anemia:** Aplastic anemia is a rare but serious condition where the bone marrow fails to produce enough red blood cells, white blood cells, and platelets. It can be caused by exposure to certain toxins, radiation, or as a result of autoimmune disorders.
5. **Sickle cell anemia:** This is an inherited form of anemia caused by a mutation in the gene responsible for producing

hemoglobin. The abnormal hemoglobin leads to the characteristic sickle shape of red blood cells, which can cause blockages in blood vessels and lead to severe pain and organ damage.

d. Define the terms:

(i) **Cardiac output:** It is the amount of blood ejected from the heart in each minute by the contraction of ventricles.

Normal value: 5040 ml

(ii) **Blood pressure:** The lateral pressure applied by blood on the walls of blood vessels while flowing through it is called blood pressure.

Normal value: 120/80 mmHg

(iii) **Stroke volume:** It is the amount of blood ejected from the heart by each contraction of the ventricles.
Normal value: 70 ml

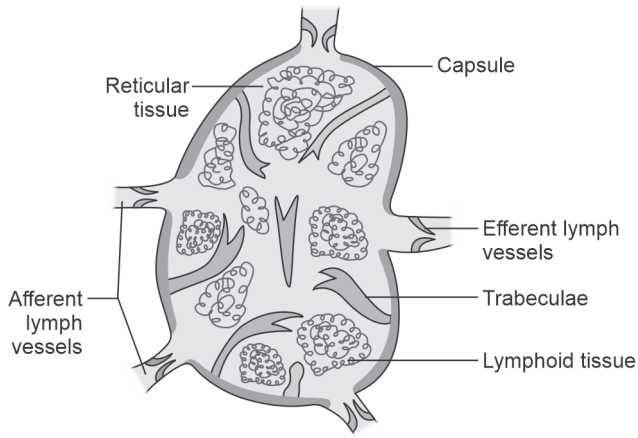
e. Explain structure and function of lymph node.

Ans: Lymph node: These are small oval or bean-shaped structures present in lymphatic vessels.

- Lymph nodes are usually distributed in groups
- They are placed superficially and also deep in the body.
- The main groups of lymph gland are present—in neck, in the axial (arm), in the thorax, in the abdomen.

Lymph node consists of the following parts:

- An outer dense fibrous tissue called capsule.
- Capsule gives rise to fibrous band on inner side called trabeculae.
- Trabeculae divide substance of lymph node into irregular spaces.
- The space between trabeculae contains lymphoid tissue which produces lymphocytes.
- As many as 4 to 5 afferent lymph vessels may enter in lymph node while only one efferent lymph vessel carries lymph away from lymph node.
- Each lymph node has concave surface called hilum where blood vessels supply blood to lymph node and efferent lymph vessel leaves.



Section of lymph node

Functions of Lymph Node:

1. Lymph node helps in the filtration of lymph and removes microbes, their toxins, foreign bodies.
2. Lymph node produces and supplies lymphocytes to blood.
3. Lymph node produces gamma globulin (which helps immunological response of the body).
4. Lymph nodes prevent spread of cancer cells.
5. Lymph node makes screening of lymph by means of phagocytic action.
6. Lymph node acts as a mechanical filter to resist the entrance of poisonous substance into circulation.
7. Lymph node acts as 1st line of defense.

f. Write composition and function of pancreatic juice.

Ans: Composition of Pancreatic Juice:

(i) Water
(ii) Mineral salts
(iii) Trypsinogen (trypsin)
(iv) Chymotrypsin (chymotrypsinogen)
(v) Amylase
(vi) Lipase

Pancreatic juice is a fluid secreted by the pancreas that plays a crucial role in digestion. It contains a variety of enzymes and bicarbonate ions that aid in the breakdown of carbohydrates, proteins, and fats.

