LATEST EDITION: FOR NEET 2026

PART-1 (CLASS 11)

NEET CODEX

The Ultimate NCERT Question Bank

Every NCERT Line, figure and Data – Transformed into MCQs

BIOLOGY

7000+ MCQs including HOTS

(Assertion-Reason,Statement-Based, Matching,Case-based and other NEET question types)

INCLUDES DETAILED ANSWER KEY WITH EXPLANATIONS & NCERT CITATIONS

Dr. Shiv Patel
MBBS
NEET 2020,AIR-267 with 690/720 marks

COMPLETE NCERT COVERAGE | ACTIVE RECALL
NO TEXTBOOK RE-READS REQUIRED

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DR. SHIV PATEL

Free Sample

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Introduction

*Every **NEET aspirant** knows one golden truth: **NCERT Biology is the foundation of success**. Yet **re-reading** the textbook multiple times is **exhausting**, **time-consuming**, and often leaves students wondering: **"Did I actually retain everything?"***

*That is why we created **NEET CODEX – The Ultimate Question Bank**. This book is built to act as your **NCERT substitute** for revision — ensuring that you never need endless rereads again. Instead, every page transforms NCERT content into **Active recall practice**, helping you memorize, apply, and master Biology for **NEET-UG.***

🌟 What Makes NEET CODEX Unique?

🗂 ***Unparalleled Content & Coverage***

- **Complete NCERT Coverage** – We've meticulously covered **every line, diagram, numerical data, example and table** from the latest NCERT textbooks, ensuring you miss nothing.
- **Almost "7000" Unique questions-** Practice makes perfect. Our **massive, high-quality question bank** is designed to cover every possible angle of a concept, leaving no room for surprises.
- **Question variety**- Our comprehensive question types range from **Simple factual Questions to** more complex varieties such as **Indirect/Application type, Assertion–Reason, Statement-based, Match the Following, Sequence-type, Multi-correct, Data anomaly, Clinical Case/Scenario based etc.**
- **Active Recall Design** – The questions are designed not only to reinforce understanding of the NCERT text but also to train students to **apply knowledge, think critically, and develop reasoning skills**—moving beyond mere rote memorization."
- **Mastery Section**–Factual recall MCQs first, followed by our special **NEET Mastery Section** with **Higher Order Thinking questions(HOTS)** including a variety of question types-Every question type has been carefully developed through an **in-depth analysis of the past 10 years of NEET exam papers.**
- **Detailed Answer Key** – Every question is backed by **concise explanations**, NCERT citations(**Source line**) and **option analysis**(For both correct and incorrect options).

🎯 ***Engineered for Exam Excellence***

- **Diagram & Data Questions** – Sharpen your analytical skills with a rich collection of questions based on **each and every diagrams, graphs, and numerical data**, mirroring the actual exam format.
- **Intra-Chapter Integrative Section** – Dedicated Higher-order MCQs that combine knowledge from **across different topics** from the same chapter.
- **"Scientist Biographies"** and "**Unit Introductions"** have also been transformed into MCQs, making sure no aspect of NCERT textbook remains uncovered.
- **Quick Revision Tables** – Summaries of **key terms, classifications, and numerical data** for last-minute prep.
- **Exam-Style Wording** – Includes tricky phrasings like "**all of the following are correct, EXCEPT", "not incorrect"**, and common distractors that mimic actual NEET papers.

🏅 ***The Seal of Quality***

⇒ **Latest Edition Guarantee** – Fully updated to align with the **Latest NCERT Biology Textbook and Syllabus for NEET-UG 2026**.

Blueprint of the Q-Bank

The Question Bank – Your Active Learning Arena .

Part 1-Active Recall Questions- *This part contains active recall questions generated from every testable element of the NCERT text, including facts, data, and diagrams.*

Section A: Text-Based MCQs

- **What It Is:** A comprehensive set of questions generated sequentially, line-by-line, from the NCERT text. It covers every fact, definition, and concept.
- **Purpose & Strategy:** This section is your **active-recall substitute for re-reading**. Instead of passively highlighting the textbook, solve these questions right after your first read. The goal is to train your brain to retrieve information actively. If you can answer all these questions, you know every fact in the chapter.

Section B: Diagram & Data MCQs

- **What It Is:** Questions that specifically target every figure, table, and graph in the chapter.
- **Purpose & Strategy:** NEET is a visual exam, and many questions are directly based on NCERT diagrams. This section trains your ability to interpret visual data, identify labeled parts, and understand the processes shown. **Never skip a diagram**, and this section ensures you master them.

Section C: Intra-Chapter Integrative MCQs

- **What It Is:** A set of higher-order thinking skill (HOTS) questions that force you to connect multiple concepts from different parts of the same chapter.
- **Purpose & Strategy:**. Use it *after* you have a good grasp of the individual facts from Sections A and B. These questions mimic the toughest, most challenging MCQs in the NEET exam that separate the top scorers from the rest. They test your true understanding, not just your memory.

Part-2-NEET Mastery Questions- *This part contains exam-oriented question formats modelled on recent NEET papers, along with select innovative formats designed to challenge conventional thinking. Each format systematically tests application, analysis, and integration of concepts, thereby bridging the gap between factual recall and problem-solving.*

This Part is your Rank Booster which will help you separate from the rest.

The formats used in this section include:

- **Assertion–Reason** – tests causal relationships between two statements
- **Statement-Based** – evaluates correctness of multiple factual statements
- **Matching Type** – links related concepts across two columns
- **Data Anomaly** – identifies inconsistencies in a dataset or graph
- **Sequence** – arranges items in correct order (chronological/procedural)
- **Multi-Correct** – selects all correct options from a given list
- **Flowchart / Process Completion** – fills missing steps in biological processes
- **Scenario-Based/Case-Based** – applies concepts to clinical or ecological situations
- **Diagnostic Pathway** – follows multi-step logical reasoning from observation to outcome

The Detailed Answer Key – Your Personal Tutor

This is arguably the most valuable part of the tool. Don't just use it to check your score.

- **What It Is:** A complete key with not just the correct answer, but a **"Justification"** for why it's right and an **"Option Analysis"** for why the other choices are wrong.

- **Purpose & Strategy:**
    - **If your answer is correct:** Read the "Justification" to confirm that your line of reasoning was the right one.
    - **If your answer is wrong:** This is where real learning happens.
        1. First, read the **"Justification"** to understand the correct concept.
        2. Next, carefully read the **"Option Analysis."** This will explain the flaw in the option you chose, helping you pinpoint and correct your specific misconception.

Quick Revision Summary Tables – Your Last-Minute Power-Up

- **What It Is:** Two concise tables summarizing all the key numerical data, classifications, and examples from the chapter.

- **Purpose & Strategy:** This is your tool for rapid revision. Use it in the days leading up to a test or the final exam. Instead of re-reading the entire chapter, a 5-minute review of these tables will refresh your memory on all the high-yield, forgettable facts (like which plant has which type of placentation).

Use Revision Tables before exams. → Solve Part-1, Section A & B → Review with the Answer Key → Challenge yourself with Section C → Review with the Answer Key → Solve Part-2 for boosting Rank.

✍About the author

NEET CODEX is an academic initiative dedicated to creating high-quality, exam-focused learning resources for students across India. Every NEET CODEX book is designed with one vision in mind: to transform textbooks into active recall companions — ensuring students can revise smarter, faster, and with greater confidence.

Behind NEET CODEX is its founder, Dr. Shiv Patel, an MBBS graduate from Government Medical College, Surat. A high-achieving student himself, he secured AIR 267 with 690/720 marks in NEET 2020 and cleared both stages of the prestigious KVPY exam twice during his school years. With this strong academic background and deep understanding of competitive exam preparation, he created this book to help students excel with clarity, precision, and efficiency.

NEET CODEX is more than an author's name. It is a promise of accuracy, innovation, and student-first learning — a growing family of trusted resources that will expand beyond Biology to Physics, Chemistry, and more.

✨ A Note to the Reader

Every journey to success begins with clarity and consistency. You already hold within you the ability to achieve your dream — all you need is the right guide to channel your effort.

This book has been designed to be that guide. Every line, every figure, every fact from NCERT has been transformed into questions to help you **recall, reinforce, and retain** effortlessly. Trust the process, stay disciplined, and use this tool as your constant companion.

Remember: **NEET is not about studying more, but about revising smarter.** With persistence and focused practice, your success is inevitable.

Stay determined. Stay consistent.
The future you're working for is waiting. ✨

— Dr Shiv Patel

Table of Contents

NEET Codex-Part-1(Class 11)

Biology Class-XI: Year Wise Number of Questions (2025-2016)

Chapters/ Units' Name	2025	2024	2023	2023 Manipur	2022 Re	2022	2021	2020 Covd	2019	2018	2017	2016	2016 II
The Living World	0	0	0	0	2	1	1	0	1	1	0	2	0
Biological Classification	1	1	2	0	0	2	1	1	2	5	3	3	5
Plant Kingdom	5	2	1	3	3	2	4	3	2	3	5	2	1
Animal Kingdom	4	4	3	4	2	2	4	2	3	4	4	1	4
Morphology of Flowering Plants	3	3	5	2	3	3	2	3	1	2	4	4	4
Anatomy of Flowering Plants	1	4	3	4	3	3	1	2	3	4	3	2	1
Structural Organisation in Animals	4	4	4	4	4	5	4	3	2	1	1	2	2
Cell: The Unit of Life	4	5	4	2	2	4	1	4	4	6	2	3	2
Biomolecules	4	6	6	3	4	3	6	4	2	3	1	2	3
Cell Cycle and Cell Division	1	3	4	6	5	4	5	4	4	2	1	3	3
Photosynthesis in Higher Plants	2	3	3	3	3	2	2	2	2	0	1	2	2
Respiration in Plants	1	2	2	2	2	3	1	1	1	2	2	1	2
Plant Growth and Development	2	3	3	3	3	3	3	3	3	2	0	1	1
Breathing and Exchange of Gases	0	2	3	3	3	2	2	2	2	0	1	2	2
Body Fluids and Circulation	1	2	2	2	2	2	2	2	2	2	2	2	1
Excretory Products and their Elimination	1	2	2	2	2	1	0	2	0	2	2	2	1
Locomotion and Movement	1	2	2	2	1	2	3	1	1	2	1	3	2
Neural Control and Coordination	0	1	2	2	2	1	2	1	1	2	3	2	1
Chemical Coordination and Integration	4	2	2	2	2	1	3	4	3	2	2	2	4

Percentage Weightage of Chapters (2016-2025)

S.No.	Chapters/Units' Name	Total Questions	Percentage Weightage (%)
1	Cell Cycle and Cell Division	48	7.91%
2	Biomolecules	48	7.91%
3	Animal Kingdom	45	7.41%
4	Cell: The Unit of Life	43	7.24%
5	Structural Organisation in Animals	43	7.08%
6	Morphology of Flowering Plants	42	6.92%
7	Plant Kingdom	39	6.43%
8	Anatomy of Flowering Plants	36	5.93%
9	Plant Growth and Development	32	5.27%
10	Chemical Coordination and Integration	32	5.27%
11	Photosynthesis in Higher Plants	30	4.94%
12	Biological Classification	27	4.45%
13	Breathing and Exchange of Gases	27	4.45%
14	Body Fluids and Circulation	25	4.12%
15	Locomotion and Movement	23	3.79%
16	Respiration in Plants	21	3.46%
17	Neural Control and Coordination	19	3.13%
18	Excretory Products and their Elimination	18	2.97%
19	The Living World	8	1.32%

Biology Class-XII: Year Wise Number of Questions (2025-2016)

Chapters Name	2025 Re	2024	2023	2023 Manipur	2022 Re	2022	2021	2020	2020 Covid	2019	2018	2017	2016	2016 II
Sexual Reproduction in Flowering Plants	5	3	2	3	3	4	3	3	2	3	4	7	3	3
Human Reproduction	5	4	5	3	2	3	2	3	3	1	4	4	4	3
Reproductive Health	1	2	2	2	4	2	1	2	2	3	1	2	2	2
Principles of Inheritance and Variation	3	6	6	5	4	5	6	2	4	3	5	4	5	2
Molecular Basis of Inheritance	7	4	6	8	7	7	10	9	5	4	5	5	7	5
Evolution	1	5	4	2	1	1	2	2	4	4	4	3	1	3
Human Health and Disease	5	2	4	3	3	2	2	1	3	2	4	3	2	4
Microbes in Human Welfare	4	2	1	0	0	1	0	1	3	3	4	1	3	1
Biotechnology: Principles and Processes	6	6	5	5	4	5	6	5	5	6	3	1	4	4
Biotechnology and Its Applications	4	5	4	1	3	2	2	7	3	2	2	4	0	1
Organisms and Populations	3	4	2	2	5	2	1	5	1	2	1	5	3	2
Ecosystem	3	2	1	2	2	3	5	3	2	3	1	1	2	1
Biodiversity and Conservation	2	4	5	2	2	3	5	0	2	2	3	1	2	3

Percentage Weightage of Chapters (2016-2025)

S.No.	Chapters Name	Total Questions	Percentage Weightage (%)
1	Molecular Basis of Inheritance	87	14.97%
2	Principles of Inheritance and Variation	66	11.36%
3	Biotechnology: Principles and Processes	64	11.02%
4	Sexual Reproduction in Flowering Plants	48	8.26%
5	Human Reproduction	46	7.92%
6	Biotechnology and Its Applications	40	6.88%
7	Organisms and Populations	39	6.71%
8	Human Health and Disease	38	6.54%
9	Evolution	37	6.37%
10	Biodiversity and Conservation	35	6.02%
11	Ecosystem	34	5.85%
12	Reproductive Health	28	4.82%
13	Microbes in Human Welfare	19	3.27%

Relative weightage during 2016-2025 is:

- **Class 11:** (607 / 1188) = **51.09%**
- **Class 12:** (581 / 1188) = **48.91%**

The weightage is almost evenly split, with Class 11 having a slightly higher weightage in the analysed period.

Chapter 5: Morphology of Flowering Plants

KEY TOPICS (BASED ON PYQ ANALYSIS)

- **Placentation:** Types and examples (marginal, axile, parietal, free-central, basal).
- **Aestivation:** Types and examples (valvate, twisted, imbricate, vexillary).
- **Flower Symmetry & Ovary Position:** Actinomorphic/Zygomorphic and Hypogynous/Perigynous/Epigynous conditions.
- **Stamen & Carpel Modifications:** Cohesion (e.g., monoadelphous, diadelphous, polyadelphous) and adhesion (epipetalous).
- **Plant Families:** Floral formulas and economic importance of Fabaceae, Solanaceae, and Liliaceae (as seen in PYQs, even though not all are detailed in this text).

QUICK REVISION SUMMARY TABLES

TABLE 1: KEY NUMERICAL DATA & CLASSIFICATIONS

Category	Classification/Type	Numerical Value / Count
Floral Appendages	Trimerous	In multiples of 3
	Tetramerous	In multiples of 4
	Pentamerous	In multiples of 5
Phyllotaxy	Alternate	1 leaf per node
	Opposite	2 leaves per node
	Whorled	More than 2 leaves per node
Androecium (Cohesion)	Monoadelphous	Stamens in 1 bundle
	Diadelphous	Stamens in 2 bundles
	Polyadelphous	Stamens in more than 2 bundles
Gynoecium	Bicarpellary	2 carpels
Seed Embryo	Monocotyledonous	1 cotyledon
	Dicotyledonous	2 cotyledons

Anther Structure	Lobes	2 (Bilobed)
	Pollen-sacs per lobe	2
Family: Solanaceae	Sepals	5 (united)
	Petals	5 (united)
	Stamens	5 (epipetalous)
	Carpels	2 (fused, superior)
Vexillary Aestivation	Total Petals	5 (1 Standard + 2 Wings + 2 Keel)

TABLE 2: KEY TERMS, CLASSIFICATIONS & EXAMPLES

Concept/Term	Classification/Type	Examples from NCERT
Root System	Tap root	Mustard
	Fibrous root	Wheat
	Adventitious root	Grass, *Monstera*, Banyan tree
Leaf Venation	Reticulate	Dicotyledonous plants
	Parallel	Monocotyledonous plants
Leaf Type	Pinnately Compound	Neem
	Palmately Compound	Silk Cotton
Phyllotaxy	Alternate	China rose, Mustard, Sun flower
	Opposite	*Calotropis*, Guava
	Whorled	*Alstonia*
Floral Symmetry	Actinomorphic (Radial)	Mustard, *Datura*, Chilli
	Zygomorphic (Bilateral)	Pea, Gulmohur, Bean, *Cassia*
	Asymmetric (Irregular)	Canna
Ovary Position	Hypogynous (Superior)	Mustard, China rose, Brinjal
	Perigynous (Half-inferior)	Plum, Rose, Peach
	Epigynous (Inferior)	Guava, Cucumber, Ray florets of sunflower
Aestivation	Valvate	*Calotropis*
	Twisted	China rose, Lady's finger, Cotton

	Imbricate	*Cassia*, Gulmohur
	Vexillary	Pea, Bean
Stamen Adhesion	Epipetalous (to petals)	Brinjal
	Epiphyllous (to perianth)	Lily
Stamen Cohesion	Monoadelphous	China rose
	Diadelphous	Pea
	Polyadelphous	Citrus
Gynoecium Cohesion	Apocarpous (free)	Lotus, Rose
	Syncarpous (fused)	Mustard, Tomato
Placentation	Marginal	Pea
	Axile	China rose, Tomato, Lemon
	Parietal	Mustard, *Argemone*
	Free Central	*Dianthus*, *Primrose*
	Basal	Sunflower, Marigold
Fruit Type	Drupe	Mango, Coconut
Seed Type	Endospermic	Castor, Wheat, Maize
	Non-endospermic	Bean, Gram, Pea, Orchids
Family: Solanaceae	Food	Tomato, Brinjal, Potato
	Spice	Chilli
	Medicine	Belladonna, Ashwagandha
	Fumigatory	Tobacco
	Ornamental	Petunia

PART 1: ACTIVE RECALL QUESTIONS

THIS PART CONTAINS ACTIVE RECALL QUESTIONS GENERATED FROM EVERY TESTABLE ELEMENT OF THE NCERT TEXT, INCLUDING FACTS, DATA, AND DIAGRAMS. THE QUESTIONS ARE PRESENTED IN SEQUENTIAL ORDER AND SUBDIVIDED ACCORDING TO NCERT CHAPTERS AND SUBHEADINGS. DESIGNED AS A **DIRECT REVISION TOOL**, THIS SECTION **MINIMIZES THE NEED FOR REPEATED READINGS OF THE TEXTBOOK.**

AT THE END OF EACH SUBHEADING, A SET OF HIGHER-ORDER THINKING SKILLS (HOTS) QUESTIONS IS PROVIDED TO STRENGTHEN CONCEPTUAL APPLICATION.

SECTION A: TEXT-BASED MCQS

INTRODUCTION

1. Despite the large diversity in the external structure of angiosperms, they are all universally characterized by the presence of which set of organs?

a) Roots, stems, leaves, flowers, and fruits

b) Tap roots, woody stems, simple leaves, and cones

c) Rhizoids, thallus, flowers, and seeds

d) Roots, stems, leaves, and sporangia

2. Variations in different plant parts are often found as adaptations to their environment for functions such as:

a) Protection, climbing, and storage

b) Only for attracting pollinators

c) Exclusively for asexual reproduction

d) Primarily for transpiration and guttation

3. The body of a typical flowering plant is divided into two main systems. The portion that remains above the ground is known as the:

a) Shoot system

b) Root system

c) Vascular system

d) Reproductive system

4. Which of the following statements is incorrect regarding the basic morphology of flowering plants?

a) The underground part of a flowering plant is always the shoot system.

b) All flowering plants, such as a common weed, possess roots, stems, and leaves.

c) The shoot system is the part of the plant that is typically found above the ground.

d) Flowers and fruits are integral parts that characterize angiosperms.

5. Consider the following statements about the general characteristics of flowering plants.

Statement I: Angiosperms exhibit a vast diversity in their external morphology.

Statement II: The underground part of a flowering plant is referred to as the root system.

Which of the following is correct?

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

5.1 THE ROOT

6. In the majority of dicotyledonous plants, the structure that forms from the direct elongation of the radicle is the:

a) secondary root

b) primary root

c) fibrous root

d) adventitious root

7. The primary root and its branches, such as secondary and tertiary roots, together constitute the:

a) fibrous root system

b) adventitious root system

c) tap root system

d) shoot system

8. Which of the following plants is given as a typical example of a tap root system?

a) Wheat

b) Monstera

c) Grass

d) Mustard

9. Identify the correct statement regarding the root system in monocotyledonous plants.

a) The primary root is long-lived and forms the main root of the plant.

b) The primary root is short-lived and is replaced by a large number of roots.

c) Roots originate directly from the elongation of the plumule.

d) They possess a prominent tap root system that persists throughout the plant's life.

10. In a wheat plant, a large number of roots originate from the base of the stem. This collection of roots is known as the:

a) tap root system

b) fibrous root system

c) adventitious root system

d) prop root system

11. Roots that arise from parts of the plant other than the radicle are referred to as:

a) primary roots

b) lateral roots

c) tap roots

d) adventitious roots

12. All of the following are examples of plants that show adventitious roots, EXCEPT:

a) Banyan tree

b) Monstera

c) Grass

d) Mustard plant

13. Which of the following is NOT considered a main function of the root system?

a) Absorption of water and minerals from the soil

b) Synthesis of plant growth regulators

c) Providing proper anchorage to the plant parts

d) Synthesis of carbohydrates through photosynthesis

14. Select the option that correctly matches the plant with its characteristic root system.

a) Wheat - Tap root system

b) Mustard - Fibrous root system

c) Banyan tree - Adventitious roots

d) Grass - Tap root system

15. Consider the following statements.

Statement I: In dicots, the primary root is formed by the direct elongation of the radicle.

Statement II: In monocots, roots originate from the base of the stem to form the tap root system.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Statement I is correct but Statement II is incorrect.

c) Statement I is incorrect but Statement II is correct.

d) Both Statement I and Statement II are incorrect.

16. The tender apex of the root is protected by a thimble-like structure as it penetrates the soil. This structure is called the:

a) root hair

b) region of elongation

c) root cap

d) coleorhiza

17. A few millimeters above the root cap is the region of meristematic activity. The cells in this region are characterized by being:

a) large, thick-walled, and with sparse protoplasm

b) very small, thin-walled, and with dense protoplasm

c) elongated, differentiated, and incapable of division

d) dead, lignified, and providing mechanical support

18. The primary responsibility for the growth of the root in length lies with the cells located in the:

a) region of maturation

b) region of root cap

c) region of elongation

d) region of meristematic activity

19. In the root tip, the zone that is proximal to the region of elongation and from which root hairs emerge is the:

a) region of maturation

b) root cap

c) meristematic zone

d) cortex

20. Very fine, delicate, thread-like structures that are formed from epidermal cells in the region of maturation are known as:

a) lateral roots

b) root hairs

c) stipules

d) lenticels

21. The principal role of root hairs is to:

a) protect the root from pathogens

b) provide mechanical anchorage

c) store reserve food materials

d) absorb water and minerals from the soil

22. Assertion (A): The root apex is protected by a root cap.

Reason (R): The cells of the meristematic region at the root apex are tender and delicate.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

23. Identify the incorrect statement regarding the regions of the root.

a) The root cap is a thimble-like structure covering the root apex.

b) The cells of the region of elongation divide repeatedly.

c) The region of meristematic activity has small, thin-walled cells with dense protoplasm.

d) Root hairs arise from the region of maturation.

24. Arrange the regions of the root tip from the apex upwards.

a) Root cap, Region of elongation, Region of meristematic activity, Region of maturation

b) Root cap, Region of meristematic activity, Region of elongation, Region of maturation

c) Region of maturation, Region of elongation, Region of meristematic activity, Root cap

d) Region of meristematic activity, Root cap, Region of elongation, Region of maturation

5.2 THE STEM

25. The part of the plant axis that ascends and bears branches, leaves, flowers, and fruits is known as the:

a) root

b) petiole

c) stem

d) rachis

26. From which part of the embryo of a germinating seed does the stem develop?

a) Radicle

b) Cotyledon

c) Endosperm

d) Plumule

27. The regions of the stem where leaves are borne are called _____, and the portions of the stem between these regions are called _____.

a) nodes, internodes

b) internodes, nodes

c) axils, buds

d) buds, axils

28. A stem is typically characterized by the presence of:

a) a root cap and root hairs

b) nodes and internodes

c) a thimble-like apex

d) only underground parts

29. Buds that are located at the tip of a stem are referred to as _____, while those that arise in the axil of leaves are _____.

a) axillary, terminal

b) terminal, axillary

c) adventitious, floral

d) floral, adventitious

30. Which of the following accurately describes the change in a stem as it matures?

a) It is initially woody and dark brown, later becoming green.

b) It remains green throughout its life.

c) It is generally green when young and often becomes woody and dark brown later.

d) It loses its nodes and internodes upon maturation.

31. All of the following are functions performed by the stem, EXCEPT:

a) Conduction of water and minerals

b) Spreading out branches bearing leaves

c) Absorption of water and minerals from the soil

d) Vegetative propagation in some plants

32. Identify the correct statement regarding the functions of a stem.

a) The sole function of the stem is to provide support to the plant.

b) Stems can be involved in food storage, protection, and vegetative propagation.

c) The stem conducts photosynthates from the roots to the leaves.

d) The main function of the stem is anchorage of the plant in the soil.

33. Assertion (A): A stem is identifiable by the presence of nodes and internodes.

Reason (R): The stem develops from the radicle of the embryo.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.3 THE LEAF

34. Which of the following best describes a leaf?

a) An axial, generally cylindrical structure borne on the stem

b) A lateral, generally flattened structure borne on the stem

c) An underground structure that develops from the radicle

d) The main reproductive organ of a flowering plant

35. A leaf develops at a node on the stem and bears a specific structure in its axil which later develops into a branch. This structure is the:

a) stipule

b) pulvinus

c) axillary bud

d) terminal bud

36. Leaves originate from the shoot apical meristems and are arranged in a(n) _____ order.

a) basipetal

b) acropetal

c) centrifugal

d) centripetal

37. The most important vegetative organs for performing photosynthesis are the:

a) roots

b) stems

c) flowers

d) leaves

38. A typical leaf is composed of which three main parts?

a) Midrib, veins, and veinlets

b) Leaf base, petiole, and lamina

c) Stipule, axillary bud, and node

d) Pulvinus, sheath, and apex

39. The part of the leaf by which it is attached to the stem is the:

a) lamina

b) petiole

c) stipule

d) leaf base

40. In some plants, the leaf base may bear two lateral small leaf-like structures known as:

a) leaflets

b) stipules

c) bracts

d) pulvini

41. In monocotyledonous plants, a characteristic feature of the leaf base is that it:

a) becomes swollen and is called a pulvinus

b) is absent

c) expands into a sheath that covers the stem

d) bears multiple axillary buds

42. The swollen leaf base observed in some leguminous plants is referred to as the:

a) stipule

b) sheath

c) petiole

d) pulvinus

43. The leaf stalk that holds the green, expanded leaf blade to light is called the:

a) rachis

b) petiole

c) midrib

d) pedicel

44. The green, expanded part of the leaf containing veins and veinlets is known as the:

a) petiole

b) pulvinus

c) lamina

d) leaf base

45. All of the following are functions of the veins in a leaf blade, EXCEPT:

a) Providing rigidity to the lamina

b) Acting as channels for water and mineral transport

c) Transporting food materials

d) Bearing the axillary bud

46. The prominent vein located in the middle of the leaf blade is the:

a) veinlet

b) rachis

c) petiole

d) midrib

47. Choose the option that correctly matches the leaf part with its description.

a) Pulvinus - Characteristic sheathing base in monocots

b) Stipules - The stalk that holds the leaf blade

c) Petiole - Swollen leaf base in legumes

d) Lamina - The green, expanded part for photosynthesis

48. Assertion (A): Long, thin, flexible petioles allow leaf blades to flutter in the wind.

Reason (R): This fluttering action helps in cooling the leaf surface and bringing fresh air to it.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.3.1 VENATION

49. The term used to describe the arrangement of veins and veinlets in the lamina of a leaf is:

a) phyllotaxy

b) aestivation

c) placentation

d) venation

50. When the veinlets form a network-like pattern in the leaf lamina, the venation is referred to as:

a) parallel

b) reticulate

c) whorled

d) alternate

51. In which type of venation do the veins run parallel to each other within the leaf lamina?

a) Reticulate

b) Imbricate

c) Parallel

d) Valvate

52. Leaves of dicotyledonous plants generally possess _____, while _____ is the characteristic of most monocotyledons.

a) parallel venation, reticulate venation

b) reticulate venation, parallel venation

c) parallel venation, alternate venation

d) reticulate venation, opposite venation

53. Upon observing a leaf from a grass plant, you would expect to find which type of venation?

a) Reticulate

b) Dichotomous

c) Palmate

d) Parallel

54. Consider the following statements about venation.

Statement I: In reticulate venation, the veins run parallel to each other.

Statement II: Parallel venation is a characteristic feature of most dicotyledonous plants.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

55. Assertion (A): The leaves of a mustard plant typically show reticulate venation.

Reason (R): Mustard is a dicotyledonous plant, and dicots generally possess reticulate venation.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.3.2 TYPES OF LEAVES

56. A leaf is described as 'simple' under which of the following conditions?

a) When the incisions of the lamina reach the midrib

b) When its lamina is entire or its incisions do not touch the midrib

c) When the lamina is broken into numerous leaflets

d) When it lacks a petiole

57. A leaf is considered 'compound' when:

a) it possesses a swollen leaf base or pulvinus

b) the lamina has parallel venation

c) the incisions of the lamina reach the midrib, breaking it into leaflets

d) it lacks an axillary bud

58. What is the key anatomical feature that can be used to distinguish between a compound leaf and a simple leaf?

a) The presence of a bud in the axil of the petiole

b) The color of the lamina

c) The type of venation present

d) The presence of a petiole

59. A bud is present in the axil of the petiole of a compound leaf, but it is characteristically absent from the axil of a:

a) stipule

b) leaflet

c) simple leaf

d) node

60. In a pinnately compound leaf, a number of leaflets are present on a common axis called the _____, which represents the midrib.

a) petiole

b) rachis

c) pulvinus

d) pedicel

61. Which plant is cited as a classic example of a pinnately compound leaf?

a) Silk cotton

b) Calotropis

c) Neem

d) Alstonia

62. In _____ compound leaves, the leaflets are attached at a common point located at the tip of the petiole.

a) pinnately

b) alternately

c) palmately

d) oppositely

63. The leaf structure of silk cotton, where all leaflets are attached at the tip of the petiole, is an example of a:

a) simple leaf

b) pinnately compound leaf

c) palmately compound leaf

d) leaf with parallel venation

64. Select the incorrect statement from the following.

a) A simple leaf has an undivided lamina.

b) A bud is absent in the axil of a leaflet.

c) In palmately compound leaves, leaflets are attached to a rachis.

d) Neem possesses a pinnately compound leaf.

65. Assertion (A): It is possible to differentiate between a leaflet and a simple leaf.

Reason (R): A bud is present in the axil of the petiole in a simple leaf, but not in the axil of a leaflet.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.3.3 PHYLLOTAXY

66. The pattern of arrangement of leaves on the stem or a branch is termed as:

a) venation

b) aestivation

c) phyllotaxy

d) placentation

67. In the alternate type of phyllotaxy, how many leaves arise at each node?

a) A single leaf

b) A pair of leaves

c) More than two leaves

d) No leaves, only a bud

68. All of the following plants are examples of alternate phyllotaxy, EXCEPT:

a) China rose

b) Mustard

c) Sun flower

d) Calotropis

69. When a pair of leaves arise at each node and lie opposite to each other, the phyllotaxy is said to be:

a) alternate

b) opposite

c) whorled

d) reticulate

70. Which of the following pairs of plants exhibits opposite phyllotaxy?

a) China rose and mustard

b) Calotropis and guava

c) Sun flower and Alstonia

d) Mustard and guava

71. The type of phyllotaxy in which more than two leaves arise at a node and form a whorl is known as:

a) alternate

b) opposite

c) whorled

d) composite

72. Which of the following plants is given as an example of whorled phyllotaxy?

a) Guava

b) Sun flower

c) China rose

d) Alstonia

73. Find the option with the incorrect match between the type of phyllotaxy and the example plant.

a) Alternate - China rose

b) Opposite - Calotropis

c) Whorled - Alstonia

d) Alternate - Guava

74. Consider the following statements.

Statement I: In opposite phyllotaxy, a single leaf arises at each node in an alternate manner.

