NEET Re-Exam 2026 Botany

Question Paper with Solutions

Conducted by National Testing Agency (NTA)

General Instructions

(i) The test is of 3 hours and 15 minutes duration.

(ii) This test paper consists of 180 questions. The maximum marks are 720.

(iii) Physics and Chemistry contains 45 questions each and Biology (Botany and Zoology) contains 90 questions.

(iv) Each question carries +4 marks for correct answer and –1 mark for wrong answer.

Botany

91. Given below are two statements :

Statement I : The class name Reptilia refers to creeping or crawling mode of locomotion.

Statement II : All organisms belonging to Reptilia have three chambered heart.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (4) Statement I is correct but Statement II is incorrect

Solution:

Concept: The classification of animals in the animal kingdom is based on distinctive morphological, anatomical, and evolutionary characteristics. Class Reptilia forms a major group under the subphylum Vertebrata. Understanding the diagnostic traits of this class—such as its etymology, locomotor adaptations, and the comparative anatomy of its circulatory system—helps identify the general characteristics alongside key evolutionary exceptions.

Step 1: Evaluation of Statement I

Let us analyze the origin and meaning of the class name **Reptilia**. The term 'Reptilia' is derived directly from the Latin words *repre* or *reptum*, which mean "to creep" or "to crawl". Therefore, the name of the class directly highlights their characteristic creeping or crawling mode of locomotion. Most reptiles move with their bellies close to or touching the ground due to the lateral placement of their limbs. Hence, **Statement I is completely correct.**

Step 2: Evaluation of Statement II

Let us analyze the circulatory anatomy of organisms belonging to Class Reptilia. The standard structural configuration of a reptile's heart features a **three-chambered structure**, consisting of:

- Two distinct atria (Left atrium and Right atrium)
- One incomplete or partially divided ventricle

However, biological groups often exhibit evolutionary modifications. Within Class Reptilia, order **Crocodilia** (which includes crocodiles, alligators, caimans, and gharials) represents a major evolutionary exception. Crocodiles possess a highly evolved, completely separated inter-ventricular septum, resulting in a true **four-chambered heart** (two atria and two ventricles), much like birds and mammals.

Because crocodiles belong to Reptilia but do not have a three-chambered heart, the generalized statement stating "*All* organisms belonging to Reptilia have three chambered heart" becomes factually invalid. Hence, **Statement II is incorrect.**

Conclusion:

Since Statement I is correct and Statement II is incorrect, the most appropriate choice is option (4).

Quick Tip: Whenever a biology question contains absolute terms like "**All**", "**Always**", or "**Never**", look closely for evolutionary exceptions. For Class Reptilia, the classic exception to remember is:

$$\text{Reptiles} \rightarrow \text{3-chambered heart} \quad \textbf{EXCEPT} \quad \text{Crocodiles} \rightarrow \text{4-chambered heart}$$

92. How many turns of Calvin cycle are required for the formation of three molecules of glucose?

(1) 18

(2) 6

(3) 3

(4) 1

Correct Answer: (1) 18

Solution:

Concept: The Calvin cycle (also known as the C_3 pathway or the dark reaction of photosynthesis) occurs in the stroma of chloroplasts. The primary purpose of this cyclic pathway is to fix inorganic carbon dioxide (CO_2) into organic macromolecules like carbohydrates (glucose). The process is divided into three distinct phases:

1. **Carboxylation:** Fixation of carbon dioxide onto RuBP (Ribulose-1,5-bisphosphate).
2. **Reduction:** Utilization of assimilatory power (ATP and NADPH) to create glyceraldehyde-3-phosphate (G3P).
3. **Regeneration:** Reconstruction of the CO_2 acceptor molecule RuBP so that the cycle can continue uninterrupted.

Step 1: Determine the carbon requirement per turn of the Calvin cycle

In a single turn of the Calvin cycle, exactly **one molecule of CO_2** enters the pathway and is fixed by the enzyme RuBisCO.

$$1 \text{ Turn of Calvin Cycle} = 1 \text{ Carbon atom fixed from } CO_2$$

Step 2: Calculate the turns needed for a single molecule of glucose

Glucose is a hexose sugar with the molecular formula $C_6H_{12}O_6$. A single molecule of glucose contains exactly **6 carbon atoms**. To synthesize one molecule of glucose, 6 molecules of carbon dioxide must be fixed. Since each turn fixes one carbon atom, we can establish the fundamental ratio:

$$\text{Turns required for 1 Glucose molecule} = 6 \text{ turns}$$

Step 3: Compute the turns required for three molecules of glucose

The problem specifically asks for the number of turns required to manufacture **three molecules of glucose**. Using a direct linear proportion:

$$\text{Total turns required} = (\text{Turns per glucose molecule}) \times (\text{Number of glucose molecules})$$

$$\text{Total turns required} = 6 \times 3 = 18 \text{ turns}$$

Thus, 18 complete turns of the Calvin cycle are mandatory to yield three molecules of glucose. This perfectly aligns with option (1).

Quick Tip: Keep a handy note of the overall energetics and stoichiometry for the synthesis of **one single molecule of glucose** ($C_6H_{12}O_6$) in C_3 plants:

- 6 molecules of CO_2 $\rightarrow$ 6 turns of the cycle
- 18 molecules of ATP consumed
- 12 molecules of NADPH consumed

For n molecules of glucose, simply multiply each of these standard baseline values by n.