Functions: The functions of pancreatic juice include:

1. **Digestion of Carbohydrates:**
   - Pancreatic amylase: Breaks down starches and complex carbohydrates into simpler sugars like maltose and dextrins.
2. **Digestion of Proteins:**
   - Trypsin: Converts proteins into smaller peptides.
   - Chymotrypsin: Further breaks down proteins into smaller peptides.
   - Carboxypeptidase: Cleaves amino acids from the carboxy (C-terminal) end of proteins.
3. **Digestion of Fats:**
   - Pancreatic lipase: Breaks down triglycerides into fatty acids and monoglycerides.
   - Phospholipase: Breaks down phospholipids into fatty acids and glycerol.
4. **Neutralization of Stomach Acid:**
   - Bicarbonate ions: Pancreatic juice contains bicarbonate ions, which help neutralize the acidic chyme (partially digested food) that enters the small intestine from the stomach.
5. **Activation of Enzymes**

g. Define the term:

i. **Tidal volume:** "The amount of air which is inspired and expired in an ordinary quite breathing is known as tidal volume."
   - Normal value: 500 ml.

ii. **Residual volume:** The amount of air remaining in the lungs after the most powerful expiration is known as residual volume."
   - Normal value: 1200 to 1500 ml.

iii. **Vital capacity:** "The volume of air that can be made to pass into and out of the lung by most forceful inspiration and expiration is known as vital capacity."
   - Normal value: 3 to 5 litres

h. Describe menstrual cycle.

Ans: Menstrual cycle: It is a series of changes in endometrium of a female, every 26 to 30 days throughout the childbearing period.

The phases of menstrual cycle are divided into:

1. **Menstrual phase (04 days):**
   - It is characterized by periodic discharge of 25–65 ml of blood, tissue fluid, mucus and epithelial cells.
   - It is caused by sudden reduction in oestrogen and progesterone and lasts for approximate 4–5 days.
   - During menstrual phase, ovarian cycle is also in operation and primary follicle begins its development.
   - At birth, each ovary contains 200,000 follicles each consisting of primary ovum surrounded by single epithelium.
   - Towards the end of menstrual phase, many primary follicles developed into secondary follicle which consists of secondary ova.
2. **Proliferative phase (10 days):**
   - It is characterized by release of oestrogen.
   - During this, endometrium gets proliferated and it gets renewed in this period
   - Also, graafian follicle is maturing and this phase is terminated when ovulation occurs and oestrogen production is inhibited.
3. **Secretory phase (14 days):**
   - Immediately after ovulation, the cells lining of ovarian follicle are stimulated by LH to develop corpus luteum which further produces progesterone.
   - Under the influence of progesterone, the endometrium becomes oedematous and secretory glands produce an increased amount of watery mucus which is also called luteal phase.
   - If the implantation of fertilized ovum occurs, then endometrium grows further.
   - Then the menstrual cycle is interrupted during the period of lactation. If ovum is not fertilized, the cycle enters in the next phase.

i. Which gland is called endocrine and exocrine? Why?

Ans: The pancreas is considered both an endocrine and exocrine gland due to its dual function in the body.

1. **Endocrine function:** The endocrine function of the pancreas involves the production and secretion of hormones directly into the bloodstream. The pancreas contains clusters of cells called islets of Langerhans, which are responsible for

producing several important hormones, including insulin, glucagon, somatostatin, and pancreatic polypeptide. These hormones play key roles in regulating blood sugar levels, metabolism, and digestion.

2. **Exocrine function:** The exocrine function of the pancreas involves the production and secretion of digestive enzymes into the small intestine. These digestive enzymes, such as amylase, lipase, and proteases, help break down carbohydrates, fats, and proteins in the food we eat, facilitating their digestion and absorption.

   Thus, the pancreas is called an endocrine gland because it produces and releases hormones directly into the bloodstream to regulate various physiological processes, and it is called an exocrine gland because it secretes digestive enzymes into the digestive tract to aid in food digestion.

j. Define hormone. Enlist all the endocrine glands with their hormones in the body.

Ans: Hormone: Hormones are the chemical substances secreted by endocrine glands and are carried by bloodstream to another organ where these have an effect on the organ function, growth and nutrition, e.g. growth hormone, oxytocin, insulin, glucagon.