Statement II: In whorled phyllotaxy, more than two leaves arise at a node.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

5.4 THE INFLORESCENCE

75. A flower is described as a modified _____, in which the shoot apical meristem transforms into the floral meristem.

a) root

b) leaf

c) shoot

d) branch

76. When a shoot tip transforms into a flower, what changes occur in the axis?

a) Internodes elongate and the axis expands.

b) Internodes do not elongate and the axis gets condensed.

c) Nodes elongate and the axis gets condensed.

d) Nodes do not elongate and the axis expands.

77. The term for the arrangement of flowers on the floral axis is:

a) phyllotaxy

b) placentation

c) venation

d) inflorescence

78. The two major types of inflorescences, racemose and cymose, are primarily defined based on:

a) the color of the flowers

b) the number of petals in the flowers

c) whether the apex continues to grow or terminates in a flower

d) the arrangement of leaves on the floral axis

79. Which type of inflorescence is characterized by the main axis continuing to grow, with flowers borne laterally in an acropetal succession?

a) Cymose

b) Racemose

c) Solitary

d) Whorled

80. In a _____ inflorescence, the main axis has limited growth because it terminates in a flower.

a) racemose

b) cymose

c) alternate

d) verticillate

81. The arrangement of flowers in a basipetal order is a characteristic feature of which inflorescence type?

a) Racemose

b) Cymose

c) Spikelet

d) Capitulum

82. Identify the incorrect statement regarding inflorescences.

a) In racemose inflorescences, flowers are arranged in an acropetal succession.

b) When a shoot tip transforms into a single flower, it is said to be solitary.

c) In cymose inflorescences, the main axis shows indefinite growth.

d) A flower is a modified shoot where the axis is condensed.

83. Assertion (A): The growth of the main axis in a racemose inflorescence is theoretically unlimited.

Reason (R): The apical meristem of the main axis in a racemose inflorescence does not transform into a flower.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.5 THE FLOWER

84. The reproductive unit in the angiosperms, which is meant for sexual reproduction, is the:

a) leaf

b) flower

c) seed

d) fruit

85. In a typical flower, the four different whorls are arranged successively on the swollen end of the stalk or pedicel. This structure is called the:

a) placenta

b) ovule

c) thalamus or receptacle

d) petiole

86. Which of the following pairs of floral whorls are considered accessory organs?

a) Androecium and Gynoecium

b) Calyx and Corolla

c) Calyx and Gynoecium

d) Corolla and Androecium

87. In flowers like the lily, the calyx and corolla are not distinct and are collectively termed as the:

a) androecium

b) gynoecium

c) thalamus

d) perianth

88. A flower is described as bisexual if it possesses:

a) only stamens

b) only carpels

c) both androecium and gynoecium

d) neither androecium nor gynoecium

89. A flower that can be divided into two equal radial halves in any radial plane passing through the center is said to be:

a) zygomorphic

b) actinomorphic

c) asymmetric

d) unisexual

90. Which of the following plants is an example of a zygomorphic flower?

a) Mustard

b) Datura

c) Chilli

d) Pea

91. The term 'asymmetric' is used for a flower, such as in canna, that:

a) can be divided into two equal halves in any plane

b) can be divided into two similar halves in only one vertical plane

c) cannot be divided into two similar halves by any vertical plane

d) has only reproductive whorls

92. If the floral appendages of a flower are in multiples of three, the flower is described as:

a) trimerous

b) tetramerous

c) pentamerous

d) polymerous

93. A flower that possesses a reduced leaf at the base of its pedicel is called _____, and one that lacks this structure is called _____.

a) bracteate, ebracteate

b) ebracteate, bracteate

c) sessile, pedicellate

d) pedicellate, sessile

94. The classification of flowers as hypogynous, perigynous, and epigynous is based on the position of the calyx, corolla, and androecium with respect to the:

a) pedicel

b) thalamus

c) ovary

d) petiole

95. In a hypogynous flower, the gynoecium occupies the highest position, and the ovary is consequently described as:

a) inferior

b) superior

c) half inferior

d) half superior

96. Which of the following plants has a superior ovary?

a) Guava

b) Cucumber

c) Brinjal

d) Peach

97. The condition where the gynoecium is situated in the center and other floral parts are located on the rim of the thalamus almost at the same level is found in _____ flowers.

a) hypogynous

b) perigynous

c) epigynous

d) actinomorphic

98. In which of the following plants is the ovary said to be half inferior?

a) Mustard

b) China rose

c) Plum

d) Guava

99. An inferior ovary is characteristic of an epigynous flower. This condition is found in:

a) the ray florets of sunflower

b) mustard

c) china rose

d) brinjal

100. Select the option that correctly matches the floral symmetry with its example.

a) Actinomorphic - Cassia

b) Zygomorphic - Mustard

c) Asymmetric - Canna

d) Zygomorphic - Chilli

101. Find the mismatch among the following pairs.

a) Superior ovary - Mustard

b) Half inferior ovary - Rose

c) Inferior ovary - Cucumber

d) Superior ovary - Guava

102. Consider the following statements.

Statement I: A zygomorphic flower can be divided into two similar halves by any vertical plane passing through the center.

Statement II: An actinomorphic flower has radial symmetry.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

5.5.1 PARTS OF A FLOWER (CALYX, COROLLA, AESTIVATION)

103. The outermost whorl of the flower is the _____, and its individual members are called _____.

a) corolla, petals

b) calyx, sepals

c) androecium, stamens

d) gynoecium, carpels

104. What is the primary function of the sepals in a flower?

a) To attract insects for pollination

b) To produce pollen grains

c) To protect the flower in the bud stage

d) To develop into the fruit after fertilization

105. A calyx in which the sepals are united is described as _____, while a calyx with free sepals is _____.

a) polysepalous, gamosepalous

b) gamosepalous, polysepalous

c) polypetalous, gamopetalous

d) gamopetalous, polypetalous

106. The corolla of a flower is composed of _____, which are typically brightly colored to _____.

a) sepals, protect the bud

b) petals, attract insects for pollination

c) stamens, produce nectar

d) carpels, receive pollen

107. A flower with a corolla where the petals are fused is called _____, and if the petals are free, it is called _____.

a) syncarpous, apocarpous

b) gamopetalous, polypetalous

c) polyandrous, monoadelphous

d) polysepalous, gamosepalous

108. The mode of arrangement of sepals or petals in a floral bud with respect to other members of the same whorl is known as:

a) placentation

b) phyllotaxy

c) venation

d) aestivation

109. In _____ aestivation, the sepals or petals in a whorl just touch one another at the margin without any overlapping.

a) valvate

b) twisted

c) imbricate

d) vexillary

110. The aestivation seen in Calotropis is an example of which type?

a) Twisted

b) Imbricate

c) Vexillary

d) Valvate

111. If one margin of a floral appendage regularly overlaps that of the next one in a specific direction, as seen in china rose and lady's finger, the aestivation is called:

a) valvate

b) twisted

c) imbricate

d) vexillary

112. The type of aestivation where the margins of sepals or petals overlap one another but not in any particular direction is termed _____, and it is found in _____.

a) twisted, china rose

b) imbricate, Cassia

c) valvate, Calotropis

d) vexillary, pea

113. Vexillary aestivation, found in pea and bean flowers, is characterized by five petals where the largest petal is the _____, the two lateral petals are the _____, and the two smallest anterior petals form the _____.

a) keel, wings, standard

b) standard, keel, wings

c) standard, wings, keel

d) wings, standard, keel

114. Another name for vexillary aestivation is:

a) papilionaceous

b) contorted

c) quincuncial

d) valvate

115. Match the type of aestivation in Column I with its correct example in Column II and select the correct option.

| Column I | Column II |

| :--- | :--- |

| A. Valvate | 1. China rose |

| B. Twisted | 2. Gulmohur |

| C. Imbricate | 3. Calotropis |

| D. Vexillary | 4. Bean |

a) A-3, B-1, C-2, D-4

b) A-2, B-1, C-4, D-3

c) A-3, B-2, C-1, D-4

d) A-1, B-3, C-2, D-4

116. Which of the following statements about floral whorls is incorrect?

a) A gamosepalous calyx has united sepals.

b) A polypetalous corolla has free petals.

c) The primary function of the corolla is to protect the flower in its bud stage.

d) Corolla shapes can be tubular, bell-shaped, or wheel-shaped.

5.5.1.3 ANDROECIUM

117. The androecium is the floral whorl that is composed of _____, which represent the male reproductive organ.

a) carpels

b) petals

c) stamens

d) sepals

118. Each stamen consists of a stalk, which is called the _____, and a terminal structure called the _____.

a) style, stigma

b) filament, anther

c) petiole, lamina

d) pedicel, thalamus

119. A typical anther is _____, and each of its lobes contains two chambers known as the _____.

a) unilobed, ovules

b) bilobed, pollen-sacs

c) trilobed, stigmas

d) unlobed, filaments

120. The structures within the anther where pollen grains are produced are the:

a) filaments

b) stigmas

c) ovules

d) pollen-sacs

121. A stamen that is sterile and does not produce pollen is known as a:

a) pistillode

b) staminode

c) carpel

d) filament

122. The condition in which stamens are attached to the petals, as observed in brinjal, is termed:

a) epiphyllous

b) epipetalous

c) polyandrous

d) gamosepalous

123. When stamens are attached to the perianth, as seen in the flowers of lily, the condition is referred to as:

a) epipetalous

b) epiphyllous

c) monoadelphous

d) polyadelphous

124. The term for the condition where the stamens of a flower are free and not united with each other is:

a) syncarpous

b) polyandrous

c) gamopetalous

d) apocarpous

125. In china rose, the stamens are united into a single bunch or bundle. This condition is known as:

a) monoadelphous

b) diadelphous

c) polyadelphous

d) syngenesious

126. The diadelphous condition, where stamens are united into two bundles, is a characteristic feature of which plant?

a) China rose

b) Citrus

c) Pea

d) Lily

127. If the stamens in a flower are united into more than two bundles, as seen in citrus, the condition is called:

a) monoadelphous

b) diadelphous

c) polyadelphous

d) polyandrous

128. Variation in the length of filaments within a single flower is a feature observed in:

a) china rose and citrus

b) pea and bean

c) lily and brinjal

d) Salvia and mustard

129. Find the incorrect match from the following pairs.

a) Monoadelphous - China rose

b) Diadelphous - Pea

c) Polyadelphous - Citrus

d) Epipetalous - Lily

130. Assertion (A): A stamen that does not produce pollen is called a staminode.

Reason (R): The stamen is the male reproductive organ of the flower.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.5.1.4 GYNOECIUM AND PLACENTATION

131. The female reproductive part of the flower, which is made up of one or more carpels, is the:

a) androecium

b) corolla

c) calyx

d) gynoecium

132. A carpel is differentiated into which three distinct parts?

a) Filament, anther, and pollen-sac

b) Stigma, style, and ovary

c) Pedicel, thalamus, and sepal

d) Petiole, lamina, and midrib

133. The part of the carpel that serves as the receptive surface for pollen grains is the:

a) ovary

b) style

c) stigma

d) ovule

134. The enlarged basal part of the carpel is the _____, which is connected to the stigma by an elongated tube called the _____.

a) ovule, style

b) ovary, style

c) style, ovary

d) ovary, filament

135. Within the ovary, ovules are attached to a flattened, cushion-like tissue known as the:

a) funicle

b) placenta

c) thalamus

d) pedicel

136. When a gynoecium has more than one carpel and they are all free, as in lotus and rose, the condition is termed:

a) syncarpous

b) apocarpous

c) polyandrous

d) gamopetalous

137. In plants like mustard and tomato, the carpels are fused. This condition is known as:

a) apocarpous

b) syncarpous

c) polysepalous

d) monoadelphous

138. Following fertilization in a flowering plant, the ovules develop into _____ and the ovary matures into a _____.

a) seeds, fruit

b) fruit, seeds

c) cotyledons, seed coat

d) endosperm, fruit wall

139. The arrangement of ovules within the ovary is referred to as:

a) aestivation

b) phyllotaxy

c) venation

d) placentation

140. In pea, the placenta forms a ridge along the ventral suture of the ovary with the ovules borne on this ridge in two rows. This type of placentation is called:

a) axile

b) parietal

c) marginal

d) basal

141. Axile placentation is characterized by a multilocular ovary where the ovules are attached to a central axis. This is found in:

a) pea

b) mustard

c) tomato

d) marigold

142. In _____ placentation, the ovules develop on the inner wall of the ovary or on its peripheral part, and a false septum may form, as seen in mustard and Argemone.

a) parietal

b) basal

c) free central

d) axile

143. The placentation type where ovules are borne on a central axis and septa are absent, as in Dianthus and Primrose, is known as:

a) axile

b) parietal

c) free central

d) basal

144. In which type of placentation does the placenta develop at the base of the ovary with a single ovule attached to it?

a) Basal

b) Marginal

c) Axile

d) Parietal

145. Find the option that correctly matches the placentation type with its example.

a) Axile - Pea

b) Parietal - Lemon

c) Basal - Sunflower

d) Marginal - Dianthus

146. Consider the following statements.

Statement I: In an apocarpous gynoecium, the carpels are fused.

Statement II: In a syncarpous gynoecium, the carpels are free.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

5.6 THE FRUIT

147. In flowering plants, the fruit is a characteristic feature that develops from a mature or ripened:

a) ovule

b) pedicel

c) ovary

d) petal

148. A fruit that is formed from the ovary without the process of fertilisation is known as a:

a) true fruit

b) false fruit

c) aggregate fruit

d) parthenocarpic fruit

149. Generally, a fruit consists of a fruit wall, known as the _____, and _____.

a) pericarp, seeds

b) seed coat, embryo

c) mesocarp, endosperm

d) epicarp, ovules

150. When the pericarp of a fruit is thick and fleshy, it is differentiated into which three layers, starting from the outermost layer?

a) Endocarp, mesocarp, epicarp

b) Epicarp, mesocarp, endocarp

c) Mesocarp, epicarp, endocarp

d) Epicarp, endocarp, mesocarp

151. The type of fruit found in both mango and coconut, which develops from a monocarpellary superior ovary and is typically one-seeded, is a:

a) berry

b) pome

c) legume

d) drupe

152. In the fruit of a mango, the edible part is the fleshy _____.

a) epicarp

b) mesocarp

c) endocarp

d) pericarp

153. The inner, stony, and hard layer of the pericarp in a mango is the:

a) epicarp

b) mesocarp

c) endocarp

d) seed coat

154. Although both are drupes, a major difference between a mango and a coconut fruit is that the mesocarp in a coconut is:

a) fleshy and edible

b) stony and hard

c) thin and papery

d) fibrous

155. Which of the following statements about fruits is correct?

a) All fruits develop after the process of fertilisation.

b) The pericarp is always a dry, thin layer.

c) Drupes, like mango, develop from monocarpellary superior ovaries.

d) In a coconut, the mesocarp is the main edible part.

156. Assertion (A): A fruit is the result of the maturation of the ovary after fertilisation.

Reason (R): The wall of the ovary develops into the pericarp.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

5.7 THE SEED

157. After fertilization, the ovules of a flowering plant develop into:

a) fruits

b) seeds

c) pericarps

d) endosperm

158. A typical seed is made up of which two primary components?

a) Radicle and plumule

b) Seed coat and embryo

c) Testa and tegmen

d) Cotyledon and endosperm

159. An embryo is composed of a radicle, an embryonal axis, and one or two _____, as seen in wheat and gram respectively.

a) seed coats

b) pericarps

c) cotyledons

d) hila

160. The outermost covering of a dicotyledonous seed is the seed coat, which consists of an outer _____ and an inner _____.

a) tegmen, testa

b) testa, tegmen

c) hilum, micropyle

d) micropyle, hilum

161. The scar on the seed coat that indicates where the developing seed was attached to the fruit is known as the:

a) micropyle

b) hilum

c) testa

d) radicle

162. In a dicot seed, the small pore located just above the hilum is the:

a) chalaza

b) funicle

c) micropyle

d) tegmen

163. In dicot seeds such as gram and pea, the cotyledons are often fleshy because they are full of:

a) water

b) air

c) photosynthetic pigments

d) reserve food materials

164. Seeds such as castor, which retain the endosperm as a food-storing tissue in the mature seed, are called:

a) non-endospermous

b) endospermic

c) non-albuminous

d) Both (b) and (c)

165. In plants like bean and pea, the endosperm is not present in mature seeds. Such seeds are referred to as:

a) endospermous

b) albuminous

c) non-endospermous

d) cotyledonous

166. While most monocotyledonous seeds are endospermic, a notable exception that is non-endospermic is the seed of:

a) maize

b) wheat

c) orchids

d) castor

167. In cereal seeds, such as maize, the seed coat is membranous and generally fused with the:

a) endosperm

b) embryo

c) fruit wall

d) cotyledon

168. The outer covering of the endosperm in a maize grain, which separates the embryo, is a proteinaceous layer called the:

a) scutellum

b) coleoptile

c) coleorhiza

d) aleurone layer

169. The large, shield-shaped cotyledon found in the embryo of a monocot seed is known as the:

a) aleurone

b) coleoptile

c) scutellum

d) coleorhiza

170. In the embryo of a monocot seed, the radicle and plumule are enclosed in protective sheaths called _____ and _____ respectively.

a) coleoptile, coleorhiza

b) coleorhiza, coleoptile

c) testa, tegmen

d) tegmen, testa

171. Identify the incorrect statement regarding the structure of a seed.

a) The testa is the outer layer of the seed coat.

b) The micropyle is a scar representing the attachment point to the fruit.

c) Castor seeds are endospermic.

d) In maize, the fruit wall and seed coat are fused.

172. Match the part of the monocot seed in Column I with its correct description in Column II.

| Column I | Column II |

| :--- | :--- |

| A. Scutellum | 1. Proteinaceous outer layer of endosperm |

| B. Coleoptile | 2. Sheath covering the embryonic root |

| C. Aleurone Layer | 3. Large, shield-shaped cotyledon |

| D. Coleorhiza | 4. Sheath covering the embryonic shoot |

a) A-3, B-4, C-1, D-2

b) A-2, B-1, C-4, D-3

c) A-3, B-2, C-1, D-4

d) A-1, B-4, C-3, D-2

5.8 SEMI-TECHNICAL DESCRIPTION OF A TYPICAL FLOWERING PLANT

173. What is the correct sequence to follow when describing the morphological features of a typical flowering plant?

a) Floral characters, vegetative characters, habit

b) Habit, floral characters, vegetative characters

c) Habit, vegetative characters (roots, stem, leaves), floral characters

d) Roots, flowers, stem, leaves, habit

174. After describing the various parts of a plant, its floral features are summarized using a:

a) phylogenetic tree and a cladogram

b) floral diagram and a floral formula

c) Punnett square and a pedigree chart

d) dichotomous key and a herbarium sheet

175. In a floral formula, the symbol 'K' stands for the _____, and 'C' stands for the _____.

a) corolla, calyx

b) calyx, corolla

c) androecium, gynoecium

d) gynoecium, androecium

176. Which symbol is used to represent the perianth in a floral formula?

a) C

b) K

c) P

d) A

177. A superior ovary is represented in a floral formula by the symbol _____, while an inferior ovary is represented by _____.

a) G, G

b) G, G

c) G, P

d) P, G

178. The symbol ⊕ in a floral formula indicates that the flower is:

a) zygomorphic

b) unisexual female

c) actinomorphic

d) bisexual

179. How is the fusion of members within a single floral whorl (cohesion) indicated in a floral formula?

a) By placing a line above the symbol

b) By enclosing the number within a bracket

c) By using a plus (+) sign between the numbers

d) By writing the number as a subscript

180. Adhesion, the fusion between different floral whorls, is represented in a floral formula by:

a) enclosing both whorls in a single bracket

b) placing a dot above the symbols

c) drawing a line above the symbols of the floral parts

d) using an equals (=) sign

181. A dot on the top of a floral diagram represents the position of the:

a) bract

b) pedicel

c) main stem

d) mother axis

182. When drawing a floral diagram, the whorls are drawn in succession from the outside to the inside. Which whorl is drawn in the absolute center?

a) Calyx

b) Corolla

c) Androecium

d) Gynoecium

183. The floral formula K(5) indicates which of the following conditions?

a) Five free sepals

b) Five fused sepals

c) Five free petals

d) Five fused petals

184. Consider the floral formula: % ♂ K(5) C1+2+(2) A(9)+1 G1. Which feature is NOT represented by this formula?

a) The flower is zygomorphic.

b) The calyx has five fused sepals.

c) The androecium is monoadelphous.

d) The ovary is superior.

5.9 SOLANACEAE

185. The family Solanaceae is commonly referred to as the:

a) 'lily family'

b) 'potato family'

c) 'pea family'

d) 'sunflower family'

186. Which of the following correctly describes a vegetative character of the leaves in the family Solanaceae?

a) Opposite phyllotaxy, exstipulate, parallel venation

b) Alternate phyllotaxy, stipulate, parallel venation

c) Whorled phyllotaxy, exstipulate, reticulate venation

d) Alternate phyllotaxy, exstipulate, reticulate venation

187. An underground stem modification for food storage is found in which member of the Solanaceae family?

a) Solanum nigrum (makoi)

b) Solanum tuberosum (potato)

c) Petunia

d) Nicotiana (tobacco)

188. The inflorescence in the family Solanaceae is typically:

a) Racemose

b) Spike

c) Solitary, axillary or cymose

d) Capitulum

189. Which set of features correctly describes the flower of a typical member of Solanaceae?

a) Bisexual, zygomorphic

b) Unisexual, zygomorphic

c) Bisexual, actinomorphic

d) Unisexual, actinomorphic

190. The calyx in Solanaceae is characterized by five united sepals that remain attached to the fruit. This condition of the calyx is described as:

a) deciduous

b) caducous

c) persistent

d) inferior

191. The aestivation of both the calyx and corolla in the Solanaceae family is:

a) valvate

b) twisted

c) imbricate

d) vexillary

192. The androecium in Solanaceae consists of five stamens that are attached to the petals. This condition is known as:

a) epiphyllous

b) polyandrous

c) epipetalous

d) monoadelphous

193. Which of the following accurately describes the gynoecium of a plant belonging to the potato family?

a) Monocarpellary, apocarpous, superior ovary, unilocular

b) Bicarpellary, syncarpous, superior ovary, bilocular

c) Tricarpellary, syncarpous, inferior ovary, trilocular

d) Bicarpellary, apocarpous, inferior ovary, bilocular

194. The placenta in the ovary of Solanaceae is swollen with many ovules, and the placentation is:

a) parietal

b) marginal

c) basal

d) axile

195. The characteristic fruits and seeds of the family Solanaceae are:

a) Fruit is a legume; seeds are non-endospermous

b) Fruit is a drupe; seeds are non-endospermous

c) Fruit is a berry or capsule; seeds are endospermous

d) Fruit is a nut; seed is single and endospermous

196. Select the correct floral formula for the family Solanaceae.

a) % ♀ ♂ K(5) C1+2+(2) A(9)+1 G1

b) ⊕ ♀ ♂ K(5) C(5) A5 G(2)

c) ⊕ ♀ ♂ K5 C5 A5 G(2)

d) % ♀ ♂ K(5) C5 A(5) G2

197. Which of the following plants from the family Solanaceae is used as a source for a fumigatory product?

a) Belladonna

b) Ashwagandha

c) Petunia

d) Tobacco

198. All of the following are sources of food from the family Solanaceae, EXCEPT:

a) Tomato

b) Brinjal

c) Potato

d) Pea

199. Match the plant from the family Solanaceae in Column I with its economic use in Column II.

| Column I | Column II |

| :--- | :--- |

| A. Chilli | 1. Ornamental |

| B. Ashwagandha | 2. Spice |

| C. Petunia | 3. Food |

| D. Brinjal | 4. Medicine |

a) A-2, B-4, C-1, D-3

b) A-3, B-1, C-4, D-2

c) A-2, B-3, C-1, D-4

d) A-4, B-2, C-3, D-1

SUMMARY

200. Which statement provides a correct generalization for distinguishing between the root systems of the two major classes of flowering plants?

a) Dicotyledonous plants generally have fibrous roots, while monocotyledonous plants have tap roots.

b) Both dicotyledonous and monocotyledonous plants primarily have adventitious roots.

c) Dicotyledonous plants generally have tap roots, while monocotyledonous plants have fibrous roots.

d) The primary root is persistent and long-lived in both monocots and dicots.

201. The summary lists several key morphological features that help differentiate a stem from a root. Which of the following is one of these distinguishing features of a stem?

a) A positively phototropic nature

b) A protective root cap

c) Unicellular hairs for absorption

d) An endogenous origin of lateral branches

202. The classification and identification of flowering plants are primarily based on which of the following?

a) The type of root system and leaf venation

b) Floral characteristics

c) The period of seed viability

d) The presence or absence of a pulvinus

203. The summary mentions that in some plants, roots are modified to perform various functions. These functions include all of the following, EXCEPT:

a) Storage of food

b) Mechanical support

c) Respiration

d) Pollination

204. According to the summary, seeds are known to vary in shape and size. Which other variable characteristic of seeds is also mentioned?

a) Number of cotyledons

b) Type of endosperm

c) Color of the seed coat

d) Period of viability

205. Consider the following statements based on the chapter summary.

Statement I: The flower is a modified shoot meant for sexual reproduction.

Statement II: After fertilisation, the ovules are modified into fruits and the ovary into seeds.

Choose the correct option.

a) Both Statement I and Statement II are correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct, but Statement II is incorrect.

d) Statement I is incorrect, but Statement II is correct.

SECTION B: DIAGRAM & DATA MCQS

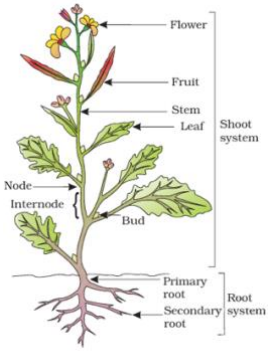


Figure 5.1 Parts of a flowering plant

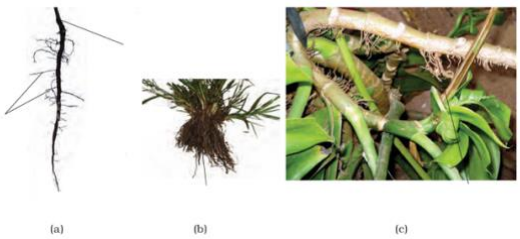
206. The above figure shows parts of a flowering plant. The structures marked as 'Node', 'Internode', 'Leaf', and 'Flower' are collectively part of the:

a) Root system

b) Primary root

c) Shoot system

d) Secondary root



207. Which diagram represents the fibrous root system characteristic of a wheat plant?

a) Diagram (a)

b) Diagram (b)

c) Diagram (c)

d) Both (a) and (b)

208. The root type shown in above figure(c) arises from a part of the plant other than the radicle. This type of root is known as:

a) Tap root

b) Fibrous root

c) Primary root

d) Adventitious root

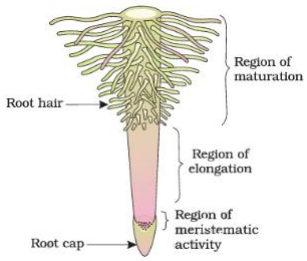


Figure 5.3 The regions of the root-tip

209. In the diagram of the root tip in above figure, which labelled region is responsible for the growth of the root in length?

a) Region of maturation

b) Region of elongation

c) Region of meristematic activity

d) Root cap

210. During the growth of a root, from which region do the root hairs develop?

a) Region of meristematic activity

b) Region of elongation

c) Region of maturation

d) Root cap

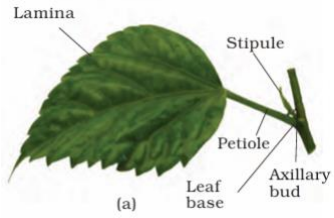
211. The 'Region of meristematic activity' is characterized by cells that are:

a) large, mature, and differentiated

b) rapidly elongating and enlarging

c) very small, thin-walled, and actively dividing

d) protective and thimble-like



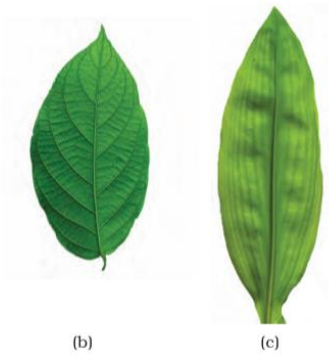
212. Above figure shows the parts of a typical leaf. The stalk that connects the lamina to the leaf base is termed as the:

a) Stipule

b) Lamina

c) Petiole

d) Axillary bud



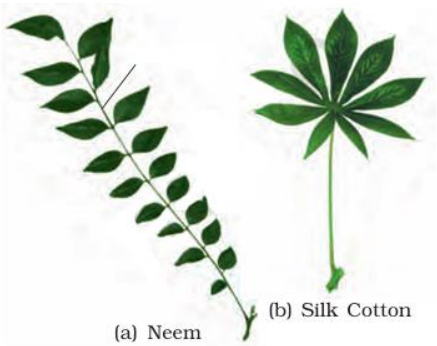
213. The venation pattern shown in figure (b) is described as _____, which is a characteristic feature of _____ plants.

a) parallel, monocotyledonous

b) reticulate, monocotyledonous

c) parallel, dicotyledonous

d) reticulate, dicotyledonous



214. The leaf of neem shown in figure (a) is an example of a _____ compound leaf, where the leaflets are attached to a common axis called the _____.

a) palmately, petiole

b) pinnately, rachis

c) palmately, rachis

d) pinnately, petiole

215. The leaf of silk cotton in figure (b) is a palmately compound leaf because the leaflets are:

a) arranged alternately on a common axis

b) attached at a common point at the tip of the petiole

c) incised but the incisions do not reach the midrib

d) arranged in an opposite manner on the rachis

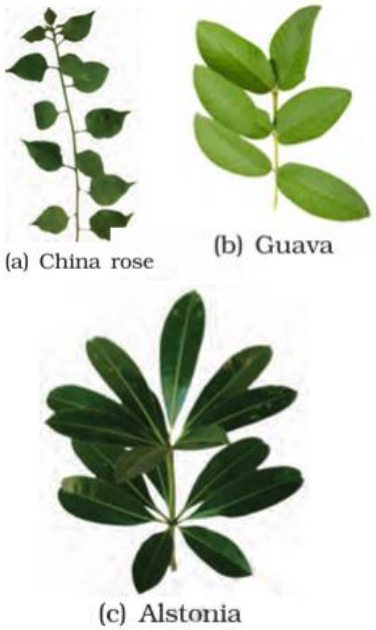
216. Figure 5.6 shows different types of phyllotaxy. Which diagram represents the whorled type, as seen in Alstonia?