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93. Photorespiration reaction catalyzed by RuBisCO is shown below :

$$\text{RuBP} + O_2 \rightarrow \text{3-Phosphoglycerate} + X$$

Identify "X" from the given options :

(1) Malate
(2) Phosphoenolpyruvate
(3) 2-Phosphoglycolate
(4) Oxaloacetate

Correct Answer: (3) 2-Phosphoglycolate

Solution:

Concept: RuBisCO (Ribulose-1,5-bisphosphate carboxylase-oxygenase) is a dual-functional enzyme. It has active binding sites for both carbon dioxide (CO_2) and oxygen (O_2).

- Under normal conditions where CO_2 concentrations are high, RuBisCO acts as a carboxylase, leading to the productive Calvin cycle.
- Under conditions of high temperature, high light intensity, and high oxygen concentration relative to CO_2, RuBisCO binds to oxygen instead. This initiates a wasteful metabolic pathway known as **photorespiration** (also called the C_2 cycle or photosynthetic carbon oxidation cycle).

Step 1: Analyze the stoichiometry of the reaction
Let us observe the substrate involved in the reaction:

- **RuBP (Ribulose-1,5-bisphosphate):** This is a **5-carbon** sugar molecule containing two phosphate groups.
- **Oxygen (O_2):** Adds no carbon atoms to the system.

When RuBisCO exhibits its oxygenase activity, it breaks down the 5-carbon RuBP molecule via oxygenation. The total carbon pool entering the reaction equals 5 carbons.

Step 2: Tracking the products of oxygenation
The reaction splits the 5-carbon substrate asymmetricaly into two specific fragments:

1. **3-Phosphoglycerate (PGA):** A **3-carbon** molecule that can enter the Calvin cycle.
2. **The unknown molecule "X":** Since the total number of reactant carbons is 5, and 3 carbons are contained in PGA, the remaining molecule must contain exactly:

$$5 \text{ carbons} - 3 \text{ carbons} = 2 \text{ carbons}$$

The standard 2-carbon phosphorylated compound produced during this step of photorespiration is **2-Phosphoglycolate**.
Let us write out the balanced biochemical equation explicitly:

$$\text{RuBP (5C)} + O_2 \xrightarrow{\text{RuBisCO (Oxygenase activity)}} \text{3-Phosphoglycerate (3C)} + \text{2-Phosphoglycolate (2C)}$$

Comparing this balanced equation with the equation given in the question statement, we find that the structural entity represented by "**X**" is precisely 2-Phosphoglycolate.

Step 3: Verification of other options

- **Option (1) Malate:** A 4-carbon organic acid primarily active in C_4 and CAM pathways.
- **Option (2) Phosphoenolpyruvate (PEP):** A 3-carbon primary CO_2 acceptor molecule in C_4 plants.
- **Option (4) Oxaloacetate (OAA):** A 4-carbon dicarboxylic acid that acts as the first stable product in C_4 photosynthesis.

None of these options match the 2-carbon product of the RuBP oxygenase step, confirming that option (3) is correct.

Quick Tip: Photorespiration is often termed the C_2 **cycle** precisely because the very first stable organic product formed outside the main path contains a chain of **2 carbon atoms** (2-Phosphoglycolate). Remembering this carbon-counting trick will help you solve problems involving alternative photosynthetic cycles instantly!

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94. Given below are two statements :

Statement I : In gymnosperms, the male and female gametophytes remain within the sporangia.

Statement II : In gymnosperms, the seeds are not covered.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Correct Answer: (2) Both Statement I and Statement II are correct

Solution:

Concept: Gymnosperms (derived from Greek: *gymnos* meaning 'naked' and *sperma* meaning 'seed') represent a group of seed-producing plants characterized by specific reproductive adaptations. Unlike bryophytes and pteridophytes, gymnosperms exhibit an advanced degree of heterospory where gametophytes are highly reduced and fully dependent on the dominant sporophytic generation.

Step 1: Detailed analysis of Statement I

In lower plant groups like bryophytes and free-sporing pteridophytes, gametophytes have an independent, free-living existence. However, gymnosperms show a significant evolutionary shift:

- They produce two distinct types of spores: haploid microspores and megaspores inside specialized sporangia (microsporangia and megasporangia).
- The male gametophyte develops from the microspore within the microsporangium.
- The female gametophyte develops from the megaspore and is retained inside the megasporangium, which is enclosed within the ovule.

Because they do not have a free-living independent existence, both male and female gametophytes remain physically enclosed and protected within the parental sporangia located on the sporophyte. Hence, **Statement I is completely correct.**

Step 2: Detailed analysis of Statement II

Let us look closely at the defining morphological characteristic of gymnosperms. The ovules of gymnosperms are exposed directly on the surfaces of reproductive structures such as cones or modified leaves (megasporophylls). They are not enclosed within an ovary wall before fertilization, nor do they develop an ovary-derived covering after fertilization. Since seeds develop directly from these exposed ovules, the final matured seeds remain exposed or "naked"—meaning they are not covered by a fruit wall. Hence, **Statement II is completely correct.**

Conclusion:

Since both Statement I and Statement II are fully accurate based on gymnosperm morphology and reproductive cycles, option (2) is the correct choice.