Endocrine glands with their hormomes:

1. **Pituitary Gland (Anterior Pituitary):**
   - Growth hormone (GH)
   - Prolactin (PRL)
   - Adrenocorticotropic hormone (ACTH)
   - Thyroid-stimulating hormone (TSH)
   - Follicle-stimulating hormone (FSH)
   - Luteinizing hormone (LH)
2. **Pituitary Gland (Posterior Pituitary):**
   - Antidiuretic hormone (ADH, vasopressin)
   - Oxytocin
3. **Thyroid Gland:**
   - Thyroxine (T4) and Triiodothyronine (T3)
   - Calcitonin
4. **Parathyroid Glands:**
   - Parathyroid hormone (PTH)

5. **Adrenal Glands:**
   - Adrenaline (epinephrine) and noradrenaline (norepinephrine)
   - Cortisol
   - Aldosterone
   - Androgens
6. **Pancreas:**
   - Insulin
   - Glucagon
   - Somatostatin
   - Pancreatic polypeptide
7. **Ovaries:**
   - Estrogen
   - Progesterone
   - Inhibin
8. **Testes:**
   - Testosterone
   - Inhibin
9. **Pineal Gland:**
   - Melatonin
10. **Thymus:**
   - Thymosin

k. Write the effect of parasympathetic stimulation on:

Ans: **i. Eye:** Constriction of pupil
ii. Salivary gland: Increased saliva production
iii. Urinary bladder: Increased contraction of urinary bladder.

Q3. Attempt ALL the following questions: 20 Marks

a. Name the 2nd cranial nerve.

Ans: Optic nerve

b. The blood vessel which carries oxygenated blood from the lungs to heart is pulmonary veins.

c. Name the muscles of respiration.

Ans: Diaphragm and intercostal muscles

d. Which hormone is secreted by testis?

Ans: Testosterone

e. Name the four fundamental tastes.

Ans: Sweet, sour, salty, bitter.

f. Which neurotransmitter is responsible for muscle contraction?

Ans: Acetylcholine (ACh)

g. Name the bones of elbow joint.

Ans: Humerus, ulna and radius

h. What are heart sounds?

Ans: Heart sounds are vibrations created by blood flowing through the heart's chambers as the valves open and close during the cardiac cycle. OR "Lub-Dub"—sound created as the cardiac valves open and close during the cardiac cycle.

i. Define anatomy and physiology.

Ans: Anatomy: It is the scientific study of body structure.
Physiology: It is the study of the function of different body organs.

j. Name the fundamental tissues of the body.

Ans: Connective tissue, epithelial tissue, muscle tissue, nervous tissue

k. Structural and functional unit of kidney is nephron.

l. Name the bones of cranium.

Ans: There are 8 cranium bones. Frontal, parietal, temporal, occipital, sphenoid, ethmoid bone.

m. The fertilization in female takes place in _____.

(i) Uterus **(iii) Fallopian tube**
(ii) Vagina **(iv) Ovary**

Ans: (iii) Fallopian tube

n. Which of the following is the property of skeletal muscle?

(i) Muscle tone
(ii) Muscle contraction
(iii) Muscle fatigue
(iv) All of the above

Ans: (iv) All of the above

o. Organ of Corti helps in _____.

(i) Hearing **(iii) Vision**
(ii) Balancing **(iv) All of the above**

Ans: (i) Hearing

p. Exchange of gases at the cellular level in lungs and tissue is described as _____.

(i) Inspiration
(ii) Internal respiration
(iii) External respiration
(iv) All of the above

Ans: (iii) External respiration

q. Retina **is the innermost nervous coat of the eye.**

r. Which of following function belongs to bile juice?

(i) Laxative action
(ii) Fat digestion
(iii) Buffer action
(iv) All of the above

Ans: (ii) Fat digestion

s. The term 'proximal' refers _____

(i) Towards the front of body
(ii) Towards the back of body
(iii) To the upper part nearest to the point of attachment
(iv) In the midline

Ans: (iii) The upper part nearest to the point of attachment.

t. Write any two functions of CSF.

Ans: 1. Protects the brain.
2. Cushioning the brain
3. Excretion of waste products.
4. Provides nutrients to brain and spinal cord.
5. CSF provides moistening to the brain.

Winter Examination 2024
(Question Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Attempt any SIX of the following: **30 Marks**

a. Classify the bones based on their shapes. Describe the structure of typical synovial joint with diagram
b. Describe the process of blood clotting.
c. Explain conduction system of the heart with neat diagram.
d. Describe the structure and functions of liver.
e. Explain the functional areas of the cerebrum with diagram. Give the functions of cerebrospinal fluid.
f. Draw the neat and label diagram of TS of eyeball. Give the functions of skin.
g. Explain the process of urine formation with neat and labelled diagram of nephron.