a) Diagram (a)

b) Diagram (b)

c) Diagram (c)

d) None of the above



217. The phyllotaxy shown in figure (a) is called 'alternate' because:

a) a pair of leaves arises at each node

b) more than two leaves arise at each node

c) a single leaf arises at each node in an alternate manner

d) the leaves lack a petiole

218. A key feature of racemose inflorescence is that the flowers are borne in a(n):

a) basipetal succession, and the main axis terminates in a flower

b) acropetal succession, and the main axis continues to grow

c) basipetal succession, and the main axis continues to grow

d) acropetal succession, and the main axis terminates in a flower

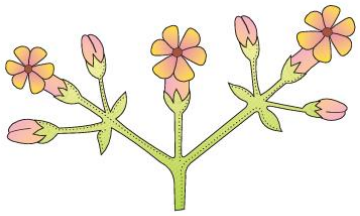


Figure 5.8 Cymose inflorescence

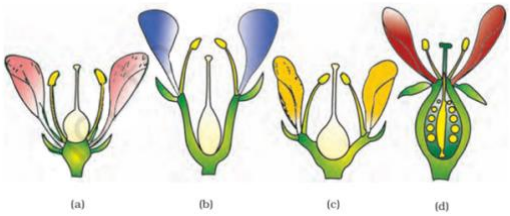
219. The cymose inflorescence is characterized by:

a) an endlessly growing main axis

b) an acropetal arrangement of flowers

c) the main axis terminating in a flower

d) the absence of a floral axis



220. The above figure illustrates the position of floral parts on the thalamus. Which diagram represents a hypogynous flower with a superior ovary?

a) Diagram (a)

b) Diagram (b)

c) Diagram (c)

d) Diagram (d)

221. Diagram (d) shows an epigynous flower. The ovary in this flower is described as:

a) superior

b) inferior

c) half inferior

d) half superior

222. The perigynous condition, where the ovary is half inferior, is depicted in which diagrams in above figure?

a) (a) only

b) (b) and (c)

c) (d) only

d) (a) and (d)

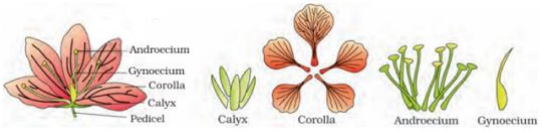


Figure 5.10 Parts of a flower

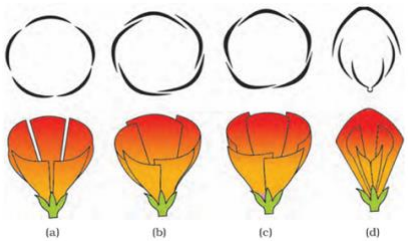
223. The four successive whorls of a typical flower are shown in Figure 5.10. The whorl labelled 'Androecium' is the:

a) outermost whorl of sepals

b) whorl of petals

c) male reproductive part

d) female reproductive part



224. Figure shows different types of aestivation. The arrangement where margins of petals overlap one another but not in any particular direction, as shown in diagram (c), is known as:

a) valvate

b) twisted

c) imbricate

d) vexillary

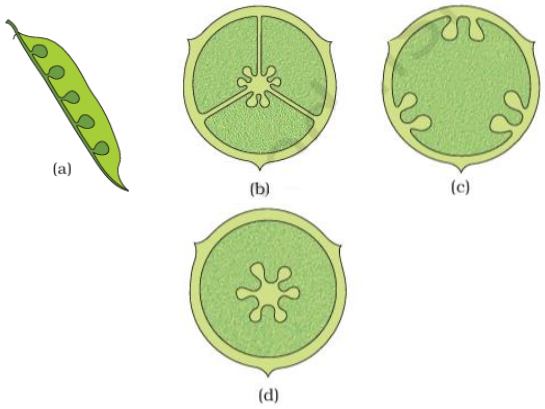
225. The type of aestivation depicted in figure (d), which is characteristic of pea flowers, is called:

a) valvate

b) twisted

c) imbricate

d) vexillary



226 Figure above displays various types of placentation. Which diagram shows axile placentation, as found in tomato and lemon?

a) Diagram (a)

b) Diagram (b)

c) Diagram (c)

d) Diagram (d)

227. The placentation type where ovules are borne on a central axis without any septa, as shown in figure (d), is:

a) parietal

b) axile

c) free central

d) basal

228. Figure (a) represents marginal placentation. This is a characteristic feature of which plant?

a) Mustard

b) Pea

c) Marigold

d) China rose

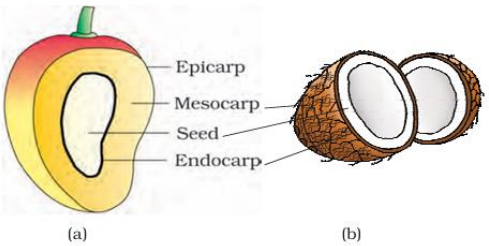


Figure 5.13 Parts of a fruit : (a) Mango (b) Coconut

229. Figure 5.13 shows the parts of a mango and a coconut fruit. In diagram (a), the fleshy, edible part is the:

a) Epicarp

b) Mesocarp

c) Endocarp

d) Seed

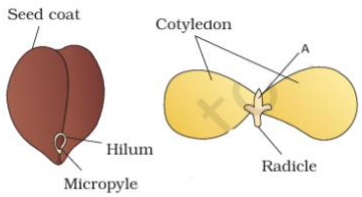


Figure 5.14 Structure of dicotyledonous seed

230. Based on the structure shown in Figure 5.14, the part labeled 'A' will develop into the future:

a) root system

b) shoot system

c) seed coat

d) cotyledon

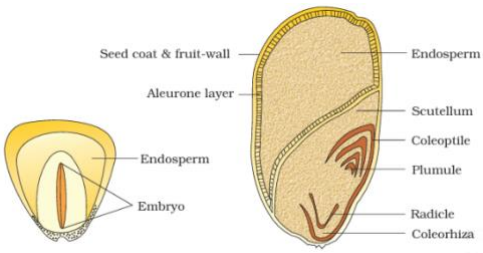


Figure 5.15 Structure of a monocotyledonous seed

231. In the structure of a monocotyledonous seed, what is the structure labeled 'Scutellum'?

a) The proteinaceous layer covering the endosperm

b) The sheath covering the plumule

c) The sheath covering the radicle

d) The single, shield-shaped cotyledon

232. Refer to Figure 5.15. The protective sheaths covering the plumule and radicle are labeled as _____ and _____ respectively.

a) aleurone layer, scutellum

b) coleoptile, coleorhiza

c) scutellum, aleurone layer

d) coleorhiza, coleoptile

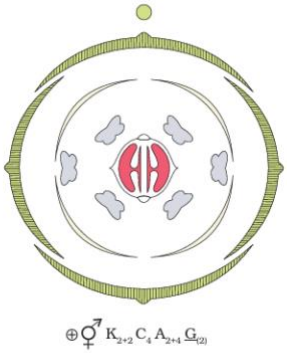


Figure 5.16 Floral diagram with floral formula

233. The floral formula K2+2 C4 A2+4 G(2) shown in Figure 5.16 represents the mustard plant. The notation G(2) signifies a:

a) gynoecium with two free carpels and an inferior ovary

b) gynoecium with two fused carpels and a superior ovary

c) gynoecium with two free carpels and a superior ovary

d) gynoecium with two fused carpels and an inferior ovary

234. In the floral diagram of Solanum nigrum shown above, the curved line drawn above the symbols for the corolla and androecium indicates that the stamens are:

a) polyandrous

b) monoadelphous

c) epipetalous

d) epiphyllous

SECTION C: INTRA-CHAPTER INTEGRATIVE MCQS

235. A plant is discovered that possesses fibrous roots, leaves with parallel venation, and trimerous flowers. Based on these features, its seeds would most likely be:

a) dicotyledonous and endospermic

b) monocotyledonous and non-endospermic

c) monocotyledonous and endospermic

d) dicotyledonous and non-endospermic

236. In the pea plant, the flower is zygomorphic and exhibits vexillary aestivation. What other combination of features is also characteristic of the pea plant?

a) Diadelphous stamens and marginal placentation

b) Monoadelphous stamens and axile placentation

c) Polyadelphous stamens and parietal placentation

d) Epipetalous stamens and basal placentation

237. A key difference between the primary root of a mustard plant and the stem of a young china rose plant is the:

a) presence of nodes and internodes on the root

b) origin from the plumule for the root and radicle for the stem

c) presence of a root cap and root hairs on the stem

d) absence of nodes and internodes on the root

238. The floral formula for the family Solanaceae is ⊕ ♂ K(5) C(5) A5 G(2). The notation G(2) indicates that the fruit will develop from a:

a) monocarpellary, superior ovary

b) bicarpellary, syncarpous, superior ovary

c) bicarpellary, apocarpous, inferior ovary

d) polycarpellary, syncarpous, inferior ovary

239. Assertion (A): The leaves of a wheat plant show parallel venation.

Reason (R): Wheat possesses a tap root system that develops directly from the radicle.

a) Both (A) and (R) are true and (R) is the correct explanation of (A).

b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

c) (A) is true but (R) is false.

d) (A) is false but (R) is true.

240. Which of the following features are correctly associated with a dicotyledonous plant like mustard?

a) Fibrous root system, parallel venation, trimerous flower, two cotyledons

b) Tap root system, reticulate venation, pentamerous flower, one cotyledon

c) Tap root system, reticulate venation, tetramerous flower, two cotyledons

d) Fibrous root system, parallel venation, tetramerous flower, one cotyledon

241. In a flower with an epigynous arrangement, such as a cucumber, the fruit develops from an ovary that is:

a) superior, and other floral parts arise below it

b) inferior, as the thalamus margin has grown to enclose it

c) half inferior, with floral parts on the rim of the thalamus

d) superior, but enclosed by the perianth

242. The term 'pulvinus' describes a swollen leaf base in legumes like pea. This same plant (pea) is also characterized by having:

a) endospermic seeds and axile placentation

b) non-endospermic seeds and marginal placentation

c) endospermic seeds and parietal placentation

d) non-endospermic seeds and axile placentation

243. A flower is described as having five united petals with twisted aestivation and monoadelphous stamens. This description best fits which of the following plants?

a) Pea

b) China rose

c) Mustard

d) Calotropis

244. The axillary bud that develops into a branch originates at a node on the stem. If the inflorescence is also axillary, as can be the case in Solanum, it means the inflorescence arises from the:

a) tip of the main stem

b) axil of a leaf

c) region of the root tip

d) margin of the lamina

245. In a maize seed, the plumule is protected by the coleoptile. This plumule will develop into the shoot system, which is characterized by:

a) nodes, internodes, and leaves with reticulate venation

b) the absence of nodes and the presence of a root cap

c) nodes, internodes, and leaves with parallel venation

d) only flowers and fruits with trimerous symmetry

246. The ray florets of a sunflower have an inferior ovary. This implies that the arrangement of floral whorls is _____ and the seeds will develop inside a fruit where other floral parts are located _____ the point of fruit attachment.

a) hypogynous, below

b) perigynous, at the same level as

c) epigynous, above

d) hypogynous, above

247. Identify the incorrect set of characteristics for a single plant.

a) Plant: China Rose; Phyllotaxy: Alternate; Aestivation: Twisted; Stamens: Monoadelphous

b) Plant: Pea; Flower Symmetry: Zygomorphic; Aestivation: Vexillary; Placentation: Marginal

c) Plant: Mustard; Root system: Tap root; Flower Symmetry: Actinomorphic; Placentation: Axile

d) Plant: Calotropis; Phyllotaxy: Opposite; Aestivation: Valvate; Gynoecium: Bicarpellary

248. A drupe, such as a mango, develops from a monocarpellary superior ovary. This implies that the flower from which it developed must have been:

a) epigynous with a single carpel

b) hypogynous with a single carpel

c) perigynous with multiple fused carpels

d) hypogynous with multiple free carpels

249. The part of the monocot embryo that is functionally equivalent to the fleshy, food-storing cotyledons of a non-endospermic dicot seed is the:

a) scutellum, as it digests and transfers food from the endosperm

b) endosperm itself

c) aleurone layer

d) coleoptile

250. The floral formula of a plant is ⊕ ♂ P (3+3) A3+3 G (3). Which set of vegetative characters would most likely be associated with this plant?

a) Tap root system and reticulate venation

b) Adventitious roots and reticulate venation

c) Fibrous root system and parallel venation

d) Tap root system and parallel venation

251. In a plant with parietal placentation like mustard, a false septum may develop. This plant also exhibits:

a) actinomorphic flowers and diadelphous stamens

b) zygomorphic flowers and tetramerous symmetry

c) actinomorphic flowers and variation in stamen length

d) an inferior ovary and imbricate aestivation

252. The presence of a bud in the axil of a petiole confirms it to be a leaf (simple or compound). The absence of this bud in the axil of a leaflet distinguishes it from a simple leaf. A plant that requires this distinction to be made is:

a) China rose

b) Neem

c) Guava

d) Alstonia

253. A fruit is found to contain many endospermous seeds arranged on a swollen central placenta in a bilocular ovary. The flower from which this fruit developed must have had which type of gynoecium and placentation?

a) Syncarpous; Axile

b) Apocarpous; Marginal

c) Syncarpous; Parietal

d) Apocarpous; Basal

254. Which of the following is a correct cascade of development?

a) Radicle → Stem → Bears nodes → Bears leaves in whorled phyllotaxy

b) Plumule → Stem → Bears flowers in racemose inflorescence → Forms syncarpous fruit

c) Radicle → Primary root → Exhibits regions of elongation and maturation → Absorbs water

d) Plumule → Flower → Ovary has parietal placentation → Develops into a single-seeded drupe

255. The epipetalous condition in brinjal signifies an adhesion between the corolla and the androecium. What other floral characters does brinjal, a dicot, possess?

a) Hypogynous flower with superior ovary

b) Epigynous flower with inferior ovary

c) Perigynous flower with half-inferior ovary

d) Hypogynous flower with inferior ovary

256. Consider a plant with the following features: alternate phyllotaxy, united petals (gamopetalous), and stamens united into two bundles (diadelphous). This combination of features is:

a) characteristic of the pea plant

b) characteristic of the china rose plant

c) characteristic of the citrus plant

d) not found, as these features are from different plants

257. A student observes a flower with free sepals, free petals, radial symmetry, and a superior ovary. The term that would NOT be used in its description is:

a) polysepalous

b) polypetalous

c) actinomorphic

d) epigynous

258. The rachis of a pinnately compound leaf is a modification of the midrib. This entire leaf structure originates from the:

a) region of maturation of the root

b) shoot apical meristem and is borne at a node

c) floral meristem as a bract

d) terminal bud only

259. If a flower is trimerous, it is most likely to be a monocot. Which of the following features would be inconsistent with this conclusion?

a) The presence of a scutellum in its seed

b) The presence of a tap root system

c) Leaves exhibiting parallel venation

d) Adventitious roots originating from the base of the stem

PART 2 : NEET MASTERY QUESTIONS

THIS PART CONTAINS EXAM-ORIENTED QUESTION FORMATS MODELLED ON RECENT NEET PAPERS, ALONG WITH SELECT INNOVATIVE FORMATS DESIGNED TO CHALLENGE CONVENTIONAL THINKING. THE PURPOSE OF THIS SECTION IS TO ENSURE THAT STUDENTS MOVE BEYOND MEMORIZATION AND DEVELOP A COMPLETE PRACTICAL UNDERSTANDING OF THE NCERT TEXT. EACH FORMAT SYSTEMATICALLY TESTS APPLICATION, ANALYSIS, AND INTEGRATION OF CONCEPTS, THEREBY BRIDGING THE GAP BETWEEN FACTUAL RECALL AND PROBLEM-SOLVING.

THE FORMATS USED IN THIS SECTION INCLUDE:

- **Assertion–Reason** – tests causal relationships between two statements
- **Statement-Based** – evaluates correctness of multiple factual statements
- **Matching Type** – links related concepts across two columns
- **Data Anomaly** – identifies inconsistencies in a dataset or graph
- **Sequence** – arranges items in correct order (chronological/procedural)
- **Multi-Correct** – selects all correct options from a given list
- **Flowchart / Process Completion** – fills missing steps in biological processes
- **Scenario-Based/Case-Based** – applies concepts to clinical or ecological situations
- **Diagnostic Pathway** – follows multi-step logical reasoning from observation to outcome

ASSERTION-REASON

Instructions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

1)Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.

2)Both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.

3)Assertion is True but the Reason is False.

4)Assertion is False but the Reason is True.

1. Assertion (A): Angiosperms, despite their vast morphological diversity, are all characterized by the presence of roots, stems, and leaves.

Reason (R): The shoot system in a flowering plant comprises the portion above the ground, while the root system is the underground part.

2. Assertion (A): In most dicotyledonous plants, the primary root is formed by the direct elongation of the radicle.

Reason (R): The primary root along with its lateral branches of several orders constitutes the tap root system.

3. Assertion (A): The fibrous root system is characteristic of monocotyledonous plants like wheat.

Reason (R): In monocots, the primary root that emerges from the radicle is long-lived and forms the main root of the plant.

4. Assertion (A): In plants like Monstera and banyan, roots arise from the base of the stem.

Reason (R): Roots that develop from any part of the plant other than the radicle are termed adventitious roots.

5. Assertion (A): The root system is crucial for providing proper anchorage to the plant parts.

Reason (R): A key function of the root system is the synthesis of plant growth regulators.

6. Assertion (A): The apex of the root is protected by a thimble-like structure called the root cap.

Reason (R): The root cap facilitates the absorption of water and minerals from the soil due to its delicate, thread-like structure.

7. Assertion (A): The cells in the region of meristematic activity are characterized by their small size, thin walls, and dense protoplasm.

Reason (R): These cells undergo rapid elongation and enlargement, contributing to the growth of the root in length.

8. Assertion (A): The region of elongation is located proximal to the region of meristematic activity.

Reason (R): The increase in the length of the root is mainly attributed to the cells in the region of elongation.

9. Assertion (A): Root hairs arise from some of the epidermal cells in the zone of elongation.

Reason (R): The cells in the zone proximal to the region of elongation gradually differentiate and mature.

10. Assertion (A): The stem is the ascending part of the plant axis that develops from the plumule of the embryo.

Reason (R): A key distinguishing feature of the stem is the presence of nodes and internodes.

11. Assertion (A): One of the primary functions of the stem is to conduct water and minerals.

Reason (R): Some stems are modified to perform functions of food storage, support, and vegetative propagation.

12. Assertion (A): Leaves originate from shoot apical meristems and are arranged in an acropetal order.

Reason (R): The leaf is a lateral, generally flattened structure borne on the internode of a stem.

13. Assertion (A): In some leguminous plants, the leaf base becomes swollen, a structure known as the pulvinus.

Reason (R): In monocotyledons, the leaf base typically expands into a sheath that partially or wholly covers the stem.

14. Assertion (A): The petiole helps to hold the leaf blade to light.

Reason (R): Long, thin, and flexible petioles allow leaf blades to flutter in the wind, which helps in cooling the leaf surface.

15. Assertion (A): The arrangement of veins and veinlets in the lamina of a leaf is termed venation.

Reason (R): Parallel venation, where veins run parallel to each other, is a characteristic feature of most monocotyledonous plants.

16. Assertion (A): Dicotyledonous plants generally possess reticulate venation.

Reason (R): In reticulate venation, the veinlets form a distinct network.

17. Assertion (A): A leaf is considered compound when the incisions of the lamina reach the midrib, breaking it into multiple leaflets.

Reason (R): A bud is present in the axil of the petiole of a simple leaf, but not in the axil of the petiole of a compound leaf.

18. Assertion (A): In a pinnately compound leaf like neem, the leaflets are present on a common axis called the rachis.

Reason (R): The rachis represents the midrib of the leaf.

19. Assertion (A): In palmately compound leaves, such as in silk cotton, the leaflets are attached at the tip of the petiole.

Reason (R): A palmately compound leaf has a common axis, the rachis, on which leaflets are borne laterally.

20. Assertion (A): Phyllotaxy refers to the pattern of arrangement of flowers on the floral axis.

Reason (R): In china rose, a single leaf arises at each node in an alternate manner.

21. Assertion (A): In plants like Calotropis and guava, a pair of leaves arise at each node and lie opposite to each other.

Reason (R): This arrangement is an example of alternate phyllotaxy.

22. Assertion (A): When more than two leaves arise at a node and form a whorl, the phyllotaxy is called whorled.

Reason (R): Whorled phyllotaxy is exemplified by the plant Alstonia.

23. Assertion (A): A flower is a modified shoot where the shoot apical meristem transforms into a floral meristem.

Reason (R): In a modified shoot that forms a flower, the internodes elongate and the axis gets spread out.

24. Assertion (A): In racemose type of inflorescence, the main axis continues to grow indefinitely.

Reason (R): The flowers in a racemose inflorescence are borne in a basipetal order.

25. Assertion (A): In a cymose inflorescence, the main axis terminates in a flower.

Reason (R): The growth of the main axis in a cymose inflorescence is limited.

26. Assertion (A): The calyx and corolla are considered reproductive organs of a flower.

Reason (R): The androecium and gynoecium are referred to as accessory organs.

27. Assertion (A): In lily, the calyx and corolla are not distinct and are collectively termed perianth.

Reason (R): A flower that possesses both androecium and gynoecium is described as unisexual.

28. Assertion (A): A flower of mustard can be divided into two equal radial halves in any radial plane passing through the center.

Reason (R): Mustard flowers are actinomorphic, exhibiting radial symmetry.

29. Assertion (A): A flower of pea or bean is zygomorphic.

Reason (R): A zygomorphic flower can be divided into two similar halves only in one particular vertical plane.

30. Assertion (A): A flower is called bracteate if it has a reduced leaf found at the base of the pedicel.

Reason (R): A pentamerous flower is one where the floral appendages are in multiples of four.

31. Assertion (A): In a hypogynous flower, the ovary is described as superior.

Reason (R): The gynoecium in a hypogynous flower occupies the highest position on the thalamus, with other parts situated below it.

32. Assertion (A): In plum and rose, the ovary is said to be half inferior.

Reason (R): These plants have perigynous flowers where the gynoecium is in the center and other floral parts are on the rim of the thalamus at the same level.

33. Assertion (A): The flower of guava has an inferior ovary.

Reason (R): In an epigynous flower, the margin of the thalamus grows upward, encloses the ovary completely, and gets fused with it.

34. Assertion (A): The calyx is the outermost whorl of a flower and is composed of sepals.

Reason (R): Sepals are typically brightly colored to attract insects for pollination.

35. Assertion (A): When the petals of a flower are united, the condition is referred to as gamopetalous.

Reason (R): The shape of the corolla in different plants can vary, being tubular, bell-shaped, or funnel-shaped.

36. Assertion (A): Aestivation is the mode of arrangement of sepals or petals in a floral bud with respect to other members of the same whorl.

Reason (R): In Calotropis, the aestivation is described as valvate.

37. Assertion (A): In china rose and cotton, the corolla shows twisted aestivation.

Reason (R): In twisted aestivation, one margin of the appendage overlaps that of the next one and so on.

38. Assertion (A): In Cassia and gulmohur, the aestivation is imbricate.

Reason (R): Imbricate aestivation is when the margins of sepals or petals overlap one another in a specific, regular direction.

39. Assertion (A): The aestivation found in pea and bean flowers is known as vexillary.

Reason (R): In vexillary aestivation, there are five petals where the smallest (standard) overlaps the two lateral petals (wings), which in turn overlap the two largest anterior petals (keel).

40. Assertion (A): The androecium, which represents the male reproductive organ of a flower, is composed of stamens.

Reason (R): Each stamen consists of a stalk or a filament and a bilobed anther where pollen grains are produced.

41. Assertion (A): In the flowers of lily, the stamens are attached to the perianth and are called epiphyllous.

Reason (R): When stamens are attached to the petals, as in brinjal, they are referred to as epipetalous.

42. Assertion (A): The stamens in a china rose flower are united into one bundle, a condition known as monoadelphous.

Reason (R): When stamens in a flower remain free, the condition is termed polyandrous.

43. Assertion (A): In pea, the stamens are united into two bundles, which is a diadelphous condition.

Reason (R): In citrus, the stamens are united into more than two bundles and are therefore called polyadelphous.

44. Assertion (A): The gynoecium is the female reproductive part of the flower, made up of one or more carpels.

Reason (R): A carpel consists of three parts: stigma, style, and anther.

45. Assertion (A): In plants like mustard and tomato, the carpels are fused, a condition termed syncarpous.

Reason (R): When more than one carpel is present and they are free, as in lotus, the condition is called apocarpous.

46. Assertion (A): After fertilisation, the ovary matures into a fruit and the ovules develop into seeds.

Reason (R): The receptive surface for pollen grains is the flattened, cushion-like placenta.

47. Assertion (A): In pea, the placenta forms a ridge along the ventral suture of the ovary with ovules borne in two rows, which is known as marginal placentation.

Reason (R): In marginal placentation, the placenta is axial and the ovules are attached to it in a multilocular ovary.

48. Assertion (A): Axile placentation is found in china rose, tomato, and lemon.

Reason (R): In axile placentation, the ovules are attached to a placenta which is axial, within a multilocular ovary.

49. Assertion (A): In mustard and Argemone, the ovary is one-chambered but becomes two-chambered due to the formation of a false septum.

Reason (R): This is an example of parietal placentation where ovules develop on the inner wall of the ovary or on the peripheral part.

50. Assertion (A): In free central placentation, as seen in Dianthus, the ovules are borne on a central axis.

Reason (R): A key feature of free central placentation is the presence of septa that divide the ovary into multiple chambers.

51. Assertion (A): In sunflower and marigold, the placentation is basal.

Reason (R): In basal placentation, the placenta develops at the base of the ovary and a single ovule is attached to it.

52. Assertion (A): A fruit that is formed without the fertilisation of the ovary is called a parthenocarpic fruit.

Reason (R): A fruit is essentially a mature or ripened ovule.

53. Assertion (A): In mango, the pericarp is differentiated into an outer epicarp, a middle mesocarp, and an inner endocarp.

Reason (R): The fruit of mango is known as a drupe, which develops from a monocarpellary superior ovary.

54. Assertion (A): In coconut, which is a drupe, the mesocarp is fibrous.

Reason (R): The edible part of the mango is its stony hard endocarp.

55. Assertion (A): A seed is composed of a seed coat and an embryo, which itself consists of a radicle, an embryonal axis, and cotyledons.

Reason (R): After fertilisation, the entire flower develops into the seed.

56. Assertion (A): The outermost covering of a dicot seed is the seed coat, made of an outer testa and inner tegmen.

Reason (R): The micropyle is a scar on the seed coat through which the developing seeds were attached to the fruit.

57. Assertion (A): In plants like bean, gram, and pea, the mature seeds are non-endospermous.

Reason (R): Non-endospermous seeds are those in which the endosperm, formed as a result of double fertilisation, is not present at maturity.

58. Assertion (A): In the seeds of cereals like maize, the seed coat is membranous and generally fused with the fruit wall.

Reason (R): Monocotyledonous seeds such as orchids are always endospermic.

59. Assertion (A): The outer covering of the endosperm in a maize seed is a proteinous layer called the aleurone layer.

Reason (R): The aleurone layer separates the endosperm from the embryo.

60. Assertion (A): The embryo of a monocot seed consists of a single large, shield-shaped cotyledon known as the scutellum.

Reason (R): The radicle and plumule in a monocot embryo are enclosed in sheaths called coleoptile and coleorhiza, respectively.

61. Assertion (A): In a floral formula, the symbol K stands for corolla and C stands for calyx.

Reason (R): The symbol G with a line drawn below it (G) indicates a superior ovary.

62. Assertion (A): Fusion of floral parts is indicated by enclosing the figure within a bracket in the floral formula.

Reason (R): Adhesion between different whorls is indicated by a line drawn above the symbols of the floral parts.

63. Assertion (A): The family Solanaceae is commonly called the 'potato family'.

Reason (R): Members of this family, such as potato, possess an underground stem.

64. Assertion (A): In the family Solanaceae, the flower is bisexual and zygomorphic.

Reason (R): The androecium in Solanaceae consists of five stamens which are epipetalous.

65. Assertion (A): The gynoecium in Solanaceae is bicarpellary, syncarpous with a superior ovary.

Reason (R): The placenta is swollen with many ovules and the placentation is axile.

STATEMENT-BASED

66. How many of the following statements regarding flowering plants are correct?

a. All angiosperms are characterized by the presence of roots, stems, leaves, flowers, and fruits.

b. Variations in plant parts can be adaptations for functions like protection, climbing, and storage.

c. The shoot system is the underground part of a flowering plant.

d. Standard technical terms and definitions are necessary for any successful attempt at classification.

1. One
2. Two
3. Three
4. Four

67. Select the option containing the incorrect statement.

1. In dicotyledonous plants, the radicle elongates to form the primary root.
2. The primary root and its branches constitute the tap root system in plants like mustard.
3. The primary root in monocotyledonous plants is long-lived and prominent.
4. The fibrous root system, as seen in wheat, originates from the base of the stem.

68. Which of the following statements is not incorrect regarding adventitious roots?

1. They arise from the direct elongation of the radicle.
2. They are found in plants like grass, *Monstera*, and banyan.
3. They are the characteristic root system of all monocotyledonous plants.
4. They consist of a main primary root with lateral branches.

69. Consider the following functions:

A. Absorption of water and minerals from the soil.

B. Providing proper anchorage to the plant parts.

C. Storing reserve food material.

D. Synthesis of plant growth regulators.

E. Photosynthesis.

Which of the given are the main functions of the root system?

1. A, B, C only
2. A, B, E only
3. A, B, C, D
4. A, B, C, D, E

70. Evaluate the two statements given below.

Statement I: The apex of the root is covered by a thimble-like root cap, which protects it as it makes its way through the soil.

Statement II: The cells in the region of elongation, which is a few millimeters above the root cap, are small, thin-walled, and divide repeatedly.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

71. Identify the set of correct statements regarding the regions of a root tip.

a. Cells proximal to the meristematic region undergo rapid elongation and are responsible for the root's growth in length.

b. The region of elongation is proximal to the region of maturation.

c. Some epidermal cells in the region of maturation form fine, delicate, thread-like root hairs.

d. Root hairs are primarily involved in providing anchorage to the plant.

1. a, b
2. a, c
3. b, d
4. c, d

72. Determine the total number of incorrect statements from the list below.

i. The root cap is a region of rapidly dividing cells.

ii. The cells of the elongation zone gradually differentiate and mature.

iii. Root hairs absorb water and minerals from the soil.

iv. The region of meristematic activity is responsible for the growth of the root in length.

v. The cells of the meristematic region have dense protoplasm.

1. One
2. Two
3. Three
4. Four

73. The following is a list of features:

a. Ascending part of the axis

b. Develops from the plumule

c. Bears nodes and internodes

d. Generally green when young

e. Conducts water, minerals, and photosynthates

To which part of the plant do all the above features apply?

1. Root
2. Stem
3. Leaf
4. Flower

74. Select the option that contains the correct statements.

A. Internodes are the regions of the stem where leaves are born.

B. The stem bears buds, which can be either terminal or axillary.

C. The main function of the stem is absorption of minerals.

D. Some stems are modified to perform the function of vegetative propagation.

1. A, C
2. B, D
3. A, B
4. C, D

75. Evaluate the correctness of the following two statements.

Statement I: The leaf develops at the node and bears a bud in its axil, which can later develop into a branch.

Statement II: Leaves originate from the shoot apical meristems and are arranged in a basipetal order on the stem.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

76. Identify the incorrect statement regarding the structure of a typical leaf.

1. A leaf consists of three main parts: leaf base, petiole, and lamina.
2. In some leguminous plants, the leaf base may become swollen, which is called the pulvinus.
3. In monocotyledons, the petiole expands into a sheath covering the stem partially or wholly.
4. The petiole holds the blade to light and long flexible petioles allow leaf blades to flutter, thereby cooling the leaf.

77. How many of the statements below are accurate?

i. The lamina is the green, expanded part of the leaf.

ii. The middle prominent vein in the lamina is called the midrib.

iii. Veins provide rigidity to the leaf blade and act as channels for transport.

iv. The shape, margin, and apex of the lamina are consistent across different leaves.

1. One
2. Two
3. Three
4. Four

78. Which of the following statements about venation is correct?

1. The arrangement of veins and veinlets in the petiole is termed venation.
2. When veinlets form a network, the venation is termed parallel and is a characteristic of dicots.
3. When veins run parallel to each other within a lamina, the venation is termed reticulate.
4. Parallel venation is the characteristic of most monocotyledons.