Quick Tip: Use this summary checklist for Gymnosperms:

Characteristic	**Status in Gymnosperms**
Gametophyte status	Reduced, dependent, retained inside sporangia
Ovary Wall	Absent
Seed Condition	Naked (not enclosed in fruit)

95. How many molecules of pyruvic acid are produced at the end of glycolysis from 206 molecules of glucose?

(1) 412
(2) 206
(3) 309
(4) 103

Correct Answer: (1) 412

Solution:

Concept: Glycolysis (originating from the Greek words *glykys* meaning sweet and *lysis* meaning splitting) is also known as the EMP pathway (Embden-Meyerhof-Parnas pathway). It is the foundational sequence of reactions in cellular respiration that occurs universally in the cytoplasm of all living cells. During this anaerobic process, a single molecule of hexose sugar (glucose) undergoes a structured series of ten enzyme-catalyzed steps to break down into a simpler 3-carbon organic acid.

Step 1: Determine the standard stoichiometric ratio of glycolysis

Let us look at the chemical composition and carbon count of the primary reactant and the final product:

- **Glucose molecule:** Contains a chain of **6 carbon atoms** ($C_6H_{12}O_6$).
- **Pyruvic acid (Pyruvate) molecule:** Contains a chain of **3 carbon atoms** ($CH_3COCOOH$).

Since no carbon atoms are lost as carbon dioxide (CO_2) during glycolysis, the total carbon pool is conserved from start to finish. Splitting a 6-carbon backbone down into 3-carbon structures yields a definitive stoichiometric output:

$$\text{1 molecule of Glucose (6C)} \xrightarrow{\text{Glycolysis}} \text{2 molecules of Pyruvic Acid (3C)}$$

This gives us a fixed conversion factor of **2 molecules of pyruvic acid per glucose molecule**.

Step 2: Calculate pyruvic acid output for 206 glucose molecules

The problem presents a starting pool consisting of exactly 206 molecules of glucose. Using the fixed conversion ratio established in Step 1, we find:

$$\text{Total Pyruvic Acid produced} = (\text{Molecules of Glucose}) \times 2$$

Substituting the value:

$$\text{Total Pyruvic Acid produced} = 206 \times 2$$

Let us carry out the multiplication step-by-step:

$$200 \times 2 = 400$$

$$6 \times 2 = 12$$

$$400 + 12 = 412$$

$$\text{Total Pyruvic Acid produced} = 412 \text{ molecules}$$

Thus, the total number of pyruvic acid molecules formed at the end of the glycolytic pathway is exactly 412, corresponding to option (1).

Quick Tip: To avoid confusion during respiratory stoichiometry calculations, always rely on conservation of carbon atoms:

$$\text{Total Initial Carbon Atoms} = \text{Total Final Carbon Atoms}$$

$$\text{Number of Glucose molecules} \times 6 = \text{Number of Pyruvate molecules} \times 3$$

This basic arithmetic rule prevents errors under exam pressure!

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96. Match List-I with List-II.

List-I	List-II
A. Fusion of protoplasms between gametes	I. Meiosis
B. Fusion of two nuclei	II. Plasmogamy
C. Generation of haploid spores	III. Karyogamy

Choose the **correct** answer from the options given below :

(1) A-I, B-III, C-II

(2) A-II, B-III, C-I

(3) A-II, B-I, C-III

(4) A-III, B-II, C-I

Correct Answer: (2) A-II, B-III, C-I

Solution:

Concept: In the sexual reproduction cycle of fungi and many lower eukaryotic organisms, the progression toward producing offspring involves a highly coordinated series of cellular and nuclear events. This sequence follows three fundamental steps: the merging of cellular fluids, the subsequent merging of genetic centers, and eventually a reduction division to restore a haploid genome.

Step 1: Analyze Item A ("Fusion of protoplasms between gametes")

The cell contents excluding the nucleus are referred to as the protoplasm or cytoplasm. The word prefix *plasmo-* relates to the plasma or cell fluid, and *-gamy* means marriage or union. Therefore, the physical fusion of motile or non-motile gametic protoplasms without immediate nuclear fusion is defined precisely as **Plasmogamy**. This matches **A with II**.

Step 2: Analyze Item B ("Fusion of two nuclei")

Following plasmogamy, the cell contains two independent nuclei (often creating a dikaryon phase). The Greek word *karyon* refers to a nut or kernel, which scientifically denotes the cell nucleus. Hence, the fusion of these two haploid nuclei to form a single diploid ($2n$) zygotic nucleus is called **Karyogamy**. This matches **B with III**.

Step 3: Analyze Item C ("Generation of haploid spores")

Once a diploid nucleus is successfully produced via karyogamy, the organism must reduce its chromosome count back to the haploid state (n) to complete its life cycle and form reproductive propagation structures. This specialized reduction division is called **Meiosis**. The spores resulting from this process are haploid sexual spores. This matches **C with I**.

Step 4: Compiling the final matches

Combining the findings from the previous steps, we get:

- $A \rightarrow II$
- $B \rightarrow III$
- $C \rightarrow I$

This precise configuration corresponds perfectly to option (2).

Quick Tip: To easily remember the sequential stages of sexual reproduction in fungi, just recall the abbreviation **P-K-M**:

$$\textbf{P}\text{lasmogamy (Protoplasm)} \rightarrow \textbf{K}\text{aryogamy (Nuclei)} \rightarrow \textbf{M}\text{eiosis (Spores)}$$

Breaking down terms etymologically (*plasmo* = cytoplasm, *karyo* = nucleus) eliminates any potential confusion!

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97. Mitochondrial inner membrane encloses__________.