Q2. Attempt any TEN of the following: **30 Marks**

a. State the function of the following:
   (i) Ribosome
   (ii) Mitochondria
   (iii) Plasma membrane
b. Write an account of simple epithelial tissue.
c. Enlist different types of blood cells with their normal value.
d. Enlist the components of lymphatic system. Give the functions of lymphatic system.
e. Write an account of basics of electrocardiogram.
f. Name the upper and lower parts of respiratory system. Give the functions of respiratory system.
g. Write the physiology of carbohydrates digestion.
h. Write the effect of parasympathetic stimulation on the following body parts:
   (i) Eye
   (ii) Cardiac muscle
   (iii) Salivary gland

i. Write the principle actions of anterior pituitary hormones.
j. Describe the phases of menstrual cycle.
k. Write the function of insulin and thyroid hormones.

Q3. Attempt ALL questions. 20 Marks

a. Define the term physiology.
b. State the meaning of medial plane.
c. Define the term cardiac output.
d. _____ present in the respiratory system helps in the voice production.
e. Name the salivary glands.
f. Name any two cranial nerves.
g. Name the two types of photoreceptor present in the retina.
h. If muscle is frequently stimulated contract, it responses to the stimulus progressively decreases, such condition is called _____.
i. State the composition of urine.
j. Name the necessary reproductive glands in the males.
k. Voluntary muscles are present in the _____.
   (i) Heart
   (ii) Limb
   (iii) Liver
   (iv) Lungs
l. The first vertebra or G, that supports the skull present at top of spine is _____.
   (i) Hyoid
   (ii) Axis
   (iii) Atlas
   (iv) Mandible
m. The shortest bone in human body is _____.
   (i) Stapes
   (ii) Malleus
   (iii) Incus
   (iv) Patella
n. The plasma protein responsible for blood clotting is _____.
   (i) Fibrinogen
   (ii) Globulin
   (iii) Serum amylase
   (iv) Albumin

o. The amount of air that moves in or out of the lungs with each normal respiratory cycle is _____.
p. When the nerve impulse reaches the neuromuscular junction, acetylcholine is released into the _____.
q. Coughing and sneezing are controlled by which part of brain?
r. The _____ membrane separates the external ear and middle ear.
s. Which receptor is present in the nose?
   (i) Photoreceptor
   (ii) Gustatory receptor
   (iii) Olfactory receptor
   (iv) Adrenoreceptor
t. The primary sex organ of the female reproductive system is _____.
   (i) Uterus
   (ii) Cervix
   (iii) Ovaries
   (iv) Fallopian tubes

Winter Examination 2024
(Specimen Answer Paper)
First Year Diploma in Pharmacy
Subject—Human Anatomy and Physiology (20114)

Time: 3 Hours **Max Marks: 80**

Q1. Attempt any SIX of the following: **30 Marks**

Ans: [*Refer to Specimen Answer Papers of Summer 2022, Winter 2022, Summer 2023, Winter 2023, Summer 2024 Examination and Answers from this book for the Question 1 (a), (b), (c), (d), (e), (f), (g)]

Q2. Attempt any TEN of the following: **30 Marks**

Ans: [*Refer to Specimen Answer Papers of Summer 2022, Winter 2022, Summer 2023, Winter 2023, Summer 2024 Examination and Answers from this book for the Question 2 (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k)]

Q3. Attempt ALL questions. **20 Marks**

a. Define the term physiology.

Ans: The word physiology derived from a Greek word for study of nature. It is the study of how the body and its parts work or function.
Or Study of working of human body parts.

b. State the meaning of medial plane.

Ans: Medial plane divides body into two equal parts, i.e. right and left.

c. Define the term cardiac output.

Ans: The amount of blood the heart pumps in one minute, expressed in litres per minute.
OR
Cardiac output (CO) is the volume of blood the heart pumps per minute.

d. _____ present in the respiratory system helps in the voice production.

Ans: The larynx

e. Name the salivary glands

Ans:
- Parotid glands
- Submandibular glands
- Sublingual glands

f. Name any two cranial nerves.

Ans: Olfactory nerve, optic nerve, oculomotor nerve, trochlear nerve, trigeminal nerve, abducent nerve, facial nerve, vestibulocochlear nerve, glossopharyngeal nerve, vagus nerve, accessory nerve, hypoglossal nerve.

g. Name the two types of photoreceptor present in the retina.