79. Find the correct statement regarding simple and compound leaves.

1. A leaf is simple when its lamina is incised, and the incisions touch the midrib.
2. In both simple and compound leaves, a bud is present in the axil of every leaflet.
3. When the incisions of the lamina reach up to the midrib, breaking it into a number of leaflets, the leaf is compound.
4. A bud is absent in the axil of the petiole in both simple and compound leaves.

80. Consider the following characteristics:

a. Leaflets are present on a common axis, the rachis.

b. The rachis represents the midrib.

c. An example is neem.

These characteristics apply to which type of leaf?

1. Simple leaf
2. Palmately compound leaf
3. Pinnately compound leaf
4. A leaf with parallel venation

81. Evaluate the given statements.

Statement I: In palmately compound leaves, the leaflets are attached at a common point at the tip of the petiole.

Statement II: Silk cotton is an example of a pinnately compound leaf.

1. Both Statement I and Statement II are correct.

2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

82. Select the option that correctly identifies the type of phyllotaxy based on the given examples.

Column I (Phyllotaxy) Column II (Example)

1. Alternate *Alstonia*
2. Opposite China rose
3. Whorled Guava
4. Alternate Mustard

83. How many of the following statements about phyllotaxy are incorrect?

a. Phyllotaxy is the pattern of arrangement of flowers on a branch.

b. In china rose, a single leaf arises at each node in an alternate manner.

c. In Calotropis, a pair of leaves arise at each node opposite to each other.

d. If more than two leaves arise at a node to form a whorl, it is called opposite phyllotaxy.

1. One
2. Two
3. Three
4. Four

84. Evaluate the two statements provided below.

Statement I: A flower is a modified shoot where the internodes do not elongate and the axis gets condensed.

Statement II: The arrangement of flowers on the floral axis is termed as phyllotaxy.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

85. Which of the following statements correctly differentiates between racemose and cymose inflorescences?

1. In racemose, the main axis terminates in a flower, while in cymose, the main axis continues to grow.
2. The flowers are borne in a basipetal order in racemose and acropetal order in cymose.
3. The main axis has limited growth in racemose and unlimited growth in cymose.
4. In racemose, flowers are borne laterally in an acropetal succession, while in cymose, the main axis terminates in a flower.

86. Identify the total number of correct statements from the list below.

i. The flower is the reproductive unit in the angiosperms.

ii. Calyx and corolla are accessory organs.

iii. Androecium and gynoecium are reproductive organs.

iv. When calyx and corolla are not distinct, as in lily, they are called perianth.

1. One
2. Two
3. Three
4. Four

87. Which of the following statements is incorrect?

1. A flower with both androecium and gynoecium is bisexual.
2. A flower with only stamens or only carpels is unisexual.
3. An actinomorphic flower can be divided into two similar halves in only one particular vertical plane.
4. Mustard, datura, and chilli are examples of actinomorphic flowers.

88. Evaluate the given statements.

Statement I: A flower of pea, gulmohur, or bean is zygomorphic.

Statement II: A flower of canna cannot be divided into two similar halves by any vertical plane passing through the centre and is thus asymmetric.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

89. A flower is described as having its floral appendages in multiples of 3. It also possesses a reduced leaf at the base of its pedicel. What are the correct terms for these two conditions respectively?

1. Pentamerous, Ebracteate
2. Trimerous, Bracteate
3. Tetramerous, Bracteate
4. Trimerous, Ebracteate

90. Select the option that contains only correct statements regarding the position of floral parts on the thalamus.

a. In hypogynous flowers, the gynoecium occupies the highest position, and the ovary is superior.

b. Mustard, china rose, and brinjal are examples of plants with hypogynous flowers.

c. In perigynous flowers, the ovary is said to be half inferior, as seen in plum, rose, and peach.

d. In epigynous flowers, the margin of the thalamus grows to enclose the ovary completely, and the ovary is inferior.

1. a, b, d
2. a, c only
3. b, d only
4. a, b, c, d

91. Identify the incorrect statement.

1. An example of a plant with an inferior ovary is cucumber.
2. The ray florets of sunflower have an inferior ovary.
3. In perigynous flowers, the other parts of the flower arise above the ovary.
4. In a hypogynous flower, floral parts like calyx, corolla, and androecium are situated below the gynoecium.

92. Evaluate the given statements about the calyx and corolla.

Statement I: The calyx is the outermost whorl composed of sepals, and when the sepals are united, it is called gamosepalous.

Statement II: The corolla is composed of brightly colored petals, and when the petals are free, it is called gamopetalous.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

93. How many of the following features correctly describe the corolla?

i. It is composed of sepals.

ii. It is usually brightly colored to attract insects for pollination.

iii. If the petals are united, it is called polypetalous.

iv. Its shape can be tubular, bell-shaped, or wheel-shaped.

1. One
2. Two
3. Three
4. Four

94. Which of the following types of aestivation is correctly described?

1. Valvate: One margin of the appendage overlaps that of the next one.
2. Twisted: The margins of appendages overlap one another but not in any particular direction.
3. Imbricate: Sepals or petals in a whorl just touch one another at the margin without overlapping.
4. Vexillary: The largest posterior petal overlaps two lateral petals which in turn overlap the two smallest anterior petals.

95. From the options below, identify the incorrect match between the plant and its type of aestivation.

1. *Calotropis* - Valvate
2. China rose - Twisted
3. *Cassia* - Imbricate
4. Bean - Twisted

96. Examine the following statements on aestivation.

A. In imbricate aestivation, the overlapping of sepals or petals is not in any particular direction, as seen in gulmohur.

B. In pea and bean flowers, the five petals are arranged in a vexillary or papilionaceous manner.

C. The largest petal in vexillary aestivation is called the standard, the lateral ones are wings, and the smallest anterior ones form the keel.

D. Cotton and lady's finger exhibit valvate aestivation.

Which of the statements are correct?

1. A, B, C
2. A, D
3. B, C, D
4. A, B, D

97. Read the following statements and select the option with the correct ones.

a. The androecium is composed of stamens, each representing the male reproductive organ.

b. A sterile stamen is called a staminode.

c. When stamens are attached to the petals, they are epipetalous, as in brinjal.

d. When stamens are attached to the perianth, they are epiphyllous, as in lily.

1. a, b only
2. c, d only
3. a, c, d
4. a, b, c, d

98. Evaluate the given statements.

Statement I: When stamens in a flower are united into one bundle, it is a monoadelphous condition, seen in china rose.

Statement II: When stamens are united into two bundles, it is a diadelphous condition, seen in citrus.

1. Both Statement I and Statement II are correct.
2. Statement I is correct but Statement II is incorrect.
3. Statement I is incorrect but Statement II is correct.
4. Both Statement I and Statement II are incorrect.

99. Which of the following correctly describes a polyadelphous condition?

1. The stamens are free.
2. The stamens are united into a single bundle.
3. The stamens are united into two bundles.
4. The stamens are united into more than two bundles.

100. How many of the following statements regarding the gynoecium are accurate?

i. It is the female reproductive part of the flower.

ii. It is composed of one or more carpels.

iii. The stigma serves as the receptive surface for pollen grains.

iv. In an apocarpous gynoecium, the carpels are fused.

v. After fertilisation, the ovary matures into a seed.

1. Two

2. Three

3. Four

4. Five

101. Select the incorrect statement concerning the gynoecium.

1. A carpel consists of three parts: stigma, style, and ovary.

2. When carpels are fused, as in mustard and tomato, they are termed syncarpous.

3. When carpels are free, as in lotus and rose, they are termed apocarpous.

4. Each ovule is attached to a flattened, cushion-like style.

102. Identify the incorrect match between the type of placentation and its example.

1. Marginal - Pea

2. Axile - Lemon

3. Parietal - China rose

4. Basal - Sunflower

103. Consider the following features:

a. Ovules develop on the inner wall of the ovary or on the peripheral part.

b. The ovary is one-chambered but becomes two-chambered due to the formation of a false septum.

c. It is found in mustard and Argemone.

Which type of placentation is described by the features above?

1. Axile

2. Parietal

3. Free central

4. Basal

104. Evaluate the two statements given below.

Statement I: In free central placentation, the ovules are borne on the central axis and septa are absent.

Statement II: Dianthus and Primrose are examples of plants showing free central placentation.

1. Both Statement I and Statement II are correct.

2. Statement I is correct but Statement II is incorrect.

3. Statement I is incorrect but Statement II is correct.

4. Both Statement I and Statement II are incorrect.

105. Evaluate the following statements.

Statement I: A fruit is a characteristic feature of flowering plants and represents a mature or ripened ovary.

Statement II: If a fruit is formed without the fertilisation of the ovary, it is called a parthenocarpic fruit.

1. Both Statement I and Statement II are correct.

2. Statement I is correct but Statement II is incorrect.

3. Statement I is incorrect but Statement II is correct.

4. Both Statement I and Statement II are incorrect.

106. Which of the following statements about the fruit is not correct?

1. The fruit consists of a wall or pericarp and seeds.

2. When the pericarp is thick and fleshy, it is differentiated into an outer epicarp, a middle mesocarp, and an inner endocarp.

3. In mango, the pericarp is well-differentiated, with the mesocarp being fleshy and edible.

4. In coconut, which is also a drupe, the mesocarp is fleshy and edible.

107. From the statements given below about the structure of a dicot seed, choose the correct combination.

a. The outermost covering of a seed is the seed coat, which has two layers, the outer testa and the inner tegmen.

b. The hilum is a small pore above which the micropyle is present.

c. Within the seed coat is the embryo, consisting of an embryonal axis and two fleshy cotyledons full of reserve food.

d. At the two ends of the embryonal axis are the radicle and the plumule.

1. a, c, d

2. a, b only

3. c, d only

4. a, b, c, d

108. Determine the total number of correct statements.

i. In castor, the endosperm is a food-storing tissue, making it an endospermic seed.

ii. In bean, gram, and pea, the endosperm is not present in mature seeds, and they are called non-endospermous.

iii. Monocotyledonous seeds are generally non-endospermic.

iv. In orchids, the seeds are endospermic.

1. One

2. Two

3. Three

4. Four

109. Which of the following statements regarding the structure of a monocotyledonous seed is correct?

1. The seed coat is thick and free from the fruit wall.

2. The outer covering of the endosperm that separates it from the embryo is a carbohydrate-rich layer called the aleurone layer.

3. The embryo consists of one large and shield-shaped cotyledon known as the scutellum.

4. The plumule and radicle are not enclosed in sheaths.

110. Evaluate the given statements.

Statement I: The coleoptile is an undifferentiated sheath that encloses the radicle in a monocot embryo.

Statement II: The coleorhiza is an undifferentiated sheath that encloses the plumule in a monocot embryo.

1. Both Statement I and Statement II are correct.

2. Statement I is correct but Statement II is incorrect.

3. Statement I is incorrect but Statement II is correct.

4. Both Statement I and Statement II are incorrect.

111. Identify the incorrect statement related to semi-technical descriptions of a flowering plant.

1. A floral formula is represented by some symbols, where K stands for calyx and C for corolla.

2. The symbol G with a line drawn below it represents an inferior ovary.

3. Fusion of floral parts is indicated by enclosing the number within a bracket.

4. A floral diagram shows the number of parts of a flower, their arrangement, and their relation to one another.

112. The following is a list of vegetative characters:

a. Leaves are alternate

b. Leaves are simple, rarely pinnately compound

c. Leaves are exstipulate

d. Venation is reticulate

These characters are descriptive of the family:

1. Brassicaceae

2. Solanaceae

3. Fabaceae

4. Liliaceae

113. How many of the following floral characters are correctly stated for the family Solanaceae?

i. Inflorescence: Solitary, axillary or cymose

ii. Flower: Bisexual, zygomorphic

iii. Calyx: Sepals five, united, persistent, imbricate aestivation

iv. Corolla: Petals five, united, valvate aestivation

v. Androecium: Stamens five, epipetalous

1. Two

2. Three

3. Four

4. Five

114. Select the option that correctly describes the gynoecium of the Solanaceae family.

1. Monocarpellary, apocarpous, ovary inferior, unilocular

2. Bicarpellary, syncarpous, ovary superior, bilocular

3. Tricarpellary, syncarpous, ovary superior, trilocular

4. Bicarpellary, apocarpous, ovary inferior, unilocular

MATCHING TYPE

115. Match the type of root system in Column I with the corresponding plant example in Column II.

Column I (Root System)	Column II (Example)
A. Tap root system	1. Wheat
B. Fibrous root system	2. Monstera

| C. Adventitious roots | 3. Mustard |

1. A-3, B-1, C-2

2. A-1, B-3, C-2

3. A-2, B-1, C-3

4. A-3, B-2, C-1

116. Identify the single incorrectly matched pair from the following.

1. Primary root elongation - Dicotyledonous plants

2. Roots from the base of the stem - Fibrous roots

3. Roots from parts other than radicle - Adventitious roots

4. Short-lived primary root - Tap root system

117. Select the option that represents a correct match.

1. Anchorage - Function of stem

2. Synthesis of PGRs - Function of root

3. Absorption of water - Function of leaf

4. Storing reserve food - Function of flower

118. Match the regions of the root tip in Column I with their primary characteristics or functions in Column II.

| Column I (Region) | Column II (Characteristic/Function) |

| :--- | :--- |

| A. Root Cap | 1. Cells undergo rapid elongation and enlargement |

| B. Region of Meristematic Activity | 2. Epidermal cells form fine, delicate root hairs |

| C. Region of Elongation | 3. Thimble-like structure that protects the root apex |

| D. Region of Maturation | 4. Cells are small, thin-walled with dense protoplasm |

1. A-3, B-4, C-1, D-2

2. A-3, B-1, C-4, D-2

3. A-2, B-4, C-1, D-3

4. A-1, B-2, C-3, D-4

119. From the given options, identify the pair that is correctly matched.

1. Stem - Develops from the radicle

2. Leaf - Arises from the internode

3. Pulvinus - Swollen leaf base in legumes

4. Stipules - Present in all monocots

120. Which of the following pairs is a mismatch?

1. Petiole - Holds the leaf blade to light

2. Lamina - Green expanded part of the leaf

3. Sheathing leaf base - Characteristic of leguminous plants

4. Axillary bud - Develops into a branch

121. Match the morphological term in Column I with its appropriate example or characteristic in Column II.

| Column I (Term) | Column II (Example/Characteristic) |

| :--- | :--- |

| A. Reticulate venation | 1. Silk cotton |

| B. Parallel venation | 2. Characteristic of most monocots |

| C. Pinnately compound leaf | 3. Characteristic of dicotyledonous plants |

| D. Palmately compound leaf | 4. Neem |

1. A-3, B-2, C-4, D-1

2. A-2, B-3, C-1, D-4

3. A-3, B-2, C-1, D-4

4. A-4, B-1, C-3, D-2

122. Identify the incorrectly matched pair.

1. Simple leaf - Lamina is entire or incisions do not reach the midrib

2. Compound leaf - Bud present in the axil of leaflets

3. Rachis - Represents the midrib in a pinnately compound leaf

4. Palmately compound leaf - Leaflets attached at the tip of the petiole

123. Match the type of phyllotaxy in Column I with the correct plant example from Column II.

| Column I (Phyllotaxy) | Column II (Example) |

| :--- | :--- |

| A. Alternate | 1. Alstonia |

| B. Opposite | 2. China rose |

| C. Whorled | 3. Guava |

1. A-2, B-3, C-1

2. A-1, B-3, C-2

3. A-3, B-2, C-1

4. A-2, B-1, C-3

124. From the following, identify the pair that is not correctly matched.

1. Single leaf at each node - Alternate phyllotaxy

2. Pair of leaves at each node - Opposite phyllotaxy

3. More than two leaves at a node - Whorled phyllotaxy

4. Calotropis - Alternate phyllotaxy

125. Select the correctly matched pair regarding inflorescence.

1. Cymose - Main axis continues to grow

2. Racemose - Flowers borne in a basipetal order

3. Cymose - Main axis has limited growth

4. Racemose - Main axis terminates in a flower

126. Match the terms in Column I with their respective examples or definitions in Column II.

| Column I (Term) | Column II (Example/Definition) |

| :--- | :--- |

| A. Actinomorphic | 1. Pea |

| B. Zygomorphic | 2. Mustard |

| C. Asymmetric | 3. Canna |

| D. Perianth | 4. Lily |

1. A-2, B-1, C-3, D-4

2. A-1, B-2, C-3, D-4

3. A-4, B-3, C-2, D-1

4. A-2, B-3, C-1, D-4

127. Which of the following is an incorrect match between the flower type and the position of its ovary?

1. Hypogynous - Superior ovary

2. Perigynous - Half inferior ovary

3. Epigynous - Inferior ovary

4. Hypogynous - Inferior ovary

128. From the options provided, choose the one that represents a correct combination.

1. Superior ovary - Cucumber

2. Inferior ovary - Brinjal

3. Half inferior ovary - Peach

4. Superior ovary - Ray florets of sunflower

129. Identify the mismatched pair.

1. Gamosepalous - Sepals are united

2. Polysepalous - Sepals are free

3. Gamopetalous - Petals are free

4. Polypetalous - Petals are free

130. Match the type of aestivation in Column I with a plant that exhibits it from Column II.

| Column I (Aestivation) | Column II (Example) |

| :--- | :--- |

| A. Valvate | 1. Gulmohur |

| B. Twisted | 2. Pea |

| C. Imbricate | 3. Lady's finger |

| D. Vexillary | 4. Calotropis |

1. A-4, B-3, C-1, D-2

2. A-4, B-1, C-3, D-2

3. A-2, B-3, C-1, D-4

4. A-1, B-2, C-4, D-3

131. Select the option with the correct match for the condition of stamens.

1. Epipetalous - Stamens attached to perianth

2. Monoadelphous - Stamens united into two bundles

3. Diadelphous - Stamens united into one bundle as in pea

4. Polyadelphous - Stamens united into more than two bundles as in citrus

132. Which of the following pairs related to the gynoecium is incorrectly matched?

1. Apocarpous - Carpels are free, as in lotus

2. Syncarpous - Carpels are fused, as in tomato

3. Stigma - Receptive surface for pollen

4. Ovary - Matures into a seed after fertilisation

133. Match the placentation type in Column I with the corresponding example in Column II.

| Column I (Placentation) | Column II (Example) |

| :--- | :--- |

| A. Marginal | 1. Dianthus |

| B. Axile | 2. Sunflower |

| C. Parietal | 3. Pea |

| D. Free central | 4. Lemon |

| E. Basal | 5. Mustard |

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

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

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

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

134. Identify the correctly matched pair.

1. Fruit - Ripened ovule

2. Drupe - A fruit type found in mango and coconut

3. Pericarp - Composed of testa and tegmen

4. Mesocarp - Fibrous in mango, edible in coconut

135. Find the incorrect match with respect to the parts of a seed.

1. Scutellum - Shield-shaped cotyledon in monocots

2. Aleurone layer - Proteinous layer in monocot seeds

3. Coleoptile - Encloses the radicle

4. Endospermic seed - Castor

136. Match the floral whorl of a Solanaceae flower with its correct description.

| Column I (Floral Whorl) | Column II (Description) |

| :--- | :--- |

| A. Calyx | 1. Five stamens, epipetalous |

| B. Corolla | 2. Bicarpellary, syncarpous, ovary superior |

| C. Androecium | 3. Five united sepals, persistent, valvate aestivation |

| D. Gynoecium | 4. Five united petals, valvate aestivation |

1. A-4, B-3, C-1, D-2

2. A-3, B-4, C-2, D-1

3. A-3, B-4, C-1, D-2

4. A-1, B-2, C-3, D-4

137. Which of the following economic importances is a mismatch for the Solanaceae family?

1. Food - Brinjal, Potato

2. Spice - Chilli

3. Fumigatory - Petunia

4. Medicine - Ashwagandha

DATA ANOMALY

138. A botanist records observations on the root systems of four different plants. Analyze the data presented in the table and identify the observation that represents a data anomaly based on established principles of root morphology.

| Observation | Plant Group | Example | Dominant Root System | Origin of Dominant Roots |

| :--- | :--- | :--- | :--- | :--- |

| 1 | Dicotyledon | Mustard | Tap Root | Direct elongation of radicle |

| 2 | Monocotyledon | Wheat | Tap Root | Direct elongation of radicle |

| 3 | Monocotyledon | Grass | Fibrous Root | Base of the stem |

| 4 | - | Banyan Tree | Adventitious Root | Parts other than radicle |

1. Observation 1

2. Observation 2

3. Observation 3

4. Observation 4

139. A student prepares a summary table of the different regions of a root tip. Critically evaluate the table to find the row containing an anomalous piece of information that contradicts the known functions and characteristics of these regions.

| Region | Location | Primary Cellular Activity | Key Structural Feature |

| :--- | :--- | :--- | :--- |

| A | Covers the apex | Protection | Thimble-like cap |

| B | Proximal to the cap | Repeated division | Small cells, dense protoplasm |

| C | Proximal to Region B | Rapid elongation and enlargement | Responsible for growth in length |

| D | Proximal to Region C | Differentiation | Formation of lateral roots |

1. Region A
2. Region B
3. Region C
4. Region D

140. An investigator is classifying plants based on the pattern of leaf arrangement on the stem. The data is compiled into the table below. Identify which entry contains an anomaly.

| Entry | Phyllotaxy Type | Description | Example Plant |

| :--- | :--- | :--- | :--- |

| 1 | Alternate | A single leaf arises at each node | China rose |

| 2 | Opposite | A pair of leaves arise at each node | Calotropis |

| 3 | Whorled | More than two leaves arise at a node | Alstonia |

| 4 | Opposite | A pair of leaves arise at each node | Sunflower |

1. Entry 1
2. Entry 2
3. Entry 3
4. Entry 4

141. The table below compares two major types of inflorescence. Scrutinize the data to identify the cell containing information that is inconsistent with the defined characteristics of these types.

Characteristic|**Racemose Inflorescence**|**Cymose Inflorescence**
Main Axis Growth|Continues to grow|Limited (terminates in a flower)
Succession of Flowers|Acropetal|Acropetal
Flower Arrangement|Flowers are borne laterally|Flowers are borne terminally and laterally
Growth Pattern|Indefinite|Definite

1. Main Axis Growth in Cymose Inflorescence
2. Succession of Flowers in Racemose Inflorescence
3. Flower Arrangement in Racemose Inflorescence
4. Succession of Flowers in Cymose Inflorescence

142. A researcher is classifying flower specimens based on their symmetry. The compiled data is shown below. Identify the specimen whose classification is an anomaly.

| Specimen ID | Flower | Symmetry Type | Rationale |

| :--- | :--- | :--- | :--- |

| F-01 | Mustard | Actinomorphic | Can be divided into two equal halves in any radial plane |

| F-02 | Pea | Zygomorphic | Can be divided into two similar halves in only one vertical plane |

| F-03 | Cassia | Actinomorphic | Can be divided into two equal halves in any radial plane |

| F-04 | Canna | Asymmetric | Cannot be divided into two similar halves by any vertical plane |

1. F-01
2. F-02
3. F-03
4. F-04

143. The table below outlines different types of aestivation. Review the information and identify the row that contains a significant error.

| Aestivation Type | Description of Margin Arrangement | Plant Example |

| :--- | :--- | :--- |

| Valvate | Margins of appendages just touch each other | Calotropis |

| Twisted | Margins overlap with the next one in a regular pattern | China rose |

| Imbricate | Margins overlap, but not in any particular direction | Pea |

| Vexillary | The largest petal overlaps two lateral petals, which overlap two smallest anterior petals | Bean |

1. Valvate
2. Twisted
3. Imbricate
4. Vexillary

144. Analyze the data on androecium cohesion compiled by a student. Which entry represents a clear contradiction of established botanical terms?

| Condition | Definition | Example |

| :--- | :--- | :--- |

| 1. Polyandrous | Stamens in the flower are free | Mustard |

| 2. Monoadelphous | Stamens are united into one bundle | China rose |

| 3. Diadelphous | Stamens are united into two bundles | Pea |

| 4. Polyadelphous | Stamens are united into a single bundle | Citrus |

1. Condition 1
2. Condition 2
3. Condition 3
4. Condition 4

145. A summary of placentation types is presented below. Find the entry that contains an anomalous description.

| Placentation Type | Key Feature | Example |

| :--- | :--- | :--- |

| A. Axile | Ovules attached to a central axis in a multilocular ovary | Tomato |

| B. Parietal | Ovules develop on the inner wall of a multilocular ovary | Argemone |

| C. Free Central | Ovules on a central axis, septa are absent | Dianthus |

| D. Basal | A single ovule is attached at the base of the ovary | Marigold |

1. Entry A
2. Entry B
3. Entry C
4. Entry D

146. A comparative analysis of Dicot and Monocot seed structures is shown. Identify the row with the anomalous data point.

| Feature | Dicot Seed (e.g., Gram) | Monocot Seed (e.g., Maize) |

| :--- | :--- | :--- |

| Number of Cotyledons | Two | One (Scutellum) |

| Endosperm | Generally absent in mature seed | Generally present in mature seed |

| Aleurone Layer | Absent | Present |

| Protective Sheaths | Coleoptile and Coleorhiza present | Absent |

1. Number of Cotyledons
2. Endosperm
3. Aleurone Layer
4. Protective Sheaths

SEQUENCE

147. Arrange the following components of a tap root system in the correct order of their development, from the main central root outwards.

A. Secondary roots
B. Primary root
C. Tertiary roots

1. A → B → C
2. B → A → C
3. C → A → B
4. B → C → A

148. Arrange the following regions of a root tip in the correct spatial sequence as one moves from the apex upwards towards the base of the root.

A. Region of elongation
B. Region of meristematic activity
C. Region of maturation
D. Root cap

1. D → B → A → C
2. D → C → B → A
3. A → B → C → D

4. C → A → B → D

149. Arrange the main parts of a typical leaf in the correct sequence, starting from its point of attachment to the stem and moving outwards to the expanded portion.

A. Petiole

B. Lamina

C. Leaf base

1. A → C → B

2. B → A → C

3. C → A → B

4. C → B → A

150. What is the correct sequence of the four floral whorls on the thalamus, arranged from the outermost whorl to the innermost whorl?

A. Gynoecium

B. Androecium

C. Corolla

D. Calyx

1. A → B → C → D

2. D → C → B → A

3. D → B → C → A

4. C → D → B → A

151. In vexillary aestivation, the petals are arranged in a specific overlapping pattern. Arrange the following petal types in the correct sequence, starting from the outermost (largest) petal that overlaps the others.

A. Wings (alae)

B. Standard (vexillum)

C. Keel (carina)

1. A → C → B

2. B → A → C

3. C → A → B

4. B → C → A

152. Arrange the parts of a gynoecium (carpel) to represent the correct path for a pollen tube to grow, from the receptive surface to the structure containing ovules.

A. Style

B. Ovary

C. Stigma

1. A → B → C

2. B → A → C

3. C → A → B

4. C → B → A

153. The pericarp of a fleshy fruit like a mango is differentiated into three distinct layers. Arrange these layers in the correct sequence from the outside to the inside.

A. Endocarp

B. Epicarp

C. Mesocarp

1. A → C → B

2. B → C → A

3. C → B → A

4. B → A → C

154. Arrange the following parts of a monocotyledonous seed (maize grain) in the correct sequence one would encounter them when moving from the periphery to the centrally located axis of the embryo.

A. Aleurone layer

B. Embryo

C. Endosperm

D. Seed coat & fruit-wall

1. D → C → A → B

2. D → A → C → B

3. A → D → C → B

4. D → C → B → A

155. When providing a semi-technical description of a flowering plant, the characters are presented in a specific sequence. Arrange the following categories into the correct order of description.

A. Vegetative characters (roots, stem, leaves)

B. Floral characters (inflorescence, flower parts)

C. Habit

1. A → B → C

2. C → A → B

3. B → A → C

4. C → B → A

156. Arrange the following biological structures and events in the correct chronological sequence that leads from a flower to a fruit.

A. Ovary matures

B. Fertilisation occurs

C. Fruit is formed

D. Ovule develops into seed

1. B → A → D → C

2. B → D → A → C

3. A → B → D → C

4. B → C → A → D

MULTI CORRECT

Instructions: In the following questions, more than one of the options may be correct. Choose the option that contains the combination of all correct statements.

157. Which of the following are the main functions attributed to the root system?

A. Absorption of water and minerals from the soil

B. Providing a proper anchorage to the plant parts

C. Synthesis of photosynthates

D. Storing reserve food material

E. Synthesis of plant growth regulators

1. A, B, and C only

2. A, B, D, and E only

3. B, C, D, and E only

4. All of the above

158. Select the option that includes all the correct statements regarding the regions of the root.

A. The root is covered at the apex by the root cap, a structure that protects the tender apex.

B. The cells of the region of elongation are very small, thin-walled, and have dense protoplasm.

C. The region of elongation is responsible for the growth of the root in length.

D. From the region of maturation, some of the epidermal cells form root hairs.

E. The cells of the meristematic zone gradually differentiate and mature.

1. A, C, and D only

2. B, C, and E only

3. A, B, and D only

4. A, C, and E only

159. Identify the combination of all correct statements regarding leaf morphology.

A. The swollen leaf base in some leguminous plants is called the pulvinus.

B. In monocotyledons, the leaf base expands into a sheath covering the stem partially or wholly.

C. Parallel venation is the characteristic of most dicotyledons.

D. In a pinnately compound leaf, a number of leaflets are present on a common axis called the rachis.

E. A bud is present in the axil of leaflets of a compound leaf.

1. A, B, and D only

2. A, C, and E only

3. B, C, and D only

4. A, B, and E only

160. Which of the following options contains all the correct examples for the given types of phyllotaxy?

A. Alternate - China rose

B. Opposite - Guava

C. Whorled - Alstonia

D. Alternate - Sunflower

E. Opposite - Mustard

1. A, B, C, and D only

2. A, B, and E only

3. C, D, and E only

4. A, B, and D only

161. From the statements below, choose the option that contains the combination of all correct statements.

A. In racemose inflorescence, the main axis continues to grow, and the flowers are borne in an acropetal succession.

B. In cymose inflorescence, the main axis terminates in a flower, and the flowers are borne in a basipetal order.

C. A flower that can be divided into two similar halves in only one particular vertical plane is zygomorphic.

D. Mustard and chilli flowers are actinomorphic.

E. A flower is described as trimerous when its floral appendages are in multiples of five.

1. A, B, and E only

2. C, D, and E only

3. A, B, C, and D only

4. B, C, and D only

162. Which of the following statements regarding ovary position and aestivation are correct?

A. In a hypogynous flower like china rose, the ovary is superior.

B. In an epigynous flower like guava, the ovary is inferior.

C. In a perigynous flower like peach, the ovary is said to be half inferior.

D. In valvate aestivation, as seen in Calotropis, the margins of sepals or petals overlap one another.

E. Vexillary aestivation is characteristic of pea and bean flowers.

1. A, B, C, and E only

2. A, B, and D only

3. C, D, and E only

4. All of the above

163. Select the option that includes all the correct statements about androecium and gynoecium.

A. When stamens are attached to petals, the condition is epipetalous.

B. In the diadelphous condition, as seen in pea, the stamens are united into two bundles.

C. A syncarpous gynoecium has free carpels.

D. In an apocarpous gynoecium, as seen in lotus, the carpels are free.

E. A sterile stamen is known as a staminode.

1. A, B, D, and E only

2. A, C, and E only

3. B, C, and D only

4. A, B, C, and D only

164. Which of the following statements correctly describe types of placentation?

A. In marginal placentation, the placenta forms a ridge along the ventral suture of the ovary.

B. In axile placentation, the ovules are attached to a central axis in a multilocular ovary.

C. In parietal placentation, the ovary is one-chambered but may become two-chambered due to a false septum.

D. In free central placentation, septa are present.

E. In basal placentation, a single ovule is attached to the base of the ovary.

1. A, B, C, and E only

2. A, D, and E only

3. B, C, and D only

4. All of the above

165. Identify the combination of all the correct statements about fruits and seeds.

A. A fruit developed without fertilisation is called a parthenocarpic fruit.

B. In coconut, which is a drupe, the mesocarp is fibrous.

C. The outermost layer of a dicot seed coat is the testa.

D. In a maize seed, the plumule is protected by the coleorhiza and the radicle by the coleoptile.

E. The scutellum is the large, shield-shaped cotyledon of a monocot embryo.

1. A, B, D, and E only

2. C, D, and E only

3. A, B, C, and E only

4. B, C, and D only

166. Which of the following are correct floral characters for the family Solanaceae?

A. Calyx: five united sepals, persistent, valvate aestivation.

B. Corolla: five united petals, valvate aestivation.

C. Androecium: five stamens, epipetalous.

D. Gynoecium: bicarpellary, syncarpous, superior ovary.

E. Placentation: Parietal.

1. A, B, C, and D only

2. B, C, D, and E only

3. A, C, and E only

4. All of the above

FLOWCHART / PROCESS COMPLETION

167. The flowchart below illustrates the development of different types of root systems. Identify the correct labels for A, B, and C.