(1) aqueous humor

(2) matrix

(3) cytosol

(4) mucus

Correct Answer: (2) matrix

Solution:

Concept: Mitochondria are double-membrane-bound organelles essential for aerobic cellular respiration, often referred to as the "powerhouses of the cell." Their structural framework consists of an outer membrane and a highly folded inner membrane. These two membranes divide the organelle into two distinct fluid-filled compartments:

1. The outer compartment, known as the intermembrane space, located between the outer and inner membranes.
2. The inner compartment, fully bounded and enclosed by the inner membrane.

Step 1: Identify the compartment enclosed by the inner membrane

The internal space enclosed directly by the highly convoluted inner mitochondrial membrane (which forms folds called cristae) is filled with a dense, homogeneous, gel-like proteinaceous fluid. This central core compartment is scientifically defined as the **matrix**. The matrix contains the circular mitochondrial DNA, ribosomes (70S), RNA molecules, and all the essential enzymes required for the Krebs cycle (Tricarboxylic Acid Cycle) and amino acid synthesis. Thus, the inner membrane encloses the matrix.

Step 2: Analysis and elimination of incorrect options

- **Option (1) Aqueous humor:** This is a clear, watery fluid filling the anterior chamber of the vertebrate eye between the cornea and the lens. It has no structural relationship with cellular organelles.
- **Option (3) Cytosol:** This is the liquid component of the cytoplasm surrounding all the organelles inside a cell. Mitochondria float within the cytosol; the cytosol is not inside the mitochondrion.
- **Option (4) Mucus:** This is a slippery, viscous secretion produced by mucous membranes and goblet cells in multicellular organisms to protect epithelial linings. It is an extracellular product, completely unrelated to sub-cellular membrane anatomy.

Therefore, option (2) is uniquely correct.

Quick Tip: Remember the division of labor inside a mitochondrion based on its anatomy:

- **Mitochondrial Matrix:** Site of Link Reaction and Krebs Cycle.
- **Inner Mitochondrial Membrane (Cristae):** Site of Electron Transport Chain (ETC) and Oxysomes ($F_0 - F_1$ complexes) for ATP synthesis.

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98. Phyllotaxy is the pattern of arrangement of ____________.

(1) sepals
(2) leaves
(3) flowers
(4) fruits

Correct Answer: (2) leaves

Solution:

Concept: Plant morphology involves studying the specialized organizational patterns of various vegetative and reproductive organs. To maximize light interception for photosynthesis and optimize structural balance, plants arrange their appendages systematically along the stem axis or branches.

Step 1: Define Phyllotaxy

The term "Phyllotaxy" is constructed from two Greek root words: *phyllo* meaning "leaf" and *taxis* meaning "arrangement" or "ordering". Therefore, by definition, **phyllotaxy is the pattern of arrangement of leaves on the stem or a branch**.

Plants display three primary variations of phyllotaxy:

- **Alternate:** A single leaf emerges at each node in an alternating fashion (e.g., China rose, mustard, sunflower).
- **Opposite:** A pair of leaves develops at each node, lying directly opposite to one another (e.g., Calotropis, guava).
- **Whorled:** More than two leaves arise together in a circular cluster or ring at a single node (e.g., Alstonia, Nerium).

Step 2: Clarify terminology for other options

To completely validate the choice, let us review the structural terms used for the arrangement of other components:

- The mode of arrangement of sepals or petals in a floral bud with respect to other members of the same whorl is called **Aestivation**.
- The pattern of arrangement of flowers on the floral axis (peduncle) is defined as **Inflorescence**.

Since the question strictly specifies phyllotaxy, it applies exclusively to leaves. Thus, option (2) is correct.

Quick Tip: Use simple linguistic associations to recall plant morphology definitions instantly:

$$\textbf{Phyllo}\text{-taxy} \rightarrow \textit{Phyllon} = \textbf{Leaf} \implies \text{Arrangement of Leaves}$$

$$\text{In-}\textbf{flores}\text{-cence} \rightarrow \textit{Flos} = \textbf{Flower} \implies \text{Arrangement of Flowers}$$

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99. Mad cow disease is caused by ____________.

(1) *Mycoplasma sp.*

(2) prions

(3) viroids

(4) *Aspergillus sp.*

Correct Answer: (2) prions

Solution:

Concept: In modern microbiology, certain infectious conditions are initiated by agents that do not fit into the standard categories of bacteria, fungi, or viruses. These sub-viral pathogens consist either of naked genetic material or completely protein-based structures capable of altering host cellular proteins.

Step 1: Understand the nature of Prions

Prions are abnormally folded, infectious proteins that lack any type of nucleic acid (neither DNA nor RNA). They cause progressive neurodegenerative disorders by interacting with normal cellular proteins in the central nervous system, forcing them to misfold into the same pathogenic configuration. This accumulation causes brain tissue to develop microscopic vacuoles, giving it a sponge-like appearance under a microscope.

Step 2: Link Prions to Mad Cow Disease

In cattle, this specific spongiform encephalopathy is clinically called Bovine Spongiform Encephalopathy (BSE), commonly recognized by its popular name, **Mad cow disease**. The human analog variant of this prion-mediated neurological disease is known as Cr-Jacob disease (CJD). Hence, prions are the causative agents of Mad cow disease.