Ans: 1. Cones
2. Rods

h. If muscle is frequently stimulated contract, it response to the stimulus progressively decreases, such condition is called _____.

Ans: Muscle fatigue

i. State the composition of urine.

Ans:
- Water (95%)
- The rest is urea (2%), creatinine (0.1%), uric acid (0.03%), chloride, sodium, potassium, sulphate, ammonium, phosphate

j. Name the necessary reproductive glands in the males.

Ans:
- Testes and epididymis
- Prostate gland
- Seminal vesicles
- Bulbourethral glands (Cowper's glands)

k. Voluntary muscles are present in _____.

(i) Heart **(iii) Liver**
(ii) Limb **(iv) Lungs**

Ans: (ii) Limb

l. The first vertebra or G, that supports the skull present at top of spine is

(i) Hyoid **(iii) Atlas**
(ii) Axis **(iv) Mandible**

Ans: (iii) Atlas

m. The shortest bone in human body is _____

(i) Stapes
(ii) Malleus
(iii) Incus
(iv) Patella

Ans: (i) Stapes

n. The plasma protein responsible for blood clotting is _____

(i) Fibrinogen
(ii) Globulin
(iii) Serum amylase
(iv) Albumin

Ans: (i) Fibrinogen

o. The amount of air that moves in or out of the lungs with each normal respiratory cycle is _____

Ans: Tidal volume

p. When the nerve impulse reaches the neuromuscular junction, acetylcholine is released into the _____

Ans: Synaptic cleft

q. Coughing and sneezing are controlled by which part of brain?

Ans: Medulla oblongata.

r. The _____ membrane separate the external ear and middle ear

Ans: Tympanic membrane

s. Which receptor is present in the nose?

(i) Photoreceptor
(ii) Gustatory receptor
(iii) Olfactory receptor
(iv) Adrenoreceptor

Ans: (iii) Olfactory receptor

t. The primary sex organ of the female reproductive system is _____.

(i) Uterus
(ii) Cervix
(iii) Ovaries
(iv) Fallopian tubes

Ans: (iii) Ovaries

CBS Confident Pharmacy Series

Fifth Edition

Human Anatomy and Physiology

for First Year Diploma in Pharmacy

Course Code: ER20-14T

is strictly written according to the new syllabus framed by Pharmacy Council of India (PCI) as per ER-2020. This book is presented and published to meet the requirements of students of first year Diploma in Pharmacy (D Pharm). The book, written in a simple and lucid language, attempts to demystify and simplify the basic concepts for the students of pharmacy for proper understanding of the subject and to get a sure success in the State Board Examinations.

Salient features of the book:

- Included Board Examination question papers and specimen answer papers.
- All topics are described in an easy to understand language.
- Gives to-the-point answers.
- Covers all the requisite contents as per new syllabus.
- Shows success key in Board Examination.

This book, as well as **CBS Confident Pharmacy Series**, will be useful not only for the students and teachers but also for candidates desiring to attempt competitive examinations for job opportunities in pharmacy profession such as hospital pharmacists in PHCs, civil hospitals, etc.



VN Raje MPharm MBA is currently Principal, Gourishankar Education Society's GES College of Pharmacy (D Pharm), Limb, Satara, Maharashtra. He has an excellent track record in pharmacy academics with 34 years of rich experience as a teacher and principal at diploma in pharmacy institution. His all 11 titles of first and second year Diploma in Pharmacy were published in 2021-22 as per PCI revised syllabus ER-2020 and well appreciated by students and teachers all over India.

The new revised editions 2025 of all these 11 titles are improved with its contents and also included Board Examination question papers and specimen answer papers for the betterment of the students.

Recently in 2024 his book *Pharma Success: A Book of Exit Exam for Diploma in Pharmacy Students* is published to achieve their hopeful success.

Dedicated to Education
CBSPD
CBS Publishers & Distributors Pvt Ltd
4819/XI, Prahlad Street, 24 Ansari Road, Daryaganj, New Delhi 110 002, India
E-mail: delhi@cbspd.com, customercare@cbspd.com; Website: www.cbspd.com
New Delhi | Bengaluru | Chennai | Kochi | Kolkata | Lucknow | Mumbai
Guajat | Hyderabad | Jharkhand | Nagpur | Patna | Pune | Uttarakhand