Radicle Elongates Directly → Forms [A] (e.g., Mustard)

Primary root is short-lived → [B] arise from base of stem (e.g., Wheat)

Roots arise from parts other than the radicle → [C] (e.g., Banyan)

1. A-Primary root, B-Secondary roots, C-Fibrous roots

2. A-Tap root system, B-Fibrous root system, C-Adventitious roots

3. A-Fibrous root system, B-Tap root system, C-Adventitious roots

4. A-Adventitious roots, B-Tap root system, C-Fibrous root system

168. Complete the flowchart, which shows the sequence of regions in a root tip from the apex upwards, by identifying A, B, and C.

[A] → Region of Meristematic Activity → [B] → Region of Maturation (with [C])

1. A-Region of Elongation, B-Root Cap, C-Root hairs

2. A-Root Cap, B-Region of Elongation, C-Root hairs

3. A-Root hairs, B-Root Cap, C-Region of Elongation

4. A-Root Cap, B-Root hairs, C-Region of Elongation

169. The diagram below represents the hierarchical organization of leaf parts. What do A, B, and C represent?

Stem → Attached by [A] → Stalk or [B] → Expanded green part [C]

1. A-Petiole, B-Lamina, C-Leaf Base

2. A-Lamina, B-Leaf Base, C-Petiole

3. A-Leaf Base, B-Stipule, C-Lamina

4. A-Leaf Base, B-Petiole, C-Lamina

170. The flowchart shows the transformation of a meristem and the subsequent arrangement of floral parts. Identify A, B, and C.

Shoot Apical Meristem → transforms into → [A] → Axis condenses → Appendages produced at successive nodes → [B] → Corolla → Androecium → [C]

1. A-Floral Meristem, B-Gynoecium, C-Calyx

2. A-Floral Meristem, B-Calyx, C-Gynoecium

3. A-Axillary Bud, B-Calyx, C-Gynoecium

4. A-Leaf Meristem, B-Perianth, C-Calyx

171. The flowchart below is a key for identifying different conditions of stamen fusion (cohesion). Find the correct labels for A, B, and C.

Are stamens united?

Yes → Into how many bundles?

One → [A] (e.g., China rose)

Two → [B] (e.g., Pea)

More than two → [C] (e.g., Citrus)

No → Polyandrous

| Option | A | B | C |

| :--- | :--- | :--- | :--- |

| 1. | Monoadelphous | Diadelphous | Polyadelphous |

| 2. | Diadelphous | Polyadelphous | Monoadelphous |

| 3. | Polyadelphous | Monoadelphous | Diadelphous |

| 4. | Monoadelphous | Polyadelphous | Diadelphous |

172. This diagram shows the process of fruit and seed formation after fertilization. Identify A, B, and C to complete the sequence.

Flower → Fertilization → [A] develops into the Seed → [B] matures into the Fruit → The fruit wall is called the [C]

| Option | A | B | C |

| :--- | :--- | :--- | :--- |

| 1. | Ovary | Ovule | Pericarp |

| 2. | Ovule | Ovary | Pericarp |

| 3. | Ovary | Ovule | Seed Coat |

| 4. | Ovule | Ovary | Endocarp |

173. The diagram illustrates the protective sheaths of the embryonal axis in a monocot seed. What do A, B, and C represent?

Embryonal Axis

* [A] → Enclosed by the → Coleoptile

* [B] → Enclosed by the → [C]

| Option | A | B | C |

| :--- | :--- | :--- | :--- |

| 1. | Radicle | Plumule | Coleoptile |

| 2. | Plumule | Radicle | Coleorhiza |

| 3. | Coleoptile | Coleorhiza | Plumule |

| 4. | Plumule | Radicle | Scutellum |

174. The flowchart below breaks down the construction of the floral formula for the family Solanaceae. Identify the missing components labeled A, B, and C.

Flower: Bisexual, Actinomorphic → ⊕ ♂

Calyx: 5 sepals, united → [A]

Corolla: 5 petals, united → C(5)

Androecium: 5 stamens, epipetalous (adhesion to corolla) → [B]

Gynoecium: 2 carpels, syncarpous, superior → [C]

| Option | A | B | C |

| :--- | :--- | :--- | :--- |

| 1. | K(5) | A(5) | G(2) |

| 2. | K5 | A5 | G(2) |

| 3. | K(5) | A5 with adhesion symbol | G(2) with superior symbol |

| 4. | K(5) | A(5) with adhesion symbol | G2 with inferior symbol |

SCENARIO-BASED

175. Scenario: A farmer is deciding which crop to plant on a hillside plot that is prone to soil erosion from heavy rains. He has two choices: Crop A (Wheat) and Crop B (Mustard). After uprooting a sample of each, he observes that Crop A has a dense, shallow, mat-like root system originating from the stem's base. Crop B has a single, deep main root with several smaller side branches.

Question: Based on these morphological observations and the goal of preventing soil erosion, which crop should the farmer choose and why?

1. Crop B, because its deep tap root system will anchor the soil more effectively.

2. Crop A, because its fibrous root system will bind the surface soil particles more effectively.

3. Crop B, because its adventitious roots are better for soil conservation.

4. Crop A, because its tap root system provides better surface coverage.

176. Scenario: A botany student is tasked with identifying two unknown leaf samples. Leaf 1 has a single, undivided lamina where the veinlets form an intricate network. Leaf 2 consists of multiple leaflets attached to a common point at the tip of the petiole, similar to the fingers of a hand.

Question: Based on the NCERT chapter, what are the correct classifications for Leaf 1 and Leaf 2?

1. Leaf 1: Simple leaf with parallel venation; Leaf 2: Pinnately compound leaf.

2. Leaf 1: Compound leaf with reticulate venation; Leaf 2: Simple leaf.

3. Leaf 1: Simple leaf with reticulate venation; Leaf 2: Palmately compound leaf.

4. Leaf 1: Palmately compound leaf; Leaf 2: Simple leaf with parallel venation.

177. Scenario: A plant breeder is working on creating a new hybrid between a China rose plant and a Guava plant. For the artificial hybridization process, she needs to perform emasculation and bagging. She observes that the China rose flower has its ovary situated at the highest position on the thalamus. In the Guava flower, the thalamus has grown upwards, completely enclosing the ovary.

Question: In which plant will it be morphologically more challenging to perform emasculation and bagging without damaging the ovary, and why?

1. China rose, because its superior ovary is too exposed to contamination.

2. Guava, because its inferior ovary is enclosed within the thalamus, making it less accessible.

3. China rose, because its perigynous condition complicates the procedure.

4. Guava, because its superior ovary is delicate and easily damaged.

178. Scenario: While studying floral morphology in a lab, a student is given a flower with five petals. The largest petal (standard) overlaps two smaller lateral petals (wings), which in turn overlap the two smallest, fused anterior petals (keel). The stamens are united into two distinct bundles.

Question: Based on these two key characteristics (aestivation and androecium), the student can infer that the flower likely belongs to a plant like:

1. China rose

2. Mustard

3. Pea

4. Lily

179. Scenario: A horticulturalist is comparing the internal structure of a tomato and a pea pod to understand their potential seed yield. A cross-section of the tomato ovary reveals it is divided into several chambers, with ovules attached to a central column. The pea pod, when opened along its seam, shows ovules attached in two neat rows along a single margin.

Question: Based on these observations, what are the respective types of placentation in the tomato and the pea?

1. Tomato: Parietal; Pea: Axile

2. Tomato: Axile; Pea: Marginal

3. Tomato: Basal; Pea: Free central

4. Tomato: Marginal; Pea: Basal

180. Scenario: You are given a mango and a coconut. While eating the mango, you consume the soft, fleshy pulp, leaving behind the hard "stone" inside. With the coconut, you find a thick, fibrous husk surrounding a hard, stony shell, and the edible part is the seed within.

Question: Both fruits are classified as drupes. The edible part of the mango and the fibrous husk of the coconut are homologous structures. Which layer of the pericarp do they both represent?

1. Epicarp

2. Mesocarp

3. Endocarp

4. Pericarp (undifferentiated)

181. Scenario: A food processing company wants to develop two new products: a high-protein flour from gram and a high-starch flour from maize. An intern observes that the gram seed splits easily into two fleshy parts, while the maize grain is a single, solid unit. A lab test confirms that the mature gram seed has its food reserves stored in its two large cotyledons, whereas the maize grain has a separate, bulky tissue for starch storage.

Question: What fundamental morphological difference explains the intern's observation?

1. Gram is a non-endospermous dicot seed, while maize is an endospermic monocot seed.

2. Gram is an endospermic dicot seed, while maize is a non-endospermous monocot seed.

3. Both are endospermic, but gram stores protein while maize stores starch.

4. Gram lacks a seed coat, making it easier to split.

182. Scenario: A pharmacologist is searching for new plant sources of alkaloids and is focusing on the

Solanaceae family, known for plants like belladonna and ashwagandha. She finds an unknown plant and, upon examining its flower, notes the following: five united sepals, five united petals, five stamens attached to the petals, and a superior ovary made of two fused carpels.

Question: Which floral formula correctly summarizes these observations, confirming the plant is likely a member of the Solanaceae family?

1. % ⚥ $K_5\ C_5\ A_{(5)}\ G_{(2)}$

2. ⊕ ⚥ $K_{(5)}\ C_{(5)}\ A_5\ G_{(2)}$

3. ⊕ ⚥ $K_{(5)}\ C_{(5)}\ A_{(5)}\ G_2$

4. % ⚥ $K_{(2+2)}\ C_4\ A_{2+4}\ G_{(2}$

DIAGNOSTIC PATHWAY

Instructions: For each question, a biological observation or premise is given. You must choose the option that presents a complete and correct logical pathway (Observation → Reason → Consequence) where each step is factually accurate and follows logically from the previous one.

183. Premise: A wheat plant is observed to be highly effective at controlling soil erosion on a farm.

1. Observation: Wheat plant controls soil erosion → Reason: It has a deep primary tap root that anchors the soil → Consequence: This makes it a characteristic dicot plant.

2. Observation: Wheat plant controls soil erosion → Reason: It possesses a dense, mat-like fibrous root system from the stem base → Consequence: This system effectively binds the surface soil particles.

3. Observation: Wheat plant controls soil erosion → Reason: It develops adventitious roots from the radicle → Consequence: These roots store large amounts of food, making the soil heavy.

4. Observation: Wheat plant controls soil erosion → Reason: Its primary root is short-lived → Consequence: This leads to poor anchorage and makes it unsuitable for preventing erosion.

184. Premise: The leaves of a hibiscus plant are seen fluttering significantly even in a gentle breeze.

1. Observation: Leaves flutter in the wind → Reason: The leaf lamina has parallel venation → Consequence: This structure provides flexibility for movement.

2. Observation: Leaves flutter in the wind → Reason: The leaf possesses a long, thin, flexible petiole → Consequence: This movement aids in cooling the leaf surface and bringing fresh air.

3. Observation: Leaves flutter in the wind → Reason: The leaf base is swollen into a pulvinus → Consequence: Turgor changes in the pulvinus cause the fluttering motion.

4. Observation: Leaves flutter in the wind → Reason: The leaf is pinnately compound → Consequence: The leaflets move independently, causing the entire leaf to flutter.

185. Premise: On a flowering stalk, the flowers at the base are open and mature, while the buds at the top are younger and still closed.

1. Observation: Older flowers are at the base, younger ones at the apex → Reason: This represents a basipetal succession → Consequence: The main axis terminates in a flower, showing limited growth.

2. Observation: Older flowers are at the base, younger ones at the apex → Reason: This is a characteristic of a cymose inflorescence → Consequence: The main axis shows indefinite growth.

3. Observation: Older flowers are at the base, younger ones at the apex → Reason: This represents an acropetal succession → Consequence: This is a racemose inflorescence where the main axis continues to grow.

4. Observation: Older flowers are at the base, younger ones at the apex → Reason: The floral meristem has condensed the axis → Consequence: The flower is solitary.

186. Premise: Upon dissecting a cucumber flower, it is observed that the sepals, petals, and stamens are attached at a level above the ovary.

1. Observation: Floral parts are above the ovary → Reason: The gynoecium occupies the highest position on the thalamus → Consequence: The flower is hypogynous with a superior ovary.

2. Observation: Floral parts are above the ovary → Reason: The thalamus rim is at the same level as the ovary → Consequence: The flower is perigynous with a half-inferior ovary.

3. Observation: Floral parts are above the ovary → Reason: The thalamus margin has grown upward, completely enclosing and fusing with the ovary → Consequence: The flower is epigynous with an inferior ovary.

4. Observation: Floral parts are above the ovary → Reason: The ovary is located below the other parts → Consequence: The flower is epigynous with a superior ovary.

187. Premise: An examination of a pea flower reveals its stamens are not all free, nor are they all fused into a single unit.

1. Observation: Stamens are arranged in a (9)+1 pattern → Reason: The stamens are united into two distinct bundles → Consequence: This condition is correctly termed diadelphous.

2. Observation: Stamens are arranged in a (9)+1 pattern → Reason: The stamens are united into a single bundle with one free → Consequence: This condition is a variant of monoadelphous.

3. Observation: Stamens are arranged in a (9)+1 pattern → Reason: The stamens are united into more than two bundles → Consequence: This condition is known as polyadelphous.

4. Observation: Stamens are arranged in a (9)+1 pattern → Reason: All ten stamens are free from each other → Consequence: This condition is known as polyandrous.

188. Premise: A cross-section of a tomato ovary shows it is divided into multiple chambers by septa, with ovules attached to a central column.

1. Observation: Ovary is multilocular with ovules on a central column → Reason: The ovules are borne on the inner wall of the ovary → Consequence: This is parietal placentation.

2. Observation: Ovary is multilocular with ovules on a central column → Reason: The placenta is axial → Consequence: This placentation is termed axile.

3. Observation: Ovary is multilocular with ovules on a central column → Reason: The placenta is axial but septa are absent → Consequence: This is free central placentation.

4. Observation: Ovary is multilocular with ovules on a central column → Reason: The placenta forms a ridge on the ventral suture → Consequence: This is marginal placentation.

189. Premise: A student observes that a mature bean seed, when split open, reveals two large, fleshy cotyledons but no separate, persistent endosperm.

1. Observation: The mature bean seed lacks endosperm → Reason: Endosperm never forms in bean plants → Consequence: The seed is classified as non-endospermous.

2. Observation: The mature bean seed lacks endosperm → Reason: The endosperm was completely consumed by the developing embryo → Consequence: The seed is correctly termed albuminous or endospermic.

3. Observation: The mature bean seed lacks endosperm → Reason: The food reserves are stored in the fleshy cotyledons after the endosperm is consumed → Consequence: The seed is correctly classified as non-endospermous or exalbuminous.

4. Observation: The mature bean seed lacks endosperm → Reason: The seed coat has absorbed the endosperm for its own nourishment → Consequence: The seed is therefore classified as exalbuminous.

ANSWER KEY

FOR PART 1: ACTIVE RECALL QUESTIONS

	1-a	2-a	3-a	4-a	5-a	6-b	7-c	8-d	9-b
10-b	11-d	12-d	13-d	14-c	15-b	16-c	17-b	18-c,	19-a
20-b	21-d	22-a	23-b	24-b	25-c	26-d	27-a	28-b	29-b
30-c	31-c	32-b	33-c	34-b	35-c	36-b	37-d	38-b	39-d
40-b	41-c	42-d	43-b	44-c	45-d	46-d	47-d	48-a	49-d
50-b	51-c	52-b	53-d	54-b	55-a	56-b	57-c	58-a	59-b
60-b	61-c	62-c	63-c	64-c	65-a	66-c	67-a	68-d,	69-b
70-b	71-c	72-d	73-d	74-d	75-c	76-b	77-d	78-c	79-b
80-b	81-b	82-c	83-a	84-b	85-c	86-b	87-d	88-c	89-b
90-d	91-c	92-a	93-a	94-c	95-b	96-c,	97-b	98-c	99-a
100-c	101-d	102-d	103-b	104-c	105-b	106-b	107-b	108-d	109-a
110-d,	111-b	112-b	113-c	114-a	115-a	116-c	117-c	118-b	119-b
120-d	121-b	122-b	123-b	124-b	125-a	126-c	127-c	128-d	129-d
130-b,	131-d	132-b	133-c	134-b	135-b	136-b	137-b	138-a	139-d
140-c	141-c	142-a	143-c	144-a	145-c,	146-b	147-c	148-d	149-a
150-b	151-d	152-b	153-c	154-d	155-c	156-a	157-b	158-b	159-c
160-b	161-b	162-c	163-d	164-b,	165-c	166-c	167-c	168-d	169-c
170-b	171-b	172-a	173-c	174-b	175-b	176-c	177-b	178-c	179-b
180-c	181-d	182-d	183-b	184-c	185-b	186-d	187-b	188-c	189-c
190-c	191-a	192-c	193-b	194-d	195-c	196-b	197-d	198-d	199-a
200-c	201-a	202-b	203-d	204-d	205-c	206-c	207-b	208-d	209-b
210-c	211-c	212-c	213-d	214-b	215-b	216-c	217-c	218-b	219-c
220-a	221-b	222-b	223-c	224-c	225-d	226-b	227-c	228-b	229-b
230-b	231-d	232-b	233-b	234-c	235-c	236-a	237-d	238-b	239-c
240-c	241-b	242-b	243-b	244-b	245-c	246-c	247-c	248-b	249-b
250-c	251-c	252-b	253-a	254-c	255-a	256-d	257-d	258-b	259-b

FOR PART 2 : NEET MASTERY QUESTIONS

Assertion-Reason

1-2	2-2	3-3	4-4	5-2	6-3	7-3	8-1	9-4	10-2
11-2	12-3	13-2	14-1	15-2	16-1	17-3	18-1	19-3	20-4
21-3	22-2	23-3	24-3	25-1	26-4	27-3	28-1	29-1	30-3
31-1	32-1	33-1	34-3	35-2	36-2	37-1	38-3	39-3	40-1
41-2	42-2	43-2	44-3	45-2	46-3	47-3	48-1	49-1	50-3
51-1	52-3	53-2	54-3	55-3	56-3	57-1	58-3	59-1	60-3
61-4	62-2	63-2	64-4	65-2					

Statement-Based

66-3	67-3	68-2	69-3	70-2	71-2	72-3	73-2	74-2	75-2
76-3	77-3	78-4	79-3	80-3	81-2	82-4	83-2	84-2	85-4
86-4	87-3	88-1	89-2	90-4	91-3	92-2	93-2	94-4	95-4
96-1	97-4	98-2	99-4	100-2	101-4	102-3	103-2	104-1	105-1
106-4	107-1	108-2	109-3	110-4	111-2	112-2	113-2	114-2	

Matching Type

115-1	116-4	117-2	118-1	119-3	120-3	121-1	122-2	123-1	124-4
125-3	126-1	127-4	128-3	129-3	130-1	131-4	132-4	133-1	134-2
135-3	136-3	137-3							

Data Anomaly

138-2	139-4	140-4	141-4	142-3	143-3	144-4	145-2	146-4

Sequence

147-2	148-1	149-3	150-2	151-2	152-3	153-2	154-2	155-2	156-2

Multi Correct

157-2	158-1	159-1	160-1	161-3	162-1	163-1	164-1	165-3	166-1

Flowchart / Process Completion

167-2	168-2	169-4	170-2	171-1	172-2	173-2	174-3

Scenario-Based

175-2	176-3	177-2	178-3	179-2	180-2	181-1	182-2

Diagnostic Pathway

183-2	184-2	185-3	186-3	187-1	188-2	189-3

JUSTIFICATIONS, OPTION ANALYSIS & CITATIONS

FOR PART 1 :ACTIVE RECALL QUESTIONS

1. **Justification:** The text explicitly states that all angiosperms are characterized by the presence of roots, stems, leaves, flowers, and fruits.
   Option Analysis: (b) Specific types not universal. (c, d) Include non-angiosperm features.
   (Source Line: "Even though the...")
2. **Justification:** The text lists adaptations for protection, climbing, storage, etc.
   Option Analysis: (b, c, d) These are too specific or incorrect functions for general adaptations of various parts.
   (Source Line: "We also need...")
3. **Justification:** The portion of the plant above the ground forms the shoot system.
   Option Analysis: (b) Root system is underground. (c, d) are parts of the overall systems, not the main division.
   (Source Line: "The underground part...")
4. **Justification:** The shoot system is the above-ground part, while the root system is the underground part. Statement (a) makes the opposite claim.
   Option Analysis: (b, c, d) are all correct statements.
   (Source Line: "The underground part...")
5. **Justification:** Statement I correctly states the diversity of angiosperms. Statement II correctly defines the root system. Both are accurate.
   Option Analysis: Both statements are correct as per the text.
   (Source Line: "Even though the...")

*****As inclusion of the entire *Justifications, Option Analysis & Citations* section in the physical book would occupy a lot more pages, for students' convenience this entire detailed section is available for download through the QR code present below.**

Chapter 14: Breathing And Exchange of Gases

KEY TOPICS (BASED ON PYQ ANALYSIS)

- **Transport of Oxygen:** The Oxyhaemoglobin dissociation curve and the factors that shift it (pCO2, H^+ concentration/Bohr effect, temperature).

- **Transport of Carbon Dioxide:** Transport as bicarbonate (role of carbonic anhydrase), as carbamino-haemoglobin, and dissolved in plasma.

- **Respiratory Volumes and Capacities:** Definitions and simple calculations of VC, FRC, IC, EC, TV, IRV, ERV, and RV.

- **Exchange of Gases:** Partial pressures (pO2 and pCO2) in alveoli, deoxygenated blood, oxygenated blood, and tissues (Table 14.1).

- **Mechanism of Breathing & Disorders:** The roles of the diaphragm and intercostal muscles in inspiration/expiration; disorders like Emphysema, Asthma.

QUICK REVISION SUMMARY TABLES

TABLE 1: KEY NUMERICAL DATA

Parameter	Value / Range	Unit
Division of Trachea (Vertebral Level)	5th	Thoracic Vertebra
Normal Breathing Rate	12 - 16	times/minute
Tidal Volume (TV)	~ 500	mL
Minute Ventilation	6000 - 8000	mL/minute
Inspiratory Reserve Volume (IRV)	2500 - 3000	mL
Expiratory Reserve Volume (ERV)	1000 - 1100	mL
Residual Volume (RV)	1100 - 1200	mL
Partial Pressure of O_2 (Atmosphere)	159	mm Hg

Partial Pressure of O_2 (Alveoli)	104	mm Hg
Partial Pressure of O_2 (Oxygenated Blood)	95	mm Hg
Partial Pressure of O_2 (Deoxygenated Blood)	40	mm Hg
Partial Pressure of O_2 (Tissues)	40	mm Hg
Partial Pressure of CO_2 (Atmosphere)	0.3	mm Hg
Partial Pressure of CO_2 (Alveoli)	40	mm Hg
Partial Pressure of CO_2 (Oxygenated Blood)	40	mm Hg
Partial Pressure of CO_2 (Deoxygenated Blood)	45	mm Hg
Partial Pressure of CO_2 (Tissues)	45	mm Hg
Solubility of CO_2 vs. O_2	20 - 25	times higher
Max O_2 molecules per Haemoglobin	4	molecules
O_2 transport by RBCs	~ 97	%
O_2 transport dissolved in plasma	~ 3	%
CO_2 transport as Bicarbonate	~ 70	%
CO_2 transport by RBCs (as Carbamino-Hb)	20 - 25	%
CO_2 transport dissolved in plasma	~ 7	%
O_2 delivered by 100 mL oxygenated blood	~ 5	mL
CO_2 delivered by 100 mL deoxygenated blood	~ 4	mL

TABLE 2: KEY TERMS, CLASSIFICATIONS & EXAMPLES

Category / Term	Definition / Classification	Examples / Key Features
Respiratory Organs	Mechanisms of breathing vary based on habitat and level of organisation.	**Entire Body Surface:** Sponges, Coelenterates, Flatworms **Moist Cuticle:** Earthworms **Tracheal Tubes:** Insects **Gills (Branchial):** Aquatic Arthropods, Molluscs, Fishes **Lungs (Pulmonary):** Terrestrial forms, Amphibians, Reptiles, Birds, Mammals **Moist Skin (Cutaneous):** Amphibians (e.g., Frogs)
Human Air Passage	The path air takes from the nostrils to the alveoli.	Nostrils → Nasal Passage → Nasal Chamber → Pharynx → Larynx → Trachea → Primary, Secondary, Tertiary Bronchi → Bronchioles → Terminal Bronchioles → Alveoli
Functional Parts	Division of the respiratory system based on function.	**Conducting Part:** Nostrils to terminal bronchioles (transports, filters, humidifies air). **Exchange/Respiratory Part:** Alveoli and their ducts (site of gas diffusion).
Thoracic Chamber	The air-tight chamber housing the lungs.	**Boundaries:** Dorsal (vertebral column), Ventral (sternum), Lateral (ribs), Lower (diaphragm).
Pleura	Double-layered membrane covering the lungs.	**Outer (Parietal) Pleura:** Lines thoracic cavity. **Inner (Visceral) Pleura:** Adheres to lung surface. **Pleural Fluid:** Reduces friction.
Respiratory Volumes	Volumes of air measured by spirometry.	**TV:** Normal breath (~500 mL) **IRV:** Forcible inspiration volume **ERV:** Forcible expiration volume **RV:** Air remaining after forcible expiration
Respiratory Capacities	Sums of two or more respiratory volumes.	**IC:** TV + IRV **EC:** TV + ERV **FRC:** ERV + RV **VC:** ERV + TV + IRV **TLC:** VC + RV
Diffusion Membrane	The three layers across which gas exchange occurs.	1. Thin squamous epithelium of alveoli 2. Endothelium of alveolar capillaries 3. Basement substance between them
Gas Transport	The primary forms in which respiratory gases are carried in the blood.	**Oxygen:** Oxyhaemoglobin (97%) **Carbon Dioxide:** Bicarbonate ions (70%), Carbamino-haemoglobin (20-25%)
Key Proteins/Enzymes	Molecules crucial for gas transport.	**Haemoglobin:** Iron-containing pigment in RBCs for O_2 and CO_2 transport.

		Carbonic Anhydrase: Enzyme in RBCs that converts CO_2 and H_2O to H_2CO_3.
Regulation Centres	Neural centres in the brain that control breathing.	**Respiratory Rhythm Centre:** Medulla (primary control) **Pneumotaxic Centre:** Pons (moderates/alters rate) **Chemosensitive Area:** Medulla (senses CO_2, H^+)
Peripheral Receptors	Receptors outside the CNS that aid in regulation.	Located in the Aortic arch and Carotid artery; sense changes in CO_2 and H^+.
Disorders	Ailments of the respiratory system.	**Asthma:** Inflammation of bronchi and bronchioles. **Emphysema:** Damage to alveolar walls, decreased surface area (major cause: smoking). **Occupational Disorders:** Inflammation and Fibrosis due to dust exposure.

PART 1: ACTIVE RECALL QUESTIONS

THIS PART CONTAINS ACTIVE RECALL QUESTIONS GENERATED FROM EVERY TESTABLE ELEMENT OF THE NCERT TEXT, INCLUDING FACTS, DATA, AND DIAGRAMS. THE QUESTIONS ARE PRESENTED IN SEQUENTIAL ORDER AND SUBDIVIDED ACCORDING TO NCERT CHAPTERS AND SUBHEADINGS. DESIGNED AS A **DIRECT REVISION TOOL**, THIS SECTION **MINIMIZES THE NEED FOR REPEATED READINGS OF THE TEXTBOOK.**

AT THE END OF EACH SUBHEADING, A SET OF HIGHER-ORDER THINKING SKILLS (HOTS) QUESTIONS IS PROVIDED TO STRENGTHEN CONCEPTUAL APPLICATION.

SECTION A: TEXT-BASED MCQS

CHAPTER INTRODUCTION

1. The primary purpose for which organisms utilize oxygen is to
a) directly synthesize complex molecules like proteins.
b) facilitate the indirect breakdown of simple molecules for energy.
c) remove harmful substances like carbon dioxide from the cells.
d) create a pressure gradient for the intake of atmospheric air.

2. During the catabolic reactions that provide energy for various activities, a substance that is considered harmful and is also released is
a) lactic acid.
b) ammonia.
c) carbon dioxide.
d) water vapor.

3. The process of exchanging atmospheric oxygen with the carbon dioxide produced by cells is known as
a) cellular respiration.
b) pulmonary ventilation.
c) breathing.
d) tissue perfusion.

4. Which of the following statements is not incorrect regarding the need for continuous gas exchange?
a) Cells need a constant supply of CO_2 for metabolic processes.
b) The build-up of O_2 in cells can become toxic over time.
c) O_2 is required by cells for energy-yielding reactions, and the CO_2 by-product must be removed.
d) Atmospheric air has a higher concentration of CO_2 than the air within the cells.

5. Select the correct statements regarding the fundamental aspects of respiration.
i. Oxygen is used to indirectly break down molecules like glucose and amino acids.
ii. Energy is derived from the anabolic build-up of fatty acids using oxygen.
iii. Carbon dioxide, a useful substance, is released during catabolic reactions.
iv. The process of exchanging O_2 from the atmosphere with CO_2 from cells is called breathing.
a) i and ii
b) i and iv
c) ii and iii
d) iii and iv

14.1 RESPIRATORY ORGANS

6. The mechanisms of breathing among different animal groups are observed to vary principally based on their
a) body size and diet.
b) habitats and levels of organisation.
c) mode of reproduction and circulatory system.
d) nervous system complexity and locomotion.

7. Which of the following organisms perform the exchange of O_2 with CO_2 through simple diffusion across their entire body surface?
a) Earthworms and insects
b) Sponges, coelenterates, and flatworms
c) Aquatic arthropods and molluscs
d) Amphibians and reptiles

8. The respiratory structure utilized by earthworms for gaseous exchange is their
a) tracheal tubes.
b) vascularised gills.
c) dry cuticle.
d) moist cuticle.

9. Insects have a network of tubes to transport atmospheric air directly within the body. These tubes are known as
a) branchial tubes.
b) pulmonary sacs.
c) tracheal tubes.
d) cutaneous pores.

10. The type of respiration that involves special vascularised structures called gills, as seen in most aquatic arthropods and molluscs, is termed
a) pulmonary respiration.
b) branchial respiration.
c) cutaneous respiration.
d) tracheal respiration.

11. Terrestrial forms of animals typically use vascularised bags for the exchange of gases. This mechanism is referred to as
a) branchial respiration.
b) integumentary respiration.
c) pulmonary respiration.
d) diffused respiration.