Step 3: Analyze and eliminate other options

- **Option (1) *Mycoplasma sp.*:** These are cell-wall-less prokaryotic bacteria known to cause atypical pneumonia in humans and pleuropneumonia in animals, not spongiform encephalopathies.
- **Option (3) Viroids:** Discovered by T.O. Diener, these are infectious agents composed purely of a low-molecular-weight free RNA strand without a protein coat. They primarily target plants, causing diseases like Potato spindle tuber disease.
- **Option (4) *Aspergillus sp.*:** This is a genus of filamentous fungi responsible for respiratory fungal infections like aspergillosis or producing aflatoxins, completely unrelated to BSE.

This firmly establishes option (2) as the correct choice.

Quick Tip: Differentiate between sub-viral infectious particles using this clean structure:

Agent	Biochemical Composition	Classic Disease Example
Viroid	Naked single-stranded RNA (No Protein)	Potato spindle tuber disease
Prion	Misfolded infectious protein (No Nucleic Acid)	Mad cow disease (BSE) / CJD

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100. Cell theory was formulated by ____________.

(1) Antonie Von Leeuwenhoek

(2) Schleiden and Schwann

(3) Robert Brown

(4) Singer and Nicolson

Correct Answer: (2) Schleiden and Schwann

Solution:

Concept: The development of cell biology as a unified branch of science began with establishing systematic principles describing the fundamental building blocks of all living organisms. These principles are summarized collectively as the **Cell Theory**.

Step 1: Historical context of the Cell Theory formulation

In the late 1830s, two German scientists working independently arrived at complementary conclusions regarding living organisms:

- **Matthias Schleiden (1838):** A German botanist who examined a wide variety of plant tissues and concluded that all plants are entirely composed of different kinds of cells, which form the tissues of the plant.

- **Theodor Schwann (1839):** A German zoologist who studied different types of animal cells. He reported that animal cells have a thin outer layer (now known as the plasma membrane) and noted that the presence of a cell wall is a unique feature characteristic only of plant cells. Based on this, he proposed the hypothesis that the bodies of both animals and plants are composed of cells and products of cells.

These two scientists combined their observations to formally outline and propose the classic **Cell Theory**.

Step 2: Analysis and elimination of other options

Let us look at the contributions of the other scientists listed in the options:

- **Option (1) Antonie Von Leeuwenhoek:** He was the first to observe, describe, and record a live, free-living cell (such as bacteria, protozoans, and spermatozoa) using his modified high-magnification single-lens microscopes.
- **Option (3) Robert Brown:** He discovered and named the central dark spherical structural component of the cell—the **nucleus**—in orchid root cells in the year 1831.
- **Option (4) Singer and Nicolson:** They proposed the widely accepted **Fluid Mosaic Model** in 1972 to describe the structural arrangement and dynamic nature of the plasma membrane.

Thus, option (2) is the accurate answer.

Quick Tip: While Schleiden and Schwann formulated the baseline Cell Theory, it had a major limitation: it could not explain *how* new cells are created. This missing link was resolved in 1855 by **Rudolf Virchow**, who introduced the phrase:

$$\textit{Omnis cellula-e cellula} \implies \text{New cells arise only from pre-existing cells}$$

Together, these contributions define the modern cell theory.

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101. Which of the following plant growth regulators promotes internode elongation prior to flowering in cabbage ?

(1) Ethephon

(2) Abscisic acid

(3) Gibberellin

(4) Indole butyric acid

Correct Answer: (3) Gibberellin

Solution:

Concept: Plant Growth Regulators (PGRs) are organic compounds other than nutrients that influence physiological processes in plants at very low concentrations. Gibberellins (GA) form a vital group of such growth-promoting hormones. One of their most characteristic physiological effects is the elongation of internodes in intact plants, especially in rosette plants like cabbage, beet, and many genetic dwarfs. The phenomenon of sudden elongation of internodes followed immediately by flowering is known as **bolting**.

Step 1: Understanding the physiological mechanism of bolting.

Rosette plants exhibit a growth habit characterized by a condensed stem with crowded leaves close to the soil level due to negligible internodal growth. Prior to the reproductive phase or under specific environmental cues (like long days or cold treatment), these plants undergo rapid axial elongation of the internodes. Under natural conditions, this is controlled by endogenous gibberellins. When gibberellin is artificially applied to rosette plants like cabbage, it triggers rapid cell division and cell elongation in the sub-apical meristem zone of the stem, prompting dramatic internodal lengthening (bolting) just before the flowering process initiates.

Step 2: Evaluating the other options to understand why they are incorrect.

Let us systematically evaluate the physiological roles of the other listed options:

- **(1) Ethephon:** Ethephon is an aqueous solution that readily breaks down into ethylene, a gaseous plant growth regulator. Its major functions include promoting fruit ripening, enhancing abscission of leaves and flowers, breaking seed/bud dormancy, and initiating flowering in a few specific crops like pineapple, but it does not cause stem or internode bolting.

- **(2) Abscisic acid (ABA):** Commonly designated as the stress hormone or growth inhibitor, ABA plays an essential role in lateral bud dormancy, seed development, maturation, and stomatal closure under drought conditions. It acts antagonistically to gibberellins and suppresses growth rather than elongating internodes.

- **(4) Indole butyric acid (IBA):** This is a naturally occurring auxin. Auxins primarily regulate apical dominance, promote cell division in the cambium, initiate root development in stem cuttings, and prevent premature fruit and leaf drop. They do not induce the characteristic bolting response observed in rosette plants.