12. Among vertebrates, all of the following respire through lungs, EXCEPT
a) reptiles.
b) birds.
c) fishes.
d) mammals.

13. Amphibians, such as frogs, possess the ability to respire through their lungs and also through their
a) dry scales, known as scaly respiration.
b) internal gills, known as pharyngeal respiration.
c) moist skin, known as cutaneous respiration.
d) buccal cavity lining, known as buccal respiration.

14. Match the organism in Column I with its corresponding respiratory organ/mechanism in Column II.
Column I	Column II
(A) Flatworms	(i) Tracheal tubes
(B) Insects	(ii) Gills
(C) Fishes	(iii) Entire body surface
(D) Birds	(iv) Lungs
Select the correct option:
a) A-(iii), B-(i), C-(ii), D-(iv)
b) A-(ii), B-(iv), C-(i), D-(iii)
c) A-(iii), B-(ii), C-(iv), D-(i)
d) A-(i), B-(iii), C-(ii), D-(iv)

15. Consider the following statements:
Statement 1: Lower invertebrates like sponges and coelenterates exchange gases via simple diffusion.
Statement 2: The respiratory organs in animals are adapted to their specific habitats.
Statement 3: All vertebrates use lungs for respiration.
Statement 4: Respiration through moist skin is called branchial respiration.
Identify the correct combination of statements.
a) Statements 1 and 2
b) Statements 2 and 3
c) Statements 3 and 4
d) Statements 1 and 4

16. Assertion (A): Earthworms can only respire effectively in a moist environment.
Reason (R): Gaseous exchange in earthworms occurs through their moist cuticle via diffusion.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

14.1.1 HUMAN RESPIRATORY SYSTEM

17. The human respiratory system begins with a pair of external openings located
a) below the lower lips.
b) above the upper lips.
c) in the buccal cavity.
d) lateral to the orbits.

18. In the human respiratory pathway, the nasal passage leads from the external nostrils to the
a) trachea.
b) larynx.
c) nasal chamber.
d) alveoli.

19. The portion of the respiratory tract that serves as a common passage for both food and air is the
a) larynx.
b) pharynx.
c) trachea.
d) oesophagus.

20. The cartilaginous structure, also known as the sound box, that helps in sound production is the
a) pharynx.
b) epiglottis.
c) glottis.
d) larynx.

21. The entry of food into the larynx is prevented by a thin elastic cartilaginous flap called the
a) glottis.
b) epiglottis.

c) pleura.
d) arytenoid cartilage.

22. The trachea is a straight tube that extends up to the mid-thoracic cavity and divides into right and left primary bronchi at the level of the
a) 2nd thoracic vertebra.
b) 5th thoracic vertebra.
c) 7th cervical vertebra.
d) 1st lumbar vertebra.

23. The correct sequence of the air passage in the lungs after the primary bronchi is
a) terminal bronchioles —> secondary bronchi —> tertiary bronchi —> bronchioles.
b) secondary bronchi —> tertiary bronchi —> bronchioles —> terminal bronchioles.
c) tertiary bronchi —> secondary bronchi —> terminal bronchioles —> bronchioles.
d) secondary bronchi —> bronchioles —> tertiary bronchi —> terminal bronchioles.

24. All of the following structures in the human respiratory system are supported by incomplete cartilaginous rings, EXCEPT
a) trachea.
b) primary bronchi.
c) tertiary bronchi.
d) terminal bronchioles.

25. Each terminal bronchiole gives rise to numerous thin, irregular-walled, vascularised bag-like structures known as
a) pleura.
b) alveoli.
c) cisternae.
d) follicles.

26. The lungs in humans are covered by a double-layered membrane called the pleura. The fluid present between these layers is known as
a) pericardial fluid.
b) synovial fluid.
c) pleural fluid.
d) cerebrospinal fluid.

27. The primary function of the fluid present between the membranes covering the lungs is to
a) facilitate gas exchange.
b) reduce friction on the lung surface.
c) provide rigidity to the lungs.
d) help in sound production.

28. Regarding the pleural membranes, the outer membrane is in close contact with the _____, while the inner membrane is in contact with the _____.
a) lung surface; thoracic lining
b) diaphragm; lung surface
c) thoracic lining; lung surface
d) lung surface; diaphragm

29. The part of the human respiratory system starting from the external nostrils up to the terminal bronchioles is referred to as the
a) exchange part.
b) respiratory part.
c) vascularised part.
d) conducting part.

30. The respiratory or exchange part of the respiratory system is constituted by the
a) trachea and its primary branches.
b) alveoli and their ducts.
c) external nostrils up to the larynx.
d) secondary and tertiary bronchioles.

31. Which of the following is not a function of the conducting part of the respiratory system?
a) Transporting atmospheric air to the alveoli
b) Clearing the inhaled air from foreign particles
c) Humidifying the atmospheric air
d) Diffusion of O_2 and CO_2 between blood and air

32. The actual site for the diffusion of gases between blood and atmospheric air in the respiratory system is the
a) conducting part.
b) tracheal part.
c) exchange part.
d) nasal part.

33. Anatomically, the thoracic chamber, which houses the lungs, is considered to be
a) a partially open chamber.
b) an air-tight chamber.
c) a fluid-filled chamber.
d) a flexible, muscular pouch.

34. The thoracic chamber is formed ventrally by the sternum, dorsally by the vertebral column, and laterally by the
a) clavicles.
b) ribs.
c) scapulae.
d) floating ribs only.

35. The dome-shaped structure that forms the lower boundary of the thoracic chamber is the
a) sternum.
b) diaphragm.
c) pelvic girdle.
d) oesophagus.

36. The anatomical setup of the lungs is such that any change in the volume of the thoracic cavity is

reflected in the lung cavity, also known as the
a) pleural cavity.
b) pericardial cavity.
c) pulmonary cavity.
d) abdominal cavity.

37. The arrangement of the lungs within the thoracic cavity is essential for breathing because humans
a) can directly alter the thoracic volume but not the pulmonary volume.
b) can directly alter the pulmonary volume but not the thoracic volume.
c) lack muscles to change the volume of the thorax.
d) can only breathe by contracting the alveolar walls directly.

38. Arrange the following steps of respiration in the correct sequential order:
i. Diffusion of gases across the alveolar membrane.
ii. Utilisation of O_2 by cells for catabolism.
iii. Transport of gases by the blood.
iv. Pulmonary ventilation.
v. Diffusion of O_2 and CO_2 between blood and tissues.
a) iv —> i —> iii —> v —> ii
b) iv —> iii —> i —> v —> ii
c) i —> iv —> iii —> ii —> v
d) ii —> v —> iii —> i —> iv

39. Identify the incorrect statement regarding the human respiratory system.
a) The larynx is a cartilaginous box that aids in sound production.
b) The trachea divides into primary bronchi at the level of the 5th thoracic vertebra.
c) The outer pleural membrane is in direct contact with the surface of the lungs.
d) The epiglottis prevents food from entering the trachea during swallowing.

40. Assertion (A): The conducting part of the respiratory system plays no role in the diffusion of gases.
Reason (R): Its functions include clearing, humidifying, and bringing the incoming atmospheric air to body temperature.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

41. Match the structure in Column I with its correct description or function in Column II.
Column I	Column II
(A) Pharynx	(i) Bag-like structure for gas exchange
(B) Epiglottis	(ii) Reduces friction on lung surface
(C) Alveoli	(iii) Covers the glottis during swallowing
(D) Pleural Fluid	(iv) Common passage for food and air

Select the correct option:
a) A-(iv), B-(iii), C-(i), D-(ii)
b) A-(ii), B-(i), C-(iv), D-(iii)
c) A-(iv), B-(i), C-(ii), D-(iii)
d) A-(iii), B-(iv), C-(i), D-(ii)

14.2 MECHANISM OF BREATHING

42. The two distinct stages involved in the process of breathing are
a) inhalation and perfusion.
b) inspiration and expiration.
c) ventilation and diffusion.
d) contraction and relaxation.

43. The movement of air into and out of the lungs is fundamentally driven by the creation of a
a) temperature gradient.
b) humidity gradient.
c) pressure gradient.
d) solubility gradient.

44. Inspiration occurs when the pressure within the lungs, known as intra-pulmonary pressure, is
a) equal to the atmospheric pressure.
b) slightly higher than the atmospheric pressure.
c) significantly higher than the atmospheric pressure.
d) less than the atmospheric pressure.

45. For expiration to take place, the intra-pulmonary pressure must be
a) lower than the atmospheric pressure.
b) equal to the pressure in the pleural cavity.
c) higher than the atmospheric pressure.
d) equal to the atmospheric pressure.

46. The generation of pressure gradients for breathing is primarily accomplished by the diaphragm and a specialized set of muscles called the
a) abdominal muscles.
b) oblique muscles.
c) intercostal muscles.
d) pectoral muscles.

47. The initiation of inspiration involves the contraction of the diaphragm, which leads to an increase in the volume of the thoracic chamber in the
a) dorso-ventral axis.

b) antero-posterior axis.
c) lateral axis.
d) vertical axis.

48. During inspiration, the contraction of which muscles lifts up the ribs and sternum, causing an increase in the thoracic volume in the dorso-ventral axis?
a) Internal inter-costal muscles
b) External inter-costal muscles
c) Abdominal muscles
d) Diaphragm

49. An overall increase in the thoracic volume results in a corresponding
a) decrease in pulmonary volume.
b) increase in pulmonary volume.
c) increase in intra-pleural pressure.
d) decrease in tidal volume.

50. The sequence of events leading to inspiration is an increase in pulmonary volume which
a) increases the intra-pulmonary pressure above atmospheric pressure.
b) decreases the intra-pulmonary pressure to less than atmospheric pressure.
c) makes the intra-pulmonary pressure equal to the atmospheric pressure.
d) increases the pressure within the pleural cavity.

51. Normal expiration is achieved by the relaxation of the
a) diaphragm and external inter-costal muscles.
b) diaphragm and internal inter-costal muscles.
c) internal inter-costal muscles only.
d) abdominal muscles and internal inter-costal muscles.

52. The expulsion of air from the lungs during expiration is caused by an increase in intra-pulmonary pressure that is
a) slightly below the atmospheric pressure.
b) equal to the atmospheric pressure.
c) slightly above the atmospheric pressure.
d) maintained by muscular contraction.

53. The strength of both inspiration and expiration can be increased with the help of additional muscles located in the
a) neck.
b) back.
c) shoulders.
d) abdomen.

54. A healthy human breathes approximately how many times per minute on average?
a) 8-10
b) 12-16
c) 20-25
d) 25-30

55. The instrument used for the clinical assessment of pulmonary functions by estimating the volume of air involved in breathing movements is the
a) stethoscope.
b) sphygmomanometer.
c) electrocardiograph.
d) spirometer.

56. Which of the following statements about the mechanism of normal inspiration is incorrect?
a) The diaphragm contracts.
b) The volume of the thoracic chamber increases in the antero-posterior axis.
c) The external inter-costal muscles contract.
d) The intra-pulmonary pressure increases above the atmospheric pressure.

57. Assertion (A): During inspiration, the volume of the thoracic cavity increases.
Reason (R): This is caused by the contraction of the diaphragm and the external intercostal muscles.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

58. Consider the following events:
i. Relaxation of diaphragm and inter-costal muscles.
ii. Reduction in thoracic and pulmonary volume.
iii. Increase in intra-pulmonary pressure.
iv. Expulsion of air from the lungs.
Select the option that correctly represents the sequence for normal expiration.
a) i —> ii —> iii —> iv
b) ii —> i —> iii —> iv
c) iv —> iii —> ii —> i
d) iii —> i —> ii —> iv

14.2.1 RESPIRATORY VOLUMES AND CAPACITIES

59. The volume of air that is inspired or expired during a normal, quiet respiration is known as the
a) Inspiratory Reserve Volume (IRV).
b) Residual Volume (RV).
c) Tidal Volume (TV).
d) Expiratory Reserve Volume (ERV).

60. The approximate value of Tidal Volume for a healthy human is
a) 100 mL.
b) 500 mL.

c) 1000 mL.
d) 2500 mL.

61. A healthy individual can inspire or expire approximately how much volume of air per minute?
a) 1000 to 2000 mL
b) 3000 to 4000 mL
c) 6000 to 8000 mL
d) 10000 to 12000 mL

62. The additional volume of air that a person can inspire by a forceful inspiration, over and above the tidal volume, is the
a) Vital Capacity (VC).
b) Inspiratory Capacity (IC).
c) Inspiratory Reserve Volume (IRV).
d) Total Lung Capacity (TLC).

63. The average value for Inspiratory Reserve Volume (IRV) is in the range of
a) 500 mL to 1000 mL.
b) 1000 mL to 1100 mL.
c) 1100 mL to 1200 mL.
d) 2500 mL to 3000 mL.

64. The additional volume of air that can be expired by a forcible expiration after a normal expiration is termed
a) Residual Volume (RV).
b) Expiratory Reserve Volume (ERV).
c) Tidal Volume (TV).
d) Functional Residual Capacity (FRC).

65. The Expiratory Reserve Volume (ERV) in an average healthy person is approximately
a) 500 mL.
b) 1000 mL to 1100 mL.
c) 1500 mL to 2000 mL.
d) 2500 mL to 3000 mL.

66. The volume of air that remains in the lungs even after a forcible expiration is called the
a) Vital Capacity (VC).
b) Tidal Volume (TV).
c) Dead Space Air.
d) Residual Volume (RV).

67. The average value for the volume of air remaining in the lungs after a maximal forced expiration is
a) 500 mL.
b) 1000 mL.
c) 1100 mL to 1200 mL.
d) 2500 mL.

68. The total volume of air a person can inspire after a normal expiration is defined as the
a) Inspiratory Capacity (IC).
b) Vital Capacity (VC).
c) Inspiratory Reserve Volume (IRV).
d) Total Lung Capacity (TLC).

69. Inspiratory Capacity (IC) is the sum of which two volumes?
a) Tidal Volume and Expiratory Reserve Volume (TV + ERV)
b) Tidal Volume and Inspiratory Reserve Volume (TV + IRV)
c) Inspiratory Reserve Volume and Expiratory Reserve Volume (IRV + ERV)
d) Expiratory Reserve Volume and Residual Volume (ERV + RV)

70. The total volume of air a person can expire after a normal inspiration is referred to as the
a) Expiratory Reserve Volume (ERV).
b) Functional Residual Capacity (FRC).
c) Vital Capacity (VC).
d) Expiratory Capacity (EC).

71. Which of the following correctly represents the Expiratory Capacity (EC)?
a) TV + IRV
b) ERV + RV
c) TV + ERV
d) IRV + ERV

72. The volume of air that will remain in the lungs after a normal expiration is known as the
a) Residual Volume (RV).
b) Expiratory Capacity (EC).
c) Functional Residual Capacity (FRC).
d) Vital Capacity (VC).

73. Functional Residual Capacity (FRC) is correctly expressed as the sum of
a) ERV + RV.
b) TV + RV.
c) TV + ERV.
d) IC + RV.

74. The maximum volume of air a person can breathe in after a forced expiration is the
a) Total Lung Capacity.
b) Inspiratory Capacity.
c) Vital Capacity.
d) Functional Residual Capacity.

75. Which of the following equations correctly represents Vital Capacity (VC)?
a) TV + IRV
b) TV + ERV + RV
c) ERV + TV + IRV
d) TV + FRC

76. The total volume of air accommodated in the lungs at the end of a forced inspiration is known as the

a) Vital Capacity (VC).
b) Total Lung Capacity (TLC).
c) Inspiratory Capacity (IC).
d) Functional Residual Capacity (FRC).

77. Total Lung Capacity (TLC) can be described as
a) Vital Capacity + Residual Volume.
b) Vital Capacity - Residual Volume.
c) Inspiratory Capacity + Functional Residual Capacity.
d) Expiratory Capacity + Inspiratory Reserve Volume.

78. Which one of the following is the correct matching of a respiratory volume/capacity with its average value?
a) Tidal Volume: 1000 mL
b) Inspiratory Reserve Volume: 1100 mL
c) Expiratory Reserve Volume: 2500 mL
d) Residual Volume: 1200 mL

79. Find the mismatch from the following pairs.
a) Inspiratory Capacity = TV + IRV
b) Expiratory Capacity = TV + ERV
c) Functional Residual Capacity = IRV + RV
d) Vital Capacity = ERV + TV + IRV

80. Assertion (A): Vital Capacity represents the maximum amount of air that can be exchanged in a single breath.
Reason (R): It is the sum of the tidal volume, inspiratory reserve volume, and expiratory reserve volume.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

81. Which of the following pulmonary capacities can be calculated by adding the Expiratory Reserve Volume to the Residual Volume?
a) Vital Capacity
b) Functional Residual Capacity
c) Total Lung Capacity
d) Expiratory Capacity

82. A person's Tidal Volume is 500 mL and their breathing rate is 14 breaths/minute. If their Inspiratory Reserve Volume is 2800 mL, what is their Inspiratory Capacity (IC)?
a) 3300 mL
b) 2300 mL
c) 7000 mL
d) 3500 mL

14.3 EXCHANGE OF GASES

83. The primary sites for the exchange of gases within the respiratory system are the
a) terminal bronchioles.
b) pleural membranes.
c) alveoli.
d) trachea.

84. In addition to the lungs, the exchange of gases also takes place between the
a) blood and interstitial fluid.
b) blood and tissues.
c) atmospheric air and the nasal chamber.
d) conducting part and the exchange part.

85. The exchange of O_2 and CO_2 at the sites of diffusion occurs via the process of
a) active transport.
b) simple diffusion.
c) facilitated diffusion.
d) osmosis.

86. The rate of gaseous diffusion is primarily dependent on the pressure/concentration gradient, and also on the
a) temperature and pH of the blood.
b) velocity of blood flow.
c) solubility of gases and thickness of the membranes.
d) number of red blood cells.

87. The pressure contributed by an individual gas in a mixture of gases is referred to as its
a) total pressure.
b) osmotic pressure.
c) absolute pressure.
d) partial pressure.

88. The representation used for the partial pressure of oxygen and carbon dioxide is, respectively,
a) POX and PCD.
b) p_ox and p_cd.
c) pO_2 and pCO_2.
d) $P(O_2)$ and $P(CO_2)$.

89. A concentration gradient for oxygen exists, facilitating its movement from the
a) blood to alveoli and then to tissues.
b) tissues to blood and then to alveoli.
c) alveoli to blood and then to tissues.
d) blood to tissues and then to alveoli.

90. The partial pressure gradient for carbon dioxide drives its movement from the
a) alveoli to blood, and then from blood to tissues.
b) tissues to blood, and then from blood to alveoli.

c) atmosphere to blood, and then from blood to tissues.
d) tissues to alveoli directly.

91. The solubility of carbon dioxide is approximately how many times higher than that of oxygen?
a) 2-3 times
b) 5-10 times
c) 20-25 times
d) 50-100 times

92. Due to its higher solubility, the amount of CO_2 that can diffuse through the diffusion membrane per unit difference in partial pressure is
a) much lower compared to that of O_2.
b) slightly lower compared to that of O_2.
c) equal to that of O_2.
d) much higher compared to that of O_2.

93. The diffusion membrane is composed of three major layers. Which of the following is not one of these layers?
a) The thin squamous epithelium of alveoli
b) The ciliated columnar epithelium of bronchioles
c) The endothelium of alveolar capillaries
d) The basement substance in between the epithelium and endothelium

94. The basement substance that lies between the alveolar epithelium and the capillary endothelium consists of
a) a single thick layer of collagen fibres.
b) two distinct basement membranes.
c) loose connective tissue with mast cells.
d) a layer of cuboidal epithelial cells.

95. The total thickness of the diffusion membrane at the respiratory surface is
a) more than a centimetre.
b) approximately one centimetre.
c) much less than a millimetre.
d) exactly one millimetre.

96. Identify the correct statement regarding the exchange of gases.
a) The primary site of gas exchange is the terminal bronchiole.
b) Gas exchange occurs by active transport requiring ATP.
c) The total thickness of the diffusion membrane is less than a millimeter.
d) Oxygen is 20-25 times more soluble in blood than carbon dioxide.

97. Assertion (A): All factors in the human body are favourable for the diffusion of O_2 from alveoli to tissues.
Reason (R): The diffusion membrane is very thin, and there is a steep partial pressure gradient for O_2 between alveoli and blood, and between blood and tissues.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

98. Even though the difference in partial pressure for CO_2 across the diffusion membrane is less compared to O_2, a large amount of CO_2 is exchanged. This is because
a) CO_2 can be actively transported.
b) the diffusion membrane is more permeable to CO_2.
c) CO_2 has a much higher solubility than O_2.
d) CO_2 is a smaller molecule than O_2.

14.4 TRANSPORT OF GASES

99. The primary medium for the transport of respiratory gases like O_2 and CO_2 in the human body is
a) lymph.
b) blood.
c) interstitial fluid.
d) synovial fluid.

100. Approximately what percentage of total oxygen is transported by being bound to haemoglobin in red blood cells?
a) 3%
b) 20-25%
c) 70%
d) 97%

101. A small fraction of oxygen, about 3 %, is transported from the lungs to the tissues
a) as oxyhaemoglobin.
b) in a dissolved state through the plasma.
c) as bicarbonate ions.
d) bound to albumin in plasma.

102. Nearly 20-25 % of carbon dioxide is transported in the blood
a) in a dissolved state in plasma.
b) as carbonic acid.
c) by being bound to haemoglobin in RBCs.
d) as bicarbonate ions.

103. The majority of carbon dioxide, approximately 70 %, is transported through the blood in the form of
a) carbamino-haemoglobin.

b) dissolved CO_2.
c) bicarbonate.
d) carboxyhaemoglobin.

104. What percentage of carbon dioxide is carried in a dissolved state through the blood plasma?
a) 3%
b) 7%
c) 25%
d) 70%

105. Match the gas with its correct percentage of transport in a specific form.
Gas & Form	Percentage
(A) O_2 by RBCs	(i) 70%
(B) CO_2 by RBCs	(ii) 97%
(C) CO_2 as bicarbonate	(iii) 7%
(D) CO_2 dissolved in plasma	(iv) 20-25%

Select the correct option:

a) A-(ii), B-(iv), C-(i), D-(iii)

b) A-(i), B-(ii), C-(iii), D-(iv)

c) A-(ii), B-(i), C-(iv), D-(iii)

d) A-(iv), B-(iii), C-(ii), D-(i)

14.4.1 TRANSPORT OF OXYGEN

106. Haemoglobin, present in RBCs, is a
a) blue coloured copper containing pigment.
b) red coloured iron containing pigment.
c) red coloured magnesium containing pigment.
d) colourless iron containing protein.

107. The binding of oxygen with haemoglobin is a reversible process that results in the formation of
a) carboxyhaemoglobin.
b) methaemoglobin.
c) oxyhaemoglobin.
d) carbamino-haemoglobin.

108. A single molecule of haemoglobin can carry a maximum of how many molecules of oxygen?
a) One
b) Two
c) Four
d) Eight

109. The binding of oxygen to haemoglobin is primarily influenced by the
a) partial pressure of O_2.
b) partial pressure of N_2.
c) concentration of bicarbonate ions.
d) temperature of the plasma.

110. Which of the following factors does not interfere with the binding of oxygen to haemoglobin?
a) Partial pressure of CO_2
b) Hydrogen ion concentration
c) Temperature
d) Partial pressure of N_2

111. When the percentage saturation of haemoglobin with oxygen is plotted against the partial pressure of oxygen, the resulting curve is
a) linear.
b) hyperbolic.
c) sigmoid.
d) bell-shaped.

112. The oxygen dissociation curve is highly useful for studying the effect of various factors on the
a) formation of carbon dioxide.
b) binding of oxygen with haemoglobin.
c) rate of breathing.
d) solubility of nitrogen in blood.

113. Which set of conditions is favourable for the formation of oxyhaemoglobin in the alveoli?
a) High pO_2, high pCO_2, high H^+ concentration
b) High pO_2, low pCO_2, lesser H^+ concentration
c) Low pO_2, low pCO_2, lesser H^+ concentration
d) Low pO_2, high pCO_2, high H^+ concentration

114. The dissociation of oxygen from oxyhaemoglobin at the tissue level is favoured by
a) low pO_2 and low temperature.
b) high pCO_2 and lesser H^+ concentration.
c) high temperature and low pCO_2.
d) low pO_2 and high pCO_2.

115. Oxygen gets bound to haemoglobin at the _____ and gets dissociated at the _____.
a) tissues; lung surface
b) lung surface; tissues
c) tissues; tissues
d) lung surface; lung surface

116. Under normal physiological conditions, every 100 ml of oxygenated blood can deliver approximately how much oxygen to the tissues?
a) 1 ml
b) 5 ml
c) 15 ml
d) 20 ml

117. Identify the incorrect statement regarding the transport of oxygen.
a) Each haemoglobin molecule can transport a maximum of four oxygen molecules.
b) High H^+ concentration in tissues favours the dissociation of oxyhaemoglobin.

c) About 97% of oxygen is transported in a dissolved state in the plasma.
d) In the alveoli, high pO_2 is a key factor for the formation of oxyhaemoglobin.

118. Assertion (A): The oxygen-haemoglobin dissociation curve is sigmoid in shape.
Reason (R): The binding of the first oxygen molecule to haemoglobin increases the affinity of the remaining subunits for oxygen, a phenomenon known as cooperative binding.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

119. A shift of the oxygen dissociation curve to the right signifies
a) increased affinity of haemoglobin for oxygen.
b) conditions found in the alveoli.
c) decreased affinity of haemoglobin for oxygen.
d) a decrease in pCO_2.

14.4.2 TRANSPORT OF CARBON DIOXIDE

120. When carbon dioxide binds to haemoglobin, the resulting compound is called
a) carboxyhaemoglobin.
b) oxyhaemoglobin.
c) carbamino-haemoglobin.
d) methaemoglobin.

121. The binding of carbon dioxide with haemoglobin is primarily related to the
a) partial pressure of O_2.
b) partial pressure of CO_2.
c) concentration of H^+ ions.
d) plasma temperature.

122. A major factor that can affect the binding of CO_2 with haemoglobin is the
a) partial pressure of nitrogen.
b) concentration of plasma proteins.
c) partial pressure of oxygen.
d) number of white blood cells.

123. The formation of carbamino-haemoglobin is favored by which conditions found in the tissues?
a) High pCO_2 and high pO_2
b) Low pCO_2 and high pO_2
c) High pCO_2 and low pO_2
d) Low pCO_2 and low pO_2

124. The dissociation of carbon dioxide from carbamino-haemoglobin is promoted by which conditions found in the alveoli?
a) Low pCO_2 and high pO_2
b) High pCO_2 and low pO_2
c) Low pCO_2 and low pO_2
d) High pCO_2 and high pO_2

125. The enzyme carbonic anhydrase, which facilitates the transport of CO_2, is found in very high concentration in
a) blood plasma only.
b) white blood cells.
c) red blood cells.
d) blood platelets.

126. The reversible reaction, $CO_2+H_2O \leftrightarrow H_2CO_3 \leftrightarrow HCO_3^- + H^+$, is catalyzed in both directions by the enzyme
a) carboxylase.
b) haemoglobin.
c) plasma anhydrase.
d) carbonic anhydrase.

127. At the tissue site, where pCO_2 is high due to catabolism, CO_2 diffuses into the blood and is converted into
a) haemoglobin and oxygen.
b) bicarbonate and hydrogen ions.
c) urea and water.
d) carbonic acid only.

128. At the alveolar site, where pCO_2 is low, the carbonic anhydrase-mediated reaction proceeds in the opposite direction, leading to the formation of
a) HCO_3^- and H^+.
b) carbamino-haemoglobin.
c) CO_2 and H_2O.
d) oxyhaemoglobin.

129. The process of trapping carbon dioxide as bicarbonate at the tissue level for transport to the alveoli allows it to be
a) released out as bicarbonate.
b) converted to oxygen.
c) released out as CO_2.
d) stored in the lungs.

130. Approximately how much carbon dioxide is delivered by every 100 ml of deoxygenated blood to the alveoli?
a) 1 ml
b) 4 ml
c) 5 ml
d) 10 ml

131. Identify the incorrect statement concerning the transport of carbon dioxide.
a) The majority of CO_2 is transported as bicarbonate ions.
b) High pO_2 in the alveoli favors the dissociation of carbamino-haemoglobin.
c) The enzyme carbonic anhydrase is exclusively found in blood plasma.
d) About 20-25% of CO_2 is carried by haemoglobin.

132. Assertion (A): In the tissues, the binding of CO_2 to haemoglobin is favored.
Reason (R): The partial pressure of O_2 is low and the partial pressure of CO_2 is high in the tissues.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

133. The formation of bicarbonate and hydrogen ions from CO_2 in the blood occurs primarily within the
a) red blood cells.
b) blood plasma.
c) leukocytes.
d) lumen of the capillaries.

134. Which of the following correctly describes the events of CO_2 transport at the level of the alveoli?
a) Carbonic anhydrase combines CO_2 and H_2O.
b) CO_2 dissociates from carbamino-haemoglobin.
c) Bicarbonate ions are formed from carbonic acid.
d) Haemoglobin has a higher affinity for CO_2 due to high pO_2.

14.5 REGULATION OF RESPIRATION

135. The ability to maintain and moderate the respiratory rhythm to meet the demands of the body is carried out by the
a) endocrine system.
b) circulatory system.
c) neural system.
d) muscular system.

136. The specialized center primarily responsible for the regulation of respiratory rhythm is located in which part of the brain?
a) Cerebrum
b) Pons
c) Medulla
d) Cerebellum

137. The primary center for regulating the respiratory rhythm is known as the
a) pneumotaxic centre.
b) respiratory rhythm centre.
c) chemosensitive area.
d) apneustic centre.

138. The functions of the respiratory rhythm centre can be moderated by another center called the pneumotaxic centre, which is located in the
a) pons region of the brain.
b) medulla oblongata.
c) cerebrum.
d) spinal cord.

139. A neural signal from the pneumotaxic centre can alter the respiratory rate by
a) increasing the duration of inspiration.
b) reducing the duration of inspiration.
c) increasing the duration of expiration.
d) having no effect on the duration of inspiration.

140. Situated adjacent to the rhythm centre is a chemosensitive area that is highly sensitive to changes in the concentration of
a) O_2 only.
b) O_2 and H^+ ions.
c) CO_2 and H^+ ions.
d) CO_2 and O_2.

141. An increase in the concentration of CO_2 and H^+ ions activates the chemosensitive area, which in turn signals the rhythm centre to
a) slow down the respiratory process.
b) make adjustments to eliminate these substances.
c) temporarily halt breathing.
d) decrease the depth of breathing.

142. In addition to the chemosensitive area in the brain, receptors that can recognize changes in CO_2 and H^+ concentration are also located in the
a) pulmonary artery and vein.
b) aortic arch and carotid artery.
c) larynx and pharynx.
d) diaphragm and intercostal muscles.

143. The role of which gas in the regulation of respiratory rhythm is considered to be quite insignificant?
a) Carbon dioxide
b) Oxygen
c) Nitrogen
d) Hydrogen

144. Select the incorrect statement regarding the regulation of respiration.
a) The respiratory rhythm centre is located in the medulla.

b) The pneumotaxic centre in the pons can moderate respiratory rhythm.
c) The chemosensitive area is highly sensitive to fluctuations in oxygen levels.
d) Receptors in the aortic arch can detect changes in blood CO_2 levels.

145. Assertion (A): A person's breathing rate increases when there is a rise in blood CO_2 levels.
Reason (R): The chemosensitive area adjacent to the respiratory rhythm centre is activated by increased CO_2 and H^+ ions.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

146. Remedial actions to adjust the respiratory rate, based on blood gas concentrations, are ultimately controlled by signals sent to the
a) pneumotaxic centre.
b) rhythm centre.
c) chemosensitive area.
d) aortic and carotid bodies.

14.6 DISORDERS OF RESPIRATORY SYSTEM

147. A difficulty in breathing that causes wheezing and is due to the inflammation of bronchi and bronchioles is known as
a) emphysema.
b) fibrosis.
c) asthma.
d) pneumonia.