Thus, Gibberellin is uniquely responsible for promoting internode elongation prior to flowering in cabbage.

Quick Tip: To remember the primary function of Gibberellins, associate the word **"Gibberellin"** directly with **"Giant growth"** and **"Bolting"**. Whenever you see keywords like "internode elongation in rosette plants", "cabbage", or "bolting prior to flowering", the correct answer is invariably Gibberellin (GA_3).

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102. Which pigment has absorption peak at 700 nm in the photosynthetic reaction centre PS I (P700) ?

(1) Carotenoids

(2) Chlorophyll b

(3) Chlorophyll a

(4) Xanthophylls

Correct Answer: (3) Chlorophyll a

Solution:

Concept: Photosynthesis relies on specialized light-harvesting complexes called photosystems embedded within the thylakoid membranes of chloroplasts. A photosystem consists of a reaction centre surrounded by accessory light-harvesting complexes (antennae). The core molecule at the reaction centre of both Photosystem I (PS I) and Photosystem II (PS II) is always a specific molecule of **Chlorophyll a**, which acts as the primary electron donor upon photoexcitation.

Step 1: Analysis of Photosystem I (PS I) and its Reaction Centre.

In Photosystem I, the reaction centre contains a specialized pair of chlorophyll a molecules designated as **P700**. The letter 'P' stands for pigment, and the number '700' indicates the specific wavelength of light (in nanometers, nm) where this pigment shows its maximum absorption peak in the red region of the electromagnetic spectrum. When light energy is transferred from the accessory pigments to this reaction centre, the Chlorophyll a P700 molecule absorbs this specific energy and gets photo-excited, thereby ejecting an energized electron to a primary electron acceptor.

Step 2: Evaluating the role of other photosynthetic pigments.

To gain absolute clarity, let us assess the functions of the alternative pigments listed:

- **(1) Carotenoids & (4) Xanthophylls:** These are lipid-soluble accessory pigments. Carotenoids (pure hydrocarbons like β-carotene) and Xanthophylls (oxygenated derivatives) absorb light energy in the blue-violet and blue-green regions of the spectrum and transfer it to chlorophyll a. Additionally, they perform a crucial protective role by quenching excess light energy, thus shielding the delicate chlorophyll molecules from photo-oxidation. They never form the core reaction centre.

- **(2) Chlorophyll b:** This is an accessory green pigment that possesses an aldehyde group (—CHO) in place of the methyl group (—CH_3) found in chlorophyll a. It absorbs light at slightly different wavelengths (mostly around 450 nm and 640 nm) to broaden the spectrum of light usable for photosynthesis. It delivers its collected excitation energy down to the reaction centre chlorophyll a.

Therefore, the core pigment molecule located at the reaction centre P700 is explicitly Chlorophyll a.

Quick Tip: Remember the golden rule of photosynthesis: **Chlorophyll a is the "King" pigment.** It is the *only* pigment that can form the operational reaction centres (P680 in PS II and P700 in PS I). All other pigments (Chlorophyll b, Carotenoids, Xanthophylls) are merely "soldiers" or accessory pigments forming the antenna complex to harvest light and protect the King!

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103. Sphenopsida class belongs to ________.

(1) pteridophytes

(2) bryophytes

(3) angiosperms

(4) gymnosperms

Correct Answer: (1) pteridophytes

Solution:

Concept: In the kingdom Plantae, plants are classified into various divisions based on evolutionary patterns, morphological structural differentiation, and vascular architecture. The division **Pteridophyta** includes horsetails and ferns. Pteridophytes are the first terrestrial plants to possess vascular tissues, namely xylem and phloem. According to standard botanical classification systems, the division Pteridophyta is broadly divided into four distinct main classes.

Step 1: Detailing the classes of Pteridophytes.

To trace where Sphenopsida stands, let us look at the comprehensive classification of the division Pteridophyta:

1. **Psilopsida:** The most primitive living vascular plants, characterized by a protostelic rhizome and lack of true roots or well-developed leaves (e.g., *Psilotum*).

2. **Lycopsida:** Commonly referred to as club mosses, featuring microphyllous leaves and distinct strobili or cones (e.g., *Selaginella*, *Lycopodium*).

3. **Sphenopsida:** Popularly known as **horsetails**. They are characterized by articulated, jointed stems showing distinct nodes and internodes, with a whorl of microphyllous leaves at each node. Their cell walls are typically impregnated with silica, giving them a rough texture (e.g., *Equisetum*).

4. **Pteropsida:** The largest group, containing the true ferns, which possess megaphyllous leaves called fronds (e.g., *Dryopteris*, *Pteris*, *Adiantum*).

This directly demonstrates that the class Sphenopsida falls explicitly under the division Pteridophytes.

Step 2: Checking alternative options for clarity.

Let us quickly verify why the other plant groups are excluded from this class name:

- **(2) Bryophytes:** Bryophytes are non-vascular plants (amphibians of the plant kingdom) divided into Hepaticopsida (liverworts), Anthocerotopsida (hornworts), and Bryopsida (true mosses).

- **(3) Angiosperms:** These are flowering vascular plants whose seeds are enclosed inside fruits. They are divided into Monocotyledonae and Dicotyledonae.

- **(4) Gymnosperms:** These are naked-seeded vascular plants, classified into groups such as Cycadopsida, Coniferopsida, and Gnetopsida.

Hence, Sphenopsida belongs cleanly to pteridophytes.