148. Emphysema is a chronic respiratory disorder characterized by
a) inflammation of the pleural membranes.
b) damage to the alveolar walls.
c) proliferation of fibrous tissues in the lungs.
d) spasm of the tracheal muscles.

149. The primary consequence of the damage to alveolar walls in emphysema is
a) increase in respiratory surface area.
b) decrease in respiratory surface area.
c) inflammation of the bronchi.
d) accumulation of fluid in the lungs.

150. One of the major causes cited for the development of emphysema is
a) bacterial infection.
b) genetic predisposition.
c) allergic reactions.
d) cigarette smoking.

151. Occupational respiratory disorders are prevalent in industries that involve
a) software development.
b) grinding or stone-breaking.
c) food processing.
d) textile manufacturing.

152. Long exposure to industrial dust can lead to inflammation and the proliferation of fibrous tissues, a condition known as
a) emphysema.
b) asthma.
c) bronchitis.
d) fibrosis.

153. What is the recommended protective measure for workers in industries like stone-breaking to prevent occupational respiratory disorders?
a) Regular intake of antibiotics
b) Wearing protective masks
c) Performing daily breathing exercises
d) Avoiding exposure to sunlight

154. Match the respiratory disorder in Column I with its corresponding feature in Column II.

Column I	Column II
(A) Asthma	(i) Damage to alveolar walls
(B) Emphysema	(ii) Proliferation of fibrous tissue
(C) Occupational Disorder	(iii) Inflammation of bronchi and bronchioles

Select the correct option:

a) A-(iii), B-(i), C-(ii)

b) A-(i), B-(iii), C-(ii)

c) A-(ii), B-(i), C-(iii)

d) A-(iii), B-(ii), C-(i)

155. Assertion (A): A major cause of emphysema is cigarette smoking.
Reason (R): Emphysema leads to a decrease in the respiratory surface area for gas exchange.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true.

CHAPTER SUMMARY

156. At a cellular level, oxygen is utilized for metabolism to produce energy, and a harmful substance that is also generated is
a) water.
b) urea.
c) carbon dioxide.
d) lactic acid.

157. The summary describes the first step in respiration, breathing, as the process where
a) atmospheric air is taken in and alveolar air is released out.
b) gases are exchanged between blood and tissues.
c) oxygen is utilized by the cells.
d) gases are transported by the blood.

158. Which of the following is not listed in the summary as a step of respiration that follows breathing?
a) Transport of gases by blood
b) Exchange of gases between oxygenated blood and tissues
c) Production of ATP through glycolysis
d) Utilization of O_2 by cells

159. Inspiration and expiration are carried out by creating pressure gradients with the help of the diaphragm and the
a) abdominal muscles.
b) pleural muscles.
c) intercostal muscles.
d) pectoral muscles.

160. According to the summary, the estimation of air volumes involved in breathing using a spirometer is significant for
a) academic research only.
b) clinical assessment.
c) athletic performance evaluation.
d) determining blood pH.

161. The exchange of O_2 and CO_2 at both the alveoli and the tissues occurs through the process of
a) osmosis.
b) active transport.
c) facilitated transport.
d) diffusion.

162. The rate of diffusion for respiratory gases is dependent on partial pressure gradients, solubility of the gases, and the
a) speed of blood flow.
b) number of alveoli.
c) thickness of the diffusion surface.
d) concentration of haemoglobin.

163. The summary states that oxygen is primarily transported in the blood as
a) dissolved gas in plasma.
b) bicarbonate ions.
c) oxyhaemoglobin.
d) carboxyhaemoglobin.

164. Oxygen easily dissociates from haemoglobin at the tissues due to conditions like low pO_2, high pCO_2, and
a) low temperature.
b) high H^+ concentration.
c) low H^+ concentration.
d) high blood pressure.

165. Nearly 70 per cent of carbon dioxide is transported as bicarbonate ions, a process aided by the enzyme
a) carboxylase.
b) pepsin.
c) carbonic anhydrase.
d) lipase.

166. In the tissues, where the partial pressure of CO_2 is high, it gets bound to the blood, whereas in the alveoli it gets removed from the blood due to
a) high pCO_2 and low pO_2.
b) low pCO_2 and high pO_2.
c) low pCO_2 and low pO_2.
d) high pCO_2 and high pO_2.

167. The maintenance of the respiratory rhythm is attributed to a respiratory centre located in the
a) cerebrum.
b) pons.
c) cerebellum.
d) medulla.

168. The summary mentions that the respiratory mechanism can be altered by a chemosensitive area in the medulla and a
a) respiratory rhythm centre in the medulla.
b) cardiovascular centre in the pons.
c) pneumotaxic centre in the pons.
d) thermoregulatory centre in the hypothalamus.

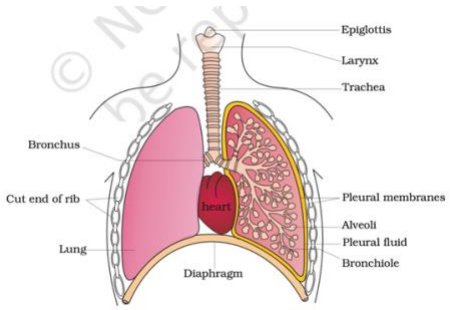
169. Read the following statements derived from the summary and select the correct one.
a) Exchange of gases at the alveoli occurs by active transport.
b) Oxygen is mainly transported as a dissolved gas in plasma.
c) 20-25 per cent of carbon dioxide is carried by haemoglobin as carbamino-haemoglobin.
d) The primary respiratory rhythm centre is located in the pons region of the brain.

170. Assertion (A): The majority of CO_2 produced in the tissues is transported to the lungs in the form of bicarbonate.

Reason (R): The conversion of CO_2 to bicarbonate is facilitated by the enzyme carbonic anhydrase found in high concentrations in RBCs.
a) Both (A) and (R) are true and (R) is the correct explanation of (A).
b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
c) (A) is true but (R) is false.
d) (A) is false but (R) is true

SECTION B: DIAGRAM & DATA MCQS

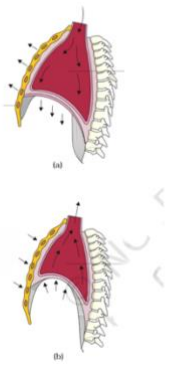
171. The Italian anatomist Alfonso Corti is credited with describing a structure containing hair cells on the basilar membrane of the cochlea that
a) regulates body balance.
b) secretes endocrine hormones.
c) converts sound vibrations into nerve impulses.
d) studied the cardiovascular system of mammals.



172. Refer to the above figure, which shows a diagrammatic view of the human respiratory system. Identify the structure that acts as a cartilaginous box for sound production.
a) Epiglottis
b) Trachea
c) Larynx
d) Pharynx

173. In the sectional view of the left lung shown in the above figure, the double-layered covering indicated by the label 'Pleural membranes' contains what substance in between its layers?
a) Air
b) Mucus
c) Pleural fluid
d) Blood

174. Based on the above figure, the structure that forms the muscular floor of the chest cavity and separates it from the abdomen is the
a) Rib cage
b) Alveoli
c) Heart
d) Diaphragm



175. In the above figure (a) illustrates the process of inspiration. Which of the following correctly describes the state of the muscles and the resulting change in thoracic volume as shown?
a) Diaphragm relaxed, volume of thorax decreased
b) Diaphragm contracted, volume of thorax increased
c) Diaphragm contracted, volume of thorax decreased
d) Diaphragm relaxed, volume of thorax increased

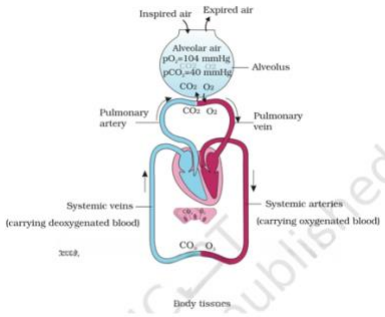
176. In the above figure (b), which depicts expiration, the ribs and sternum are shown returning to their original position, and the diaphragm is
a) contracted and flattened.
b) contracted and arched upwards.
c) relaxed and flattened.
d) relaxed and arched upwards.

177. By comparing Figure (a) and (b), the movement of air out of the lungs is a consequence of
a) an increase in the volume of the thorax.
b) a decrease in the volume of the thorax.
c) the contraction of the diaphragm and external intercostals.
d) the raising of the ribs and sternum.

178. What is the partial pressure of oxygen (pO_2) in atmospheric air and in the alveoli, respectively?(Table 14.1)
a) 104 mm Hg and 159 mm Hg
b) 159 mm Hg and 104 mm Hg
c) 40 mm Hg and 95 mm Hg
d) 159 mm Hg and 40 mm Hg

179. Based on Table 14.1, the partial pressure of carbon dioxide (pCO_2) is highest in which of the following?
a) Alveoli
b) Blood (Oxygenated)
c) Tissues
d) Atmospheric Air

180. What is the partial pressure difference for oxygen (pO_2) that drives its diffusion from the alveoli into the deoxygenated blood?(Table 14.1)
a) 5 mm Hg
b) 55 mm Hg
c) 64 mm Hg
d) 95 mm Hg



181. As shown in Figure above, the pulmonary artery carries deoxygenated blood to the lungs. This blood has a pCO_2 of
a) 40 mm Hg.
b) 45 mm Hg.
c) 95 mm Hg.
d) 104 mm Hg.

182. In the schematic representation in Figure 14.3, the systemic arteries carry oxygenated blood to the body tissues. What is the partial pressure of oxygen (pO_2) in this blood?
a) 40 mm Hg
b) 45 mm Hg
c) 95 mm Hg
d) 104 mm Hg

183. Figure 14.3 illustrates that at the level of the body tissues, which of the following gas movements occurs?
a) O_2 moves from tissues to blood, CO_2 moves from blood to tissues.
b) Both O_2 and CO_2 move from blood to tissues.
c) O_2 moves from blood to tissues, CO_2 moves from tissues to blood.
d) Both O_2 and CO_2 move from tissues to blood.

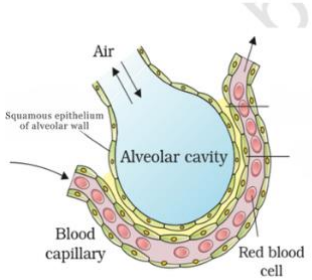


Fig-14.4

184. Figure 14.4 shows a section of an alveolus with a capillary. The diffusion membrane through which gases must pass consists of all the following layers shown, EXCEPT the
a) Squamous epithelium of alveolar wall.
b) Red blood cell membrane.
c) Endothelium of blood capillary.
d) Basement substance.

185. In Figure 14.4, the structure labeled "Squamous epithelium of alveolar wall" is described as being
a) two-celled thick.
b) one-celled thick.
c) multi-layered.
d) composed of columnar cells.

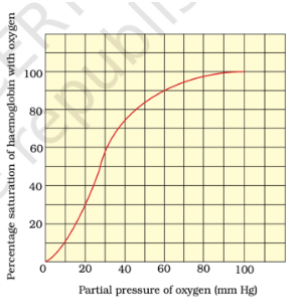


Figure 14.5 Oxygen dissociation curve

186. Refer to the Oxygen dissociation curve in Figure 14.5. At a partial pressure of oxygen of 40 mm Hg, which is typical in tissues, the percentage saturation of haemoglobin is approximately
a) 25%.
b) 50%.
c) 75%.
d) 97%.

187. According to the graph in Figure 14.5, in the alveoli where the partial pressure of oxygen is around 100 mm Hg, the haemoglobin is approximately
a) 50% saturated.
b) 70% saturated.
c) 85% saturated.
d) 98% saturated.

188. The characteristic shape of the curve presented in Figure 14.5, which plots percentage saturation of haemoglobin against the partial pressure of oxygen, is
a) linear.
b) hyperbolic.
c) sigmoid.
d) bell-shaped.

SECTION C: INTRA-CHAPTER INTEGRATIVE MCQS

189. The muscular action of inspiration, involving the contraction of the diaphragm and external intercostal muscles, directly facilitates the exchange of gases in the alveoli by
a) increasing the solubility of oxygen in the blood.
b) decreasing the thickness of the alveolar membrane.
c) drawing in atmospheric air, which establishes a high alveolar pO_2 gradient relative to the blood.
d) causing the dissociation of oxygen from haemoglobin.

190. How does the transport of carbon dioxide as bicarbonate in the blood directly influence the neural regulation of respiration?
a) The formation of bicarbonate consumes H^+ ions, signaling the pneumotaxic centre to slow breathing.
b) The reaction releases H^+ ions, which are detected by the chemosensitive area, leading to an increased respiratory rate.
c) Bicarbonate ions directly block signals from the respiratory rhythm centre.
d) The process is independent of respiratory regulation, which only responds to oxygen levels.

191. The chronic respiratory disorder emphysema directly compromises the efficiency of gas exchange by affecting which key factor?
a) It increases the thickness of the diffusion membrane, as seen in fibrosis.
b) It decreases the total surface area available for diffusion.
c) It lowers the partial pressure of atmospheric oxygen.
d) It reduces the solubility of carbon dioxide in blood plasma.

192. Which statement correctly contrasts the respiratory strategy of an insect with that of a human?
a) Insects use moist skin for respiration, while humans rely on lungs and blood transport.
b) The insect's tracheal system relies on blood for gas transport, unlike the human system.
c) The human respiratory system requires a circulatory medium for gas transport, whereas the insect tracheal system largely bypasses it.
d) Both systems utilize haemoglobin for oxygen transport, but the binding affinity differs.

193. The presence of incomplete cartilaginous rings in the trachea and bronchi is structurally important for the mechanism of breathing because they
a) contract to help force air out during expiration.
b) prevent the airway from collapsing when intra-pulmonary pressure falls during inspiration.
c) are the primary sites of gas diffusion into the bloodstream.
d) secrete pleural fluid to reduce friction.

194. A higher Vital Capacity (VC) is advantageous for an athlete because it allows for a greater
a) Residual Volume, preventing lung collapse.
b) volume of air to be exchanged per breath, maximizing the alveolar pO_2 gradient during exertion.
c) rate of CO2 transport by haemoglobin.
d) sensitivity of the chemosensitive area to H^+ ions.

195. Which of the following events would be favored by the conditions within the capillaries of an actively metabolizing muscle tissue?
a) Formation of oxyhaemoglobin and dissociation of carbamino-haemoglobin.
b) An increase in haemoglobin's affinity for oxygen due to a decrease in temperature.
c) Binding of CO_2 to haemoglobin and release of O_2 from oxyhaemoglobin.
d) Conversion of bicarbonate ions back into CO_2 and water.

196. A patient with fibrosis develops thickened alveolar membranes. This condition would most likely lead to a chronic stimulation of the respiratory rhythm centre because
a) the thickened membrane would trap oxygen, leading to dangerously high blood pO_2.
b) impaired gas exchange would cause a buildup of CO_2 and H^+ ions in the blood.
c) the pneumotaxic centre would become overactive, reducing the duration of inspiration.
d) the patient's Tidal Volume would permanently increase.

197. Which sequence correctly outlines the path of a carbon dioxide molecule from a body tissue to the atmosphere?
i. Dissociation from carbamino-haemoglobin or conversion from bicarbonate in the alveoli.
ii. Transport in the blood, primarily as bicarbonate.
iii. Diffusion from the tissue cell into a systemic capillary.
iv. Movement out of the lungs during expiration.
v. Diffusion from alveolar capillaries into the alveolar space.
a) iii —> ii —> i —> v —> iv
b) ii —> iii —> i —> iv —> v

c) iii —> v —> ii —> i —> iv
d) i —> iii —> ii —> v —> iv

198. The values for Tidal Volume and Vital Capacity are measured using a spirometer, but neither can provide a direct measurement of Total Lung Capacity. This is because a spirometer cannot measure the
a) Inspiratory Reserve Volume.
b) Expiratory Reserve Volume.
c) Residual Volume.
d) Inspiratory Capacity.

199. A high partial pressure of CO_2 in the blood not only stimulates the chemosensitive area to increase breathing rate but also facilitates oxygen transport by
a) increasing the binding affinity of haemoglobin for oxygen.
b) decreasing the affinity of haemoglobin for oxygen, promoting its release in the tissues.
c) directly converting haemoglobin to oxyhaemoglobin.
d) increasing the amount of oxygen that can dissolve in plasma.

200. Asthma is a disorder that causes difficulty in breathing due to inflammation and narrowing of the bronchi and bronchioles. This would most directly interfere with
a) the diffusion of gases across the alveolar membrane.
b) the process of pulmonary ventilation.
c) the oxygen-carrying capacity of haemoglobin.
d) the transport of CO_2 as bicarbonate.

201. The anatomical features of the alveoli, being thin-walled, irregular, and highly vascularized, are critical for the process of gas exchange because they
a) maximize the surface area and minimize the diffusion distance, as required for efficient diffusion.
b) allow for the active transport of gases against their concentration gradients.
c) provide structural support with cartilaginous rings, preventing collapse during expiration.
d) humidify and warm the air before it participates in gas exchange.

202. While the regulatory role of oxygen is minimal, the primary regulatory response to increased blood CO_2 and H^+ ions serves to restore oxygen homeostasis by
a) increasing the oxygen-carrying capacity of each haemoglobin molecule.
b) increasing the rate and depth of breathing, which enhances the uptake of atmospheric oxygen.
c) decreasing the body's metabolic rate to lower oxygen demand.
d) triggering the formation of new red blood cells to transport more oxygen.

203. Which respiratory capacity best represents the maximum functional range of the primary breathing muscles, such as the diaphragm and intercostals, from a state of maximum contraction to maximum relaxation?
a) Functional Residual Capacity (FRC)
b) Total Lung Capacity (TLC)
c) Inspiratory Capacity (IC)
d) Vital Capacity (VC)

204. In a patient with a severe respiratory disorder like fibrosis that impairs gas exchange, a resulting buildup of carbon dioxide in the blood would lead to
a) an increase in blood pH due to the formation of carbamino-haemoglobin.
b) a decrease in blood pH as the carbonic anhydrase reaction produces excess H^+ ions.
c) a reflexive slowing of the breathing rate by the pneumotaxic centre.
d) an increase in the affinity of haemoglobin for oxygen.

205. How does asthma, a disorder of the conducting pathway, primarily differ from emphysema, a disorder of the respiratory pathway?
a) Asthma impairs ventilation by obstructing airflow, while emphysema impairs diffusion by reducing respiratory surface area.
b) Asthma reduces Vital Capacity, while emphysema increases Residual Volume.
c) Asthma is caused by smoking, while emphysema is an allergic reaction.
d) Asthma affects the rate of oxygen binding to haemoglobin, while emphysema affects CO2 transport.

206. The entry of carbon dioxide into red blood cells within tissue capillaries stimulates the release of oxygen from haemoglobin. This is because
a) CO_2 directly competes with O_2 for the same binding site on haemoglobin.
b) the subsequent formation of H^+ ions lowers the affinity of haemoglobin for oxygen.
c) carbon dioxide transport raises the temperature, favoring oxygen release.
d) the enzyme carbonic anhydrase breaks down oxyhaemoglobin.

207. In response to a signal from the chemosensitive area to increase ventilation, the Tidal Volume is increased by drawing upon the
a) Residual Volume.
b) Functional Residual Capacity.
c) Inspiratory and Expiratory Reserve Volumes.
d) Vital Capacity and Residual Volume.

208. The vast difference in the solubility of CO_2 and O_2 in blood plasma is a key reason why
a) oxygen requires a dedicated carrier molecule like haemoglobin for efficient transport, while a significant portion of CO_2 can be transported as bicarbonate.
b) they are exchanged via active transport rather than simple diffusion.
c) oxygen is the primary regulator of respiration, while carbon dioxide is not.
d) the diffusion membrane must be much thicker for CO_2 than for O_2.

209. The neural signals originating from the respiratory rhythm centre in the medulla exert direct control over the mechanism of breathing by stimulating the
a) alveoli and bronchioles.
b) diaphragm and external intercostal muscles.
c) pneumotaxic centre and carotid artery receptors.
d) smooth muscles of the pulmonary arteries.

210. An increase in body temperature during vigorous exercise shifts the oxygen dissociation curve to the right. This physiological change complements the increased breathing rate by
a) increasing the binding of oxygen to haemoglobin in the lungs.
b) facilitating a more efficient unloading of oxygen from haemoglobin to the active tissues.
c) decreasing the amount of CO_2 produced by the tissues.
d) increasing the pH of the blood to favor oxygen retention.

211. During a severe asthma attack, a person may use their abdominal muscles. This action is a conscious effort to aid in
a) normal, passive inspiration.
b) increasing the Inspiratory Reserve Volume.
c) forcible expiration to overcome the high resistance in the narrowed airways.
d) reducing the volume of air in the Functional Residual Capacity.

212. A mountaineer ascending to a very high altitude will encounter low atmospheric pO_2. Which of the following represents the most immediate cascade of physiological responses?
a) An increase in haemoglobin saturation, followed by a decrease in breathing rate.
b) A decrease in blood pCO_2, stimulating the chemosensitive area.
c) A decrease in haemoglobin saturation, which is compensated for by an increase in respiratory rate and depth.
d) An immediate increase in the production of red blood cells to enhance oxygen transport.

213. The reason Total Lung Capacity (TLC) cannot be measured by a simple spirometer is because it includes Residual Volume (RV), which is the volume of air
a) remaining after a normal expiration (FRC).
b) that cannot be forcefully expired and thus cannot be measured by the device.
c) inhaled during a forcible inspiration (IRV).
d) that is exchanged during a normal breath (TV).

214. The partial pressure of oxygen in blood leaving the alveolar capillaries (oxygenated blood) is 95 mm Hg, which is slightly less than the 104 mm Hg in the alveoli. This difference implies that
a) the diffusion of oxygen from alveoli to blood is an inefficient, slow process.
b) some deoxygenated blood may mix with oxygenated blood, or equilibrium is not perfectly reached.
c) haemoglobin has a low affinity for oxygen even at high pO_2.
d) carbon dioxide actively competes with and displaces oxygen from the blood.

215. The creation of a negative intra-pulmonary pressure relative to the atmosphere is a critical event in breathing. This pressure change is a direct consequence of a(n)
a) decrease in thoracic volume, which causes an increase in pulmonary volume.
b) increase in thoracic volume, which causes an increase in pulmonary volume.
c) increase in thoracic volume, which causes a decrease in pulmonary volume.
d) relaxation of the diaphragm and external intercostal muscles.

PART 2-NEET MASTERY

THIS PART CONTAINS EXAM-ORIENTED QUESTION FORMATS MODELLED ON RECENT NEET PAPERS, ALONG WITH SELECT INNOVATIVE FORMATS DESIGNED TO CHALLENGE CONVENTIONAL THINKING. THE PURPOSE OF THIS SECTION IS TO ENSURE THAT STUDENTS MOVE BEYOND MEMORIZATION AND DEVELOP A COMPLETE PRACTICAL UNDERSTANDING OF THE NCERT TEXT. EACH FORMAT SYSTEMATICALLY TESTS APPLICATION, ANALYSIS, AND INTEGRATION OF CONCEPTS, THEREBY BRIDGING THE GAP BETWEEN FACTUAL RECALL AND PROBLEM-SOLVING.

THE FORMATS USED IN THIS SECTION INCLUDE:

- **Assertion–Reason** – tests causal relationships between two statements
- **Statement-Based** – evaluates correctness of multiple factual statements
- **Matching Type** – links related concepts across two columns
- **Data Anomaly** – identifies inconsistencies in a dataset or graph
- **Sequence** – arranges items in correct order (chronological/procedural)
- **Multi-Correct** – selects all correct options from a given list
- **Flowchart / Process Completion** – fills missing steps in biological processes
- **Scenario-Based/Case-Based** – applies concepts to clinical or ecological situations
- **Diagnostic Pathway** – follows multi-step logical reasoning from observation to outcome

ASSERTION-REASONS

Instructions: For the following questions, two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c), and (d) as given below.

(a) Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.

(c) Assertion is True but the Reason is False.

(d) Assertion is False but the Reason is True or both Assertion and Reason are false.

1. (A): In lower invertebrates like sponges and flatworms, gaseous exchange occurs across the entire body surface.

(R): These organisms possess a very low metabolic rate and a high surface area to volume ratio.

2. (A): Most aquatic arthropods and molluscs respire through vascularized structures called gills.

(R): Respiration through gills is known as pulmonary respiration.

3. (A): The pharynx acts as a common passage for both food and air.

(R): The pharynx opens into the trachea through the glottis, which is guarded by the epiglottis.

4. (A): The trachea and initial bronchioles are supported by incomplete cartilaginous rings.

(R): These rings prevent the conducting passages from collapsing during expiration.

5. (A): A double-layered pleura with pleural fluid covers the lungs.

(R): The pleural fluid increases friction on the lung surface during breathing movements.

6. (A): The conducting part of the respiratory system warms, humidifies, and filters the incoming air.

(R): The exchange part is the site of actual diffusion of O_2 and CO_2 between blood and atmospheric air.

7. (A): The thoracic chamber is an anatomically air-tight chamber.

(R): The anatomical setup of the lungs in the thorax is such that any change in the volume of the thoracic cavity is reflected in the pulmonary cavity.

8. (A): Inspiration is an active process initiated by the contraction of respiratory muscles.

(R): Inspiration occurs when the intra-pulmonary pressure is higher than the atmospheric pressure.

9. (A): A healthy human breathes, on average, 12-16 times per minute.

(R): The volume of air involved in breathing movements can be estimated using a spirometer.

10. (A): An increase in pulmonary volume decreases the intra-pulmonary pressure, leading to inspiration.

(R): Air always moves from an area of higher pressure to an area of lower pressure.

11. (A): Expiratory Reserve Volume (ERV) is the volume of air remaining in the lungs after a forcible expiration.

(R): Adding Tidal Volume (TV) and Inspiratory Reserve Volume (IRV) gives the Expiratory Capacity (EC).

12. (A): The rate of diffusion of gases is influenced by the thickness of the diffusion membrane.

(R): The total thickness of the diffusion membrane in the alveoli is much less than a millimeter, which favors gas exchange.

13. (A): The partial pressure of oxygen in the alveoli is higher than in deoxygenated blood.

(R): A concentration gradient for oxygen exists from alveoli to blood, and then from blood to tissues.

14. (A): The solubility of CO_2 is 20-25 times higher than that of O_2.

(R): A greater amount of CO_2 can diffuse through the diffusion membrane per unit difference in partial pressure compared to O_2.

15. (A): Nearly 97% of oxygen is transported in the blood as oxyhemoglobin.

(R): Hemoglobin is a red-colored, iron-containing pigment found in red blood cells.

16. (A): The oxygen-hemoglobin dissociation curve is a sigmoid curve.

(R): The binding of oxygen to hemoglobin is primarily related to the partial pressure of O_2.

17. (A): In the tissues, conditions are favorable for the dissociation of oxygen from oxyhemoglobin.

(R): Tissues have a low pO_2, high pCO_2, high H+ concentration, and higher temperature.

18. (A): When pCO_2 is high and pO_2 is low, as in the tissues, more carbon dioxide binds to hemoglobin.

(R): The binding of carbon dioxide with hemoglobin is primarily related to the partial pressure of O_2.

19. (A): The enzyme carbonic anhydrase is present in very high concentration in RBCs and in minute quantities in the plasma.

(R): This enzyme facilitates the conversion of CO_2 and water into carbonic acid, and the reverse reaction, at a very slow rate.

20. (A): In the alveoli, bicarbonate is converted back into CO_2 and water.

(R): The partial pressure of CO_2 is low in the alveoli, which drives the carbonic anhydrase-mediated reaction in the reverse direction.

21. (A): The respiratory rhythm is primarily controlled by a specialized center in the pons region of the brain.

(R): The pneumotaxic center can moderate the functions of the respiratory rhythm center.

22. (A): An increase in the concentration of CO_2 and H^+ in the blood can activate the chemosensitive area adjacent to the rhythm center.

(R): The role of oxygen in the regulation of respiratory rhythm is quite significant.

23. (A): Asthma is characterized by difficulty in breathing and wheezing.

(R): Asthma is a chronic disorder where the alveolar walls are damaged, leading to a decreased respiratory surface.

24. (A): Long exposure to dust in industries like stone-breaking can lead to fibrosis.

(R): Fibrosis is the proliferation of fibrous tissues in the lungs, causing serious lung damage.

25. (A): Emphysema is a respiratory disorder primarily caused by cigarette smoking.

(R): In emphysema, the alveolar walls are damaged, which increases the respiratory surface area.

26. (A): Total Lung Capacity (TLC) is the total volume of air accommodated in the lungs at the end of a forced inspiration.

(R): Total Lung Capacity is the sum of Vital Capacity (VC) and Expiratory Reserve Volume (ERV).

27. (A): The summary of respiration involves breathing, gaseous exchange at two sites, transport of gases, and cellular utilization.

(R): The rate of diffusion depends on partial pressure gradients, solubility, and the thickness of the diffusion membrane

STATEMENT-BASED

1. Consider the following statements regarding the necessity of gaseous exchange:

I. Oxygen is utilized to indirectly build up complex molecules like glucose.

II. The process of breaking down simple molecules to derive energy is catabolic.

III. Carbon dioxide, which is harmful, is released during the aforementioned reactions.

IV. Breathing is the process of exchanging atmospheric CO_2 with O_2 produced by the cells.

Select the option with the correct combination of statements.

a) I and II only

b) II and III only

c) I, II, and III

d) II, III, and IV

2. How many of the following organisms perform respiration using simple diffusion over their entire body surface?

- Sponges
- Earthworms
- Coelenterates
- Insects
- Flatworms
- Molluscs

a) Two

b) Three

c) Four

d) Five

3. Evaluate the following statements:

Statement-I: In insects, a network of tracheal tubes transports atmospheric air directly within the body.

Statement-II: Respiration by lungs is called branchial respiration, while respiration by gills is called pulmonary respiration.

a) Both Statement-I and Statement-II are correct.

b) Statement-I is correct, but Statement-II is incorrect.

c) Statement-I is incorrect, but Statement-II is correct.

d) Both Statement-I and Statement-II are incorrect.

4. Which of the following statements is not incorrect?

a) The nasal chamber opens into the larynx, which is the common passage for food and air.

b) The larynx is a bony box that helps in sound production and is covered by the glottis during swallowing.

c) The trachea is a straight tube that divides at the level of the 5th thoracic vertebra into right and left primary bronchi.

d) The primary, secondary, and tertiary bronchi are vascularized bags that form the main sites of gas exchange.

5. Identify the structure to which the following features apply:

I. It is covered by a double-layered pleura.

II. The branching network of bronchi, bronchioles, and alveoli comprises it.

III. The inner pleural membrane is in close contact with its surface.

IV. It is situated in an air-tight thoracic chamber.

a) Heart

b) Diaphragm

c) Lung

d) Alveolus

6. From the statements given below, select the option that lists all the correct functions of the conducting part of the human respiratory system.

I. Transports atmospheric air to the alveoli.

II. Is the primary site of diffusion for O_2 and CO_2.

III. Clears the inhaled air of foreign particles.

IV. Brings the temperature of the air up to body temperature.

V. Humidifies the incoming air.

a) I, II, and III only

b) I, III, IV, and V only

c) II, IV, and V only

d) All of the above

7. How many of the following statements correctly describe the process of inspiration under normal conditions?

- It is initiated by the relaxation of the diaphragm.
- The contraction of external intercostal muscles increases the volume of the thoracic chamber in the antero-posterior axis.
- An increase in pulmonary volume leads to an increase in intra-pulmonary pressure.
- Air moves into the lungs because the intra-pulmonary pressure is less than the atmospheric pressure.
- It is an active process.

a) One

b) Two

c) Three

d) Four

8. Evaluate the following statements:

Statement-I: During inspiration, the diaphragm contracts, increasing the thoracic volume in the antero-posterior axis.