Quick Tip: To remember the four major classes of Pteridophytes, memorize the mnemonic phrase: **"Please Let Sister Pray"** - **P**silopsida - **L**ycopsida - **S**phenopsida (*Equisetum* / Horsetail) - **P**teropsida (Ferns)

104. Which of the following represents the correct sequence of arrangement of bones in the lower limb of humans ?

(1) Femur-tarsal-patella-tibia

(2) Femur-tibia-patella-tarsal

(3) Patella-femur-tibia-tarsal

(4) Femur-patella-tibia-tarsal

Correct Answer: (4) Femur-patella-tibia-tarsal

Solution:

Concept: The human skeletal system is divided into the axial skeleton and the appendicular skeleton. The appendicular skeleton includes the limbs (upper and lower limbs) and their respective girdles. Each lower limb contains exactly 30 distinct bones arranged in a precise structural sequence from proximal (closest to the hip girdle attachment point) to distal (farthest down at the toes) regions to enable bipedal locomotion, weight bearing, and structural stability.

Step 1: Anatomical tracing of the lower limb bones from top to bottom.
Let us review the sequential arrangement of bones along the axis of a human lower limb:

1. **Femur (Thigh bone):** The longest, heaviest, and strongest bone in the human body, situated in the thigh region. Its proximal head articulates with the acetabulum of the pelvic girdle.

2. **Patella (Knee cap):** A large, triangular-shaped sesamoid bone situated anteriorly at the knee joint. It develops within the tendon of the quadriceps femoris muscle and protects the knee joint, acting as a fulcrum for extension.

3. **Tibia and Fibula (Shank bones):** These form the lower leg skeleton below the knee. The **Tibia** (shin bone) is the larger, medial, weight-bearing bone, while the **Fibula** is slender and lateral.

4. **Tarsals (Ankle bones):** A group of 7 short, irregular bones located in the ankle region (including the calcaneus and talus).

5. **Metatarsals:** 5 elongated bones forming the sole of the foot.

6. **Phalanges:** 14 bones constituting the toes (arranged in a 2, 3, 3, 3, 3 pattern).

Step 2: Matching the sequence with the given options.

Let us check the structural sequence provided across the options from proximal to distal direction:

- Option (1): Femur → Tarsal → Patella → Tibia (Incorrect; tarsal is placed before the knee and shin).
- Option (2): Femur → Tibia → Patella → Tarsal (Incorrect; tibia cannot precede the patella chronologically down the limb).
- Option (3): Patella → Femur → Tibia → Tarsal (Incorrect; begins at the knee cap instead of the thigh bone).
- Option (4): Femur → Patella → Tibia → Tarsal (Correct; perfectly follows the anatomical order from the thigh down to the ankle).

Quick Tip: To remember the top-to-bottom sequence of major lower limb segments, think of your body movement: **Thigh → Knee → Shin → Ankle** Translate this directly to bones: **Femur → Patella → Tibia → Tarsal**

---

105. Which of the following plant growth regulators is used as herbicide ?

(1) Gibberellin

(2) 2,4-D

(3) Kinetin

(4) Abscisic acid

Correct Answer: (2) 2,4-D

Solution:

Concept: Synthetic plant growth regulators are extensively utilized in modern agricultural practices to optimize crop yields and manage weeds. Synthetic auxins have a unique property: when applied at exceptionally high or concentrated doses, they selectively target and disrupt the metabolic processes of specific plant groups without harming others. A classic example of such a chemical herbicide (weedicide) is **2,4-D** (2,4-Dichlorophenoxyacetic acid).

Step 1: Understanding the action and selectivity of 2,4-D.

The compound **2,4-D** is a powerful synthetic auxin. In agricultural fields, it is widely used as a selective herbicide because it specifically targets and eradicates **broad-leaved dicotyledonous weeds**, while leaving mature monocotyledonous plants (such as cereal crops like wheat, rice, maize, and lawn grasses) completely unaffected. It induces uncontrolled, rapid, and distorted cellular growth in the dicot weeds, leading to epinasty, twisting of stems, disruption of vascular transport phloem tissues, and eventual death of the weed. This makes it an incredibly useful tool for maintaining weed-free lawns and crop fields.

Step 2: Checking the other plant growth regulators for any herbicide properties.
Let us review the options to confirm they lack herbicidal functions:

- **(1) Gibberellin:** Used primarily to increase the length of grape stalks, elongate and improve the shape of fruits like apples, delay senescence, and speed up the malting process in the brewing industry. It is never used as an herbicide.
- **(3) Kinetin:** A type of cytokinin that promotes cell division, delays leaf senescence (Richmond-Lang effect), and helps overcome apical dominance. It is used in tissue culture to induce shoot differentiation but has no weed-killing property.
- **(4) Abscisic acid (ABA):** Functions as an internal plant hormone regulating stress responses and inducing seed dormancy. It is costly to synthesize artificially and is not used as a commercial agricultural spray or herbicide.

Thus, 2,4-D is specifically manufactured and marketed as a potent commercial herbicide.

Quick Tip: Keep this structural formula or shorthand in mind: **2,4-D = Dicot Destroyer.** It kills **D**icot weeds selectively. Because it is a synthetic auxin, it mimics normal plant hormones but acts like a poison at high concentrations only for broad-leaved plants, making it a stellar herbicide!

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106. Genus represents ___________.

(1) a group of closely related families
(2) an individual plant or animal
(3) a population of plants and animals
(4) a group of closely related species

Correct Answer: (4) a group of closely related species

Solution:

Concept: Taxonomic hierarchy consists of various ranks arranged in descending or ascending order, where each rank denotes a category or taxon. Moving upward from the most specific unit (Species), categories aggregate based on shared evolutionary similarities.

Step 1: Define Genus

A **Genus** comprises an assembly of species that share common structural, reproductive, and evolutionary characteristics. It ranks directly above the level of species and below the level of family. The component species within a genus possess more features in common with each other compared to species belonging to other genera. For example, the lion (*Panthera leo*), leopard (*Panthera pardus*), and tiger (*Panthera tigris*) are distinct species that all belong to the same genus, *Panthera*.

Step 2: Analyze and eliminate other options

- **Option (1):** A group of closely related families describes an **Order** or **Cohort**, not a genus.
- **Option (2):** An individual organism represents a single biological entity belonging to a specific population, which is the finest unit rather than a taxonomic grouping category.
- **Option (3):** A population refers to an ecological grouping of individuals of a single species occupying a particular geographic area, not a formal taxonomic grouping category like a genus.

Therefore, option (4) is correct.

Quick Tip: To remember the arrangement of standard taxonomic levels from broadest to most specific, memorize the phrase:

King **P**hilip **C**ame **O**ver **F**or **G**ood **S**oup

Kingdom → **P**hylum → **C**lass → **O**rder → **F**amily → **G**enus → **S**pecies

Since Species is at the base, the level right above it (**Genus**) is naturally a collection of closely related species!

107. The plastid that stores xanthophyll is known as ___________.

(1) amyloplast

(2) chloroplast

(3) chromoplast

(4) aleuroplast

Correct Answer: (3) chromoplast

Solution:

Concept: Plastids are semi-autonomous double-membrane-bound organelles found in the cells of plants and algae. Based on the presence or absence of specific pigments and their metabolic role, plastids are divided into three major classes: leucoplasts (colorless storage plastids), chloroplasts (green photosynthetic plastids), and chromoplasts (colored, non-photosynthetic plastids).

Step 1: Understand the nature of Chromoplasts

Chromoplasts are responsible for synthesizing and accumulating fat-soluble carotenoid pigments, such as carotene and **xanthophyll**. These pigments give parts of the plant—like flower petals, ripening fruits, and certain roots—their characteristic bright yellow, orange, or red colors. Thus, the plastid containing and storing xanthophyll is the chromoplast.

Step 2: Review and eliminate the alternative options

- **Option (1) Amyloplast:** This is a type of colorless leucoplast specialized specifically for the synthesis and storage of starch granules (e.g., in potato tubers).
- **Option (2) Chloroplast:** This contains chlorophyll and carotenoid pigments mainly dedicated to trapping solar energy for photosynthesis, giving plants their green appearance.
- **Option (4) Aleuroplast:** Also known as a proteinoplast, this is a specialized leucoplast that stores proteins (e.g., in maize grains).

This confirms option (3) is uniquely correct.

Quick Tip: Categorize plastids easily with this clean functional breakdown:

Plastid Type	Key Pigments / Material Stored	Color Profile
Chloroplast	Chlorophyll, Carotenoids (Photosynthesis)	Green
Chromoplast	Carotene, **Xanthophyll**	Yellow, Orange, Red
Amyloplast	Starch (Carbohydrate Storage)	Colorless
Aleuroplast	Proteins	Colorless
Elaioplast	Fats and Oils	Colorless

---

108. In water, frogs respire using ____________.

(1) trachea

(2) skin

(3) buccal cavity

(4) lungs

Correct Answer: (2) skin

Solution:

Concept: Amphibians like frogs exhibit diverse respiratory strategies depending on their environment and life cycle stage. Because they divide their life history between aquatic and terrestrial habitats, adult frogs utilize multiple respiratory surfaces: the skin, the lining of the buccal cavity, and the lungs.

Step 1: Analyze respiration in an aquatic medium

When a frog is fully submerged **in water**, its primary mode of gas exchange is through its highly vascularized, thin, and moist skin. This process is called **cutaneous respiration**. Dissolved oxygen in the water diffuses directly across the thin dermal layer into the subcutaneous blood capillaries, while carbon dioxide diffuses outward into the surrounding water.

Step 2: Understand respiration on land for context

When a frog moves onto land, it can use pulmonary respiration (via the lungs) and buccal respiration (via the moist epithelium lining the oral cavity). However, inside the water, the lungs remain inactive, and gas exchange relies almost entirely on cutaneous diffusion.

Therefore, option (2) is correct.

Quick Tip: Remember the two key rules for a frog's respiratory shifts:

- **In Water / During Hibernation & Aestivation:** Respiration is strictly **Cutaneous** (via the **skin**).
- **On Land:** Uses a mix of **Pulmonary** (lungs), **Buccal** (mouth lining), and **Cutaneous** (skin) respiration.

---

109. Which of the following is not a characteristic of chordates?

(1) Presence of post anal part (tail)

(2) Presence of notochord

(3) Central nervous system is dorsal

(4) Absence of gills

Correct Answer: (4) Absence of gills

Solution:

Concept: Phylum Chordata is defined by a distinct suite of fundamental morphological traits present at some stage of their development. Identifying non-chordate properties requires evaluating these key distinguishing markers against non-chordate invertebrates.

Step 1: Review the core characteristics of Chordates