Statement-II: During normal expiration, the diaphragm and external intercostal muscles relax, reducing the thoracic volume.

a) Both Statement-I and Statement-II are correct.

b) Statement-I is correct, but Statement-II is incorrect.

c) Statement-I is incorrect, but Statement-II is correct.

d) Both Statement-I and Statement-II are incorrect.

9. Which of the following compound statements is correct?

a) Contraction of external intercostal muscles lifts the ribs and sternum, thereby increasing thoracic volume in the antero-posterior axis.

b) Relaxation of the diaphragm returns it to its arched position, thereby causing a decrease in the pulmonary volume.

c) The strength of inspiration can be increased by additional muscles in the neck, while the strength of expiration is solely dependent on abdominal muscles.

d) A healthy human breathes 12-16 times per minute, and the instrument used to measure this rate is a spirometer.

10. Identify the physiological process described by the following characteristics:

I. The diaphragm contracts and flattens.

II. The external intercostal muscles contract.

III. The volume of the thoracic cavity increases.

IV. The intra-pulmonary pressure falls below the atmospheric pressure.

a) Normal Expiration

b) Forced Expiration

c) Inspiration

d) Cutaneous Respiration

11. Select the option that correctly defines the given respiratory volumes.

I. Tidal Volume (TV): Volume of air inspired or expired during a forcible respiration.

II. Inspiratory Reserve Volume (IRV): Additional volume of air a person can inspire by a forcible inspiration.

III. Expiratory Reserve Volume (ERV): Additional volume of air a person can expire by a forcible expiration.

IV. Residual Volume (RV): Volume of air remaining in the lungs after a normal expiration.

a) I and IV only

b) II and III only

c) I, II, and III

d) II, III, and IV

12. How many of the following equations for pulmonary capacities are correct?

- Inspiratory Capacity (IC) = TV + ERV
- Expiratory Capacity (EC) = TV + ERV
- Functional Residual Capacity (FRC) = ERV + RV
- Vital Capacity (VC) = ERV + TV + IRV
- Total Lung Capacity (TLC) = VC - RV

a) One

b) Two

c) Three

d) Four

13. Evaluate the following statements:

Statement-I: Vital Capacity is the maximum volume of air a person can breathe in after a forced expiration.

Statement-II: Total Lung Capacity is the total volume of air accommodated in the lungs at the end of a normal inspiration.

a) Both Statement-I and Statement-II are correct.

b) Statement-I is correct, but Statement-II is incorrect.

c) Statement-I is incorrect, but Statement-II is correct.

d) Both Statement-I and Statement-II are incorrect.

14. Which of the following compound statements regarding respiratory volumes is incorrect?

a) The Tidal Volume is approximately 500 mL, meaning a healthy man can expire about 6000 to 8000 mL of air per minute.

b) The Inspiratory Reserve Volume averages 2500 mL to 3000 mL, while the Expiratory Reserve Volume averages 1000 mL to 1100 mL.

c) The Residual Volume averages 1100 mL to 1200 mL, and it can be measured directly with a spirometer.

d) Functional Residual Capacity is the volume of air remaining after a normal expiration, and it includes ERV + RV.

15. Consider the following statements about the exchange of gases:

I. The primary site for the exchange of gases is the alveoli.

II. Gases are exchanged by active transport, mainly based on pressure gradients.

III. The solubility of gases and the thickness of the diffusion membrane are important factors affecting the rate of diffusion.

IV. The pressure contributed by an individual gas in a mixture is called its vital pressure.

Choose the correct option.

a) I and III are correct.

b) I and II are correct.

c) II and IV are correct.

d) III and IV are correct.

16. Evaluate the following statements regarding partial pressures.

Statement-I: A concentration gradient for oxygen exists from the tissues to the blood and then to the alveoli.

Statement-II: A concentration gradient for carbon dioxide exists from the tissues to the blood and then to the alveoli.

a) Both Statement-I and Statement-II are correct.

b) Statement-I is correct, but Statement-II is incorrect.

c) Statement-I is incorrect, but Statement-II is correct.

d) Both Statement-I and Statement-II are incorrect.

17. How many of the following statements about the diffusion membrane are correct?

- It is made up of three major layers.
- The layers include the cuboidal epithelium of the alveoli.
- The total thickness is much less than a millimeter.
- The basement substance is composed of a single, thick basement membrane.
- Its properties are favorable for the diffusion of O_2 from alveoli to tissues.

a) Two

b) Three

c) Four

d) Five

18. Identify the gas to which the following transport percentages apply:

I. ~97% transported by RBCs

II. ~3% carried in a dissolved state through plasma

a) Carbon Dioxide

b) Oxygen

c) Nitrogen

d) Carbon Monoxide

19. Select the option that lists all the factors that can interfere with the binding of oxygen to hemoglobin.

I. Partial pressure of O_2

II. Partial pressure of CO_2

III. Bicarbonate ion concentration

IV. Hydrogen ion concentration

V. Temperature

a) I, II, IV, and V only

b) II, IV, and V only

c) I, III, and V only

d) All of the above

20. Which of the following compound statements is correct regarding the oxygen dissociation curve?

a) A hyperbolic curve is obtained when the percentage saturation of hemoglobin with O_2 is plotted against the pCO_2.

b) In the alveoli, where there is high pO_2, low pCO_2, and lower temperature, the conditions are favorable for the dissociation of oxyhemoglobin.

c) In the tissues, where there is low pO_2, high pCO_2, and higher temperature, the conditions are favorable for the formation of oxyhemoglobin.

d) The curve is highly useful in studying the effect of factors like pCO_2 and H^+ concentration on the binding of O_2 with hemoglobin.

21. Evaluate the following statements regarding the transport of carbon dioxide.

Statement-I: When pCO_2 is high and pO_2 is low, as in the alveoli, the dissociation of CO_2 from carbamino-hemoglobin takes place.

Statement-II: The enzyme carbonic anhydrase is found in very high concentration in RBCs and facilitates the formation of H_2CO_3 from CO_2 and H_2O.

a) Both Statement-I and Statement-II are correct.

b) Statement-I is correct, but Statement-II is incorrect.

c) Statement-I is incorrect, but Statement-II is correct.

d) Both Statement-I and Statement-II are incorrect.

22. How many of the following statements concerning the regulation of respiration are correct?

- The respiratory rhythm center is primarily located in the pons.
- The pneumotaxic center can increase the duration of inspiration.
- The chemosensitive area is highly sensitive to O_2 and H^+ ions.
- Receptors in the aortic arch and carotid artery can detect changes in CO_2 and H^+ concentration.
- The role of oxygen in regulating respiratory rhythm is quite significant.

a) One

b) Two

c) Three

d) Four

23. Which of the following statements is correct?

a) Asthma is a chronic disorder in which alveolar walls are damaged.

b) Emphysema is characterized by wheezing due to inflammation of bronchi.

c) Long exposure to industrial dust can lead to fibrosis, which is the proliferation of fibrous tissues.

d) Wearing protective masks is a primary treatment for emphysema.

24. Identify the respiratory disorder described by the following features:

I. It is a chronic disorder.

II. The alveolar walls are damaged.

III. The respiratory surface area is decreased.

IV. A major cause is cigarette smoking.

a) Asthma

b) Fibrosis

c) Occupational Respiratory Disorder

d) Emphysema

25. Read the following statements from the summary and identify the correct ones.

I. Oxygen is transported mainly as carboxyhemoglobin.

II. Nearly 70 percent of carbon dioxide is transported as bicarbonate.

III. The respiratory rhythm is maintained by a center in the medulla.

IV. A pneumotaxic center in the medulla can alter the respiratory mechanism.

a) I and IV only

b) II and III only

c) I, II, and III

d) II, III, and IV

MATCHING TYPE

1. Match the organisms in Column-I with their primary respiratory organ or mechanism in Column-II.

Column-I	Column-II
(A) Sponges	(i) Tracheal tubes
(B) Earthworms	(ii) Lungs
(C) Insects	(iii) Moist cuticle
(D) Birds	(iv) Entire body surface

a) A-(iv), B-(iii), C-(i), D-(ii)

b) A-(i), B-(ii), C-(iii), D-(iv)

c) A-(iv), B-(iii), C-(ii), D-(i)

d) A-(iii), B-(iv), C-(i), D-(ii)

2. From the following pairs, identify the one which is not a correct match.

a) Aquatic Arthropods - Gills

b) Frogs - Moist Skin

c) Fishes - Lungs

d) Reptiles - Lungs

3. Select the correctly matched pair from the following.

a) Branchial respiration - Terrestrial forms

b) Pulmonary respiration - Most aquatic molluscs

c) Moist Cuticle- Earthworms

d) Tracheal tubes - Sponges

4. Match the structures of the human respiratory system in Column-I with their corresponding descriptions in Column-II.

Column-I	Column-II
(A) Larynx	(i) Bag-like structures for gas exchange
(B) Pleural fluid	(ii) Divides at the level of the 5th thoracic vertebra
(C) Trachea	(iii) Reduces friction on the lung surface
(D) Alveoli	(iv) Cartilaginous sound box

a) A-(iv), B-(iii), C-(ii), D-(i)

b) A-(i), B-(ii), C-(iii), D-(iv)

c) A-(iii), B-(iv), C-(ii), D-(i)

d) A-(ii), B-(i), C-(iv), D-(iii)

5. Which of the following pairs is incorrectly matched?

a) Conducting part - Humidifies air

b) Exchange part - Actual site of diffusion

c) Diaphragm - Forms the dorsal boundary of the thorax

d) Epiglottis - Prevents entry of food into the larynx

6. Select the correctly matched pair of a respiratory volume/capacity and its description.

a) Tidal Volume - Volume of air remaining after forcible expiration.

b) Vital Capacity - Total volume of air a person can expire after a normal inspiration.

c) Inspiratory Capacity - Total volume of air a person can inspire after a normal expiration.

d) Residual Volume - Volume of air inspired or expired during a normal respiration.

7. From the following, identify the mismatch between a respiratory capacity and its constituent volumes.

a) Inspiratory Capacity - TV + IRV

b) Expiratory Capacity - TV + ERV

c) Functional Residual Capacity - ERV + RV

d) Total Lung Capacity - VC + ERV

Match the information in Column-I with the corresponding partial pressures in Column-II (values in mm Hg).

Column-I	Column-II
(A) pO_2 in Alveoli	(i) 40
(B) pCO_2 in Tissues	(ii) 95
(C) pO_2 in Oxygenated Blood	(iii) 45
(D) pCO_2 in Oxygenated Blood	(iv) 104

a) A-(iv), B-(iii), C-(ii), D-(i)

b) A-(ii), B-(iii), C-(iv), D-(i)

c) A-(iv), B-(i), C-(ii), D-(iii)

d) A-(i), B-(ii), C-(iii), D-(iv)

9. Select the correctly matched pair regarding gas transport.

a) Oxygen - 70% as oxyhemoglobin

b) Carbon dioxide - 97% as bicarbonate

c) Oxygen - 3% dissolved in plasma

d) Carbon dioxide - 7% as carbamino-hemoglobin

10. Which of the following is a mismatched pair?

a) Respiratory rhythm center - Medulla

b) Pneumotaxic center - Pons

c) Chemosensitive area - Sensitive to pO_2

d) Aortic arch receptors - Sensitive to pCO_2 and H^+

11. Select the correctly matched pair of a respiratory disorder and its description.

a) Asthma - Damage to alveolar walls leading to decreased respiratory surface.

b) Emphysema - Inflammation of bronchi and bronchioles causing wheezing.

c) Fibrosis - Proliferation of fibrous tissues in the lungs due to long exposure to dust.

d) Occupational Disorder - A chronic disorder caused primarily by cigarette smoking.

DATA ANOMALY

1. The table below shows the partial pressures of O_2 and CO_2 at different sites in the respiratory system for a person at rest. Analyze the data to find the anomaly.

Gas	Alveoli	Deoxygenated Blood	Oxygenated Blood	Tissues
pO_2 (mm Hg)	104	40	95	40
pCO_2 (mm Hg)	40	45	**50**	45

Which value in the table represents a physiological anomaly?

a) The pO_2 in the alveoli is 104 mm Hg.

b) The pO_2 in deoxygenated blood is 40 mm Hg.

c) The pCO_2 in oxygenated blood is 50 mm Hg.

d) The pCO_2 in the tissues is 45 mm Hg.

2. A clinic performs a spirometry test on a healthy adult and records the following values. Identify the anomalous result.

- **Tidal Volume (TV):** 500 mL
- **Inspiratory Reserve Volume (IRV):** 3000 mL
- **Expiratory Reserve Volume (ERV):** 1100 mL
- **Residual Volume (RV):** 1200 mL
- **Calculated Vital Capacity (VC):** 4600 mL
- **Calculated Total Lung Capacity (TLC): 4400 mL**

Which of the following values or calculations represents the data anomaly?

a) The Inspiratory Reserve Volume is 3000 mL.

b) The calculated Vital Capacity is 4600 mL.

c) The Residual Volume is 1200 mL.

d) The calculated Total Lung Capacity is 4400 mL.

3. The graph below represents a standard oxygen-hemoglobin dissociation curve. Four points (A, B, C, and D) are marked corresponding to specific conditions. Analyze the points to find the one that represents a physiological anomaly.

- **Point A:** pO_2 = 25 mm Hg, Saturation = 45%
- **Point B:** pO_2 = 40 mm Hg, Saturation = 75%
- **Point C:** pO_2 = 95 mm Hg, Saturation = 97%
- **Point D:** pO_2 = 70 mm Hg, Saturation = **65%**

Which labeled point on the curve is anomalous?

a) Point A

b) Point B

c) Point C

d) Point D

SEQUENCE-BASED

1. Arrange the following parts of the human respiratory tract in the correct order that air follows during inhalation.

I. Pharynx

II. Trachea

III. Alveoli

IV. Nasal Chamber

V. Bronchioles

a) IV → I → II → V → III

b) IV → II → I → V → III

c) I → IV → II → III → V

d) IV → I → V → II → III

2. The overall process of respiration involves several steps. Arrange the following steps in the correct chronological order from beginning to end.

I. Transport of gases by the blood.

II. Utilisation of O_2 by the cells for catabolic reactions.

III. Breathing or pulmonary ventilation.

IV. Diffusion of O_2 and CO_2 between blood and tissues.

V. Diffusion of gases across the alveolar membrane.

a) III → V → I → IV → II

b) III → I → V → IV → II

c) V → III → I → II → IV

d) III → V → IV → I → II

3. Arrange the following events in the correct sequence as they occur during the process of normal inspiration.

I. Intra-pulmonary pressure drops below atmospheric pressure.

II. The diaphragm and external intercostal muscles contract.

III. Pulmonary volume increases.

IV. Air rushes into the lungs.

V. Thoracic volume increases.

a) II → V → III → I → IV

b) V → II → III → I → IV

c) II → III → V → IV → I

d) I → IV → II → V → III

4. Arrange the sequence of events that occurs during normal expiration.

I. Thoracic and pulmonary volume decrease.

II. The diaphragm and external intercostal muscles relax.

III. Intra-pulmonary pressure increases to slightly above atmospheric pressure.

IV. Air is expelled from the lungs.

a) II → I → III → IV

b) I → II → III → IV

c) II → III → I → IV

d) III → I → II → IV

5. Arrange the following steps in the correct order for the journey of an oxygen molecule from an alveolus to a body tissue.

I. Binding with hemoglobin in an RBC to form oxyhemoglobin.

II. Diffusion across the alveolar and capillary walls.

III. Transport via the pulmonary vein and systemic arteries.

IV. Dissociation from oxyhemoglobin.

V. Diffusion from the systemic capillary into a tissue cell.

a) II → I → III → IV → V

b) I → II → III → V → IV

c) II → III → I → IV → V

d) I → III → II → V → IV

6. Trace the correct sequence for the transport of a CO_2 molecule as a bicarbonate ion from a tissue cell to its release in the lungs.

I. Conversion to carbonic acid, catalyzed by carbonic anhydrase in the RBC.

II. Diffusion of CO_2 from the tissue into the blood plasma and then into an RBC.

III. Dissociation of carbonic acid into H^+ and HCO_3^-.

IV. The reaction reverses in the alveolar capillaries, reforming CO_2.

V. Transport of HCO_3^- in the blood plasma to the lungs.

a) II → I → III → V → IV

b) II → III → I → V → IV

c) I → II → III → V → IV

d) II → I → V → III → IV

MULTI CORRECT

Instructions: In the following questions, one or more of the given statements/items are correct. Choose the option which contains the combination of all correct items.

1. Which of the following organisms use their entire body surface for gaseous exchange?

I. Sponges

II. Coelenterates

III. Earthworms

IV. Flatworms

V. Insects

a) I, II, and IV only

b) I, II, III, and IV

c) III and V only

d) I and IV only

2. Which of the following structures are considered part of the conducting part of the human respiratory system?

I. Alveoli

II. Trachea

III. Pharynx

IV. Terminal bronchioles

V. Alveolar ducts

a) I and V only

b) II, III, and IV only

c) I, II, III, and IV

d) II and III only

3. The pressure gradients for breathing are generated with the help of which of the following muscles?

I. Diaphragm

II. External intercostals

III. Internal intercostals

IV. Abdominal muscles

V. Pectoral muscles

a) I and II only

b) I, II, and III only

c) I, II, III, and IV only

d) All of the above

4. Which of the following respiratory capacities, by definition, include the Tidal Volume (TV) in their calculation?

I. Inspiratory Capacity (IC)

II. Expiratory Capacity (EC)

III. Functional Residual Capacity (FRC)

IV. Vital Capacity (VC)

V. Total Lung Capacity (TLC)

a) I, II, and IV only

b) I, II, IV, and V only

c) I, III, and V only

d) II and IV only

5. The rate of diffusion of gases across the respiratory membrane is dependent on which of the following factors?

I. Pressure/concentration gradient

II. Velocity of blood flow

III. Solubility of the gases

IV. Number of RBCs

V. Thickness of the membranes

a) I, III, and V only

b) I, II, and III only

c) I, IV, and V only

d) All of the above

6. The dissociation of oxygen from hemoglobin at the tissues is favored by which of the following conditions?

I. High pO_2

II. High pCO_2

III. Lower temperature

IV. High H^+ concentration

V. Low pO_2

a) I, III, and IV only

b) II, IV, and V only

c) II and V only

d) I and III only

7. Carbon dioxide is transported in the blood in which of the following forms?

I. Dissolved in plasma

II. As bicarbonate

III. As carboxyhemoglobin

IV. As carbamino-hemoglobin

V. Bound to plasma proteins

a) I, II, and IV only

b) I, III, and V only

c) II and IV only

d) All of the above

FLOWCHART / PROCESS COMPLETION

1. Complete the following flowchart representing the pathway of inhaled air by choosing the correct option for A, B, and C.

External Nostrils → Nasal Passage → **(A)** → Pharynx → **(B)** → Trachea → Bronchi → **(C)** → Alveoli

a) A-Larynx, B-Nasal Chamber, C-Bronchioles

b) A-Nasal Chamber, B-Larynx, C-Bronchioles

c) A-Nasal Chamber, B-Bronchioles, C-Larynx

d) A-Larynx, B-Bronchioles, C-Nasal Chamber

2. The flowchart below shows the process of inspiration. Identify the correct labels for A, B, and C.

Contraction of Diaphragm and External Intercostals → **(A)** → Increase in Pulmonary Volume → **(B)** → Air flows into lungs → **(C)**

a) A-Decrease in Thoracic Volume, B-Increase in Intra-pulmonary pressure, C-Expiration

b) A-Increase in Thoracic Volume, B-Decrease in Intra-pulmonary pressure, C-Inspiration

c) A-Increase in Thoracic Volume, B-Increase in Intra-pulmonary pressure, C-Forced Expiration

d) A-Decrease in Thoracic Volume, B-Decrease in Intra-pulmonary pressure, C-Inspiration

3. The following diagram represents the exchange of gases at the tissue level. Identify A and B.

Blood in Systemic Capillary (pO_2 = 95, pCO_2 = 40) → (A) → Blood leaves in Systemic Vein (pO_2 = 40, pCO_2 = 45)

↑ ↓

Tissue Cell (pO_2 = 40, pCO_2 = 45) → (B) → Tissue Cell

a) A - O_2 diffuses into tissue, B - O_2 diffuses out of tissue

b) A - CO_2 diffuses into tissue, B - O_2 diffuses out of tissue

c) A - O_2 diffuses into tissue, B - CO_2 diffuses into blood

d) A - CO_2 diffuses into blood, B - O_2 diffuses into tissue

4. Complete the flowchart illustrating the formation of bicarbonate from CO_2 in a red blood cell at the tissue level.

$CO_2 + H_2O$ ---(**A**)--> H_2CO_3 --> **(B)** + H^+

a) A-Oxyhemoglobin, B-HCO_3^-

b) A-Carbonic Anhydrase, B-HCO_3^-

c) A-Carbaminohemoglobin, B-CO_3^{2-}

d) A-Carbonic Anhydrase, B-CO_3^{2-}

5. The flowchart below depicts the neural regulation of breathing in response to increased physical activity. Identify A, B, and C.

Increased tissue metabolism → Rise in blood **(A)** → Detected by **(B)** → Signal to **(C)** → Increased rate and depth of breathing

a) A-pO_2, B-Pneumotaxic center, C-Diaphragm

b) A-pCO_2 and H^+, B-Chemosensitive area and peripheral receptors, C-Respiratory rhythm center

c) A-pO_2, B-Respiratory rhythm center, C-Pneumotaxic center

d) A-pCO_2 and H^+, B-Pneumotaxic center, C-Chemosensitive area.

CASE-BASED

1. Clinical Case: A 15-year-old boy is brought to the emergency room with severe difficulty in breathing and an audible wheezing sound. He has a known allergy to dust mites. The symptoms are likely due to an inflammation of his bronchi and bronchioles. What is the most probable diagnosis?

a) Emphysema

b) Fibrosis

c) Asthma

d) Pneumonia

2. Clinical Case: A 68-year-old man, who has smoked two packs of cigarettes a day for 40 years, presents with chronic shortness of breath. A pulmonary function test reveals a significantly decreased vital capacity and an increased residual volume. A chest X-ray suggests damage to the alveolar walls. Which disorder best fits this clinical picture?

a) Asthma

b) Acute Bronchitis

c) Occupational Lung Disease

d) Emphysema

3. Clinical Case: A 55-year-old woman has worked in a quartz grinding factory for over 20 years without adequate respiratory protection. She now suffers from severe breathlessness and a persistent cough. A lung biopsy shows excessive proliferation of fibrous connective tissue, leading to stiffening of the lung tissue. This pathological condition is known as:

a) Emphysema

b) Fibrosis

c) Asthma

d) Atelectasis

4. Clinical Case: A patient is brought to the hospital after being rescued from a burning building and has inhaled a significant amount of smoke. Though the atmospheric air was low in oxygen, the patient's primary issue is the inhalation of a gas that binds to hemoglobin with a much higher affinity than oxygen, preventing oxygen from binding to the RBCs. This interference with the transport of oxygen would lead to what condition?

a) Increased formation of oxyhemoglobin

b) A rightward shift in the oxygen dissociation curve

c) Widespread tissue hypoxia

d) Stimulation of the pneumotaxic center

5. Scenario: An athlete travels from sea level to a high-altitude training camp. On the first day, they experience rapid breathing (hyperventilation) during mild exercise. This is an adaptive response. Which of the following best explains this initial reaction?

a) The lower atmospheric pO_2 leads to lower oxygen saturation of hemoglobin, and the body compensates by increasing the breathing rate to maximize oxygen intake.

b) The higher atmospheric pCO_2 at altitude stimulates the chemosensitive area, increasing the respiratory drive.

c) The cold temperature at high altitude causes inflammation of the bronchi, leading to an asthmatic-like response.

d) The body's residual volume increases significantly, forcing the athlete to breathe more rapidly to maintain their vital capacity.

DIAGNOSTIC PATHWAY

This is a new innovative question type designed to follow multi-step logical reasoning from observation to outcome.

Instructions: For the following questions, a premise is given. From the options, choose the one that represents a correct and logical diagnostic pathway (Observation → Reason → Consequence).

1. Premise: During normal breathing, air flows into the lungs.

a) Diaphragm relaxes → Thoracic volume decreases → Intra-pulmonary pressure drops.

b) External intercostals contract → Ribs and sternum are lifted → Thoracic volume in the dorso-ventral axis increases.

c) Pulmonary volume decreases → Intra-pulmonary pressure increases → Air is drawn in from the atmosphere.

d) Intra-pulmonary pressure equals atmospheric pressure → A pressure gradient is established → Air flows in.

2. Premise: A chronic smoker complains of feeling out of breath.

a) Bronchioles are inflamed → Wheezing sound is produced → Condition is diagnosed as emphysema.

b) Alveolar walls are damaged → Respiratory surface area is decreased → Gaseous exchange is impaired.

c) Fibrous tissues proliferate → Lung elasticity increases → Vital capacity increases.

d) Mucus secretion increases → Airway narrows → Oxygen's affinity for hemoglobin decreases.

3. Premise: During vigorous exercise, the rate of respiration increases.

a) Tissue pO_2 levels rise → Chemosensitive area is activated → Rhythm center signals for slower breathing.

b) Blood pCO_2 and H^+ levels rise → Peripheral and central chemoreceptors are stimulated → Rhythm center signals for faster and deeper breathing.

c) Pneumotaxic center is inhibited → Duration of inspiration increases → Overall respiratory rate decreases.

d) Body temperature drops → Oxygen dissociation curve shifts left → Breathing rate increases to compensate.

4. Premise: A person's blood becomes slightly more acidic as it passes through the capillaries of active tissues.

a) O_2 is released from hemoglobin → Blood pH decreases → Chemosensitive area is inhibited.

b) CO_2 diffuses into RBCs → Carbonic anhydrase forms H_2CO_3, which releases H^+ → This facilitates the unloading of O_2 from hemoglobin.

c) Lactic acid is produced → pCO_2 in the blood drops significantly → Hemoglobin binds more tightly to O_2.

d) Bicarbonate ions enter the RBCs → H^+ ions are consumed → Blood pH increases, promoting O_2 binding.

5. Premise: In the alveolar capillaries, hemoglobin readily binds to oxygen.

a) pCO_2 is high → Hemoglobin changes shape → Oxygen affinity decreases.

b) Temperature is high → Dissociation of O_2 is favored → Less oxyhemoglobin is formed.

c) H^+ concentration is high → The oxygen dissociation curve shifts right → Saturation percentage decreases.

d) pO_2 is high and pCO_2 is low → Affinity of hemoglobin for oxygen is high → Nearly complete saturation to form oxyhemoglobin occurs.

ANSWER KEY

FOR PART 1:ACTIVE RECALL QUESTIONS

1-b	2-c	3-c	4-c	5-b	6-b	7-b	8-d	9-c	10-b
11-c	12-c	13-c	14-a	15-a	16-a	17-b	18-c	19-b	20-d
21-b	22-b	23-b	24-d	25-b	26-c	27-b	28-c	29-d	30-b
31-d	32-c	33-b	34-b	35-b	36-c	37-a	38-a	39-c	40-a
41-a	42-b	43-c	44-d	45-c	46-c	47-b	48-b	49-b	50-b
51-a	52-c	53-d	54-b	55-d	56-d	57-a	58-a	59-c	60-b
61-c	62-c	63-d	64-b	65-b	66-d	67-c	68-a	69-b	70-d
71-c	72-c	73-a	74-c	75-c	76-b	77-a	78-d	79-c	80-a
81-b	82-a	83-c	84-b	85-b	86-c	87-d	88-c	89-c	90-b
91-c	92-d	93-b	94-b	95-c	96-c	97-a	98-c	99-b	100-d
101-b	102-c	103-c	104-b	105-a	106-b	107-c	108-c	109-a	110-d
111-c	112-b	113-b	114-d	115-b	116-b	117-c	118-a	119-c	120-c
121-b	122-c	123-c	124-a	125-c	126-d	127-b	128-c	129-c	130-b
131-c	132-a	133-a	134-b	135-c	136-c	137-b	138-a	139-b	140-c
141-b	142-b	143-b	144-c	145-a	146-b	147-c	148-b	149-b	150-d
151-b	152-d	153-b	154-a	155-b	156-c	157-a	158-c	159-c	160-b
161-d	162-c	163-c	164-b	165-c	166-b	167-d	168-c	169-c	170-a
171-c	172-c	173-c	174-d	175-b	176-d	177-b	178-b	179-c	180-c
181-b	182-c	183-c	184-b	185-b	186-c	187-d	188-c	189-c	190-b
191-b	192-c	193-b	194-b	195-c	196-b	197-a	198-c	199-b	200-b
201-a	202-b	203-d	204-b	205-a	206-b	207-c	208-a	209-b	210-b
211-c	212-c	213-b	214-b	215-b					

FOR PART 2:NEET MASTERY QUESTIONS

Assertion-Reason

1-b	2-c	3-a	4-c	5-c	6-b	7-b	8-c	9-b	10-a
11-d	12-a	13-a	14-a	15-b	16-b	17-a	18-c	19-c	20-a
21-d	22-c	23-c	24-a	25-c	26-c	27-b			

Statement-Based

1-b	2-b	3-b	4-c	5-c	6-b	7-b	8-a	9-b	10-c
11-b	12-c	13-b	14-c	15-a	16-c	17-b	18-b	19-b	20-d
21-c	22-a	23-c	24-d	25-b					

Matching Type

1-a	2-c	3-c	4-a	5-c	6-c	7-d	8-a	9-c	10-c
11-c									

Data Anomaly

1-c	2-d	3-d

Sequence

1-a	2-a	3-a	4-a	5-a	6-a

Multi Correct

1-a	2-b	3-c	4-b	5-a	6-b	7-a

Flowchart / Process Completion

1-b	2-b	3-c	4-b	5-b

Scenario-Based

1-c	2-d	3-b	4-c	5-a

Diagnostic Pathway

1-b	2-b	3-b	4-b	5-d

JUSTIFICATION, OPTION ANALYSIS AND CITATIONS.

FOR PART 1: ACTIVE RECALL QUESTIONS

1. **Justification:** Oxygen is utilized by organisms to indirectly break down simple molecules like glucose, amino acids, etc., to derive energy for various activities.
   Option Analysis: (a) is incorrect as synthesis is an anabolic process. (c) is incorrect as oxygen utilization produces, not removes, CO2. (d) is incorrect as pressure gradients are created by muscular action, not by oxygen itself.
   (Source Line: "As you have...")
2. **Justification:** During catabolic reactions for energy derivation, carbon dioxide (CO_2), which is harmful, is released.
   Option Analysis: (a) is produced during anaerobic respiration. (b) is a nitrogenous waste. (d) is also produced but is not considered harmful in this context.
   (Source Line: "Carbon dioxide (CO2)...")
3. **Justification:** The process of exchanging O_2 from the atmosphere with CO_2 produced by cells is called breathing.
   Option Analysis: (a) refers to the cellular level reactions. (b) is a component of breathing but not the complete definition of exchange. (d) refers to blood flow in tissues.
   (Source Line: "This process of...")
4. **Justification:** This statement accurately reflects that O_2 is needed for catabolism and the harmful by-product CO_2 must be removed.
   Option Analysis: (a) is incorrect; CO_2 is a waste product to be removed. (b) is incorrect; a lack of O_2, not a build-up, is the issue. (d) is incorrect; atmospheric air has very low CO_2 concentration.
   (Source Line: "It is, therefore,...")
5. **Justification:** Statement (i) correctly states oxygen's role. Statement (iv) correctly defines breathing.
   Option Analysis: (ii) is incorrect; energy is derived from catabolism (breakdown), not anabolism. (iii) is incorrect; CO_2 is described as a harmful, not useful, substance in this context.
   (Source Line: "As you have...")

*****As inclusion of the entire *Justifications, Option Analysis & Citations* section in the physical book would occupy a lot more pages, for students' convenience this entire detailed section is available for download through the QR code present below.**

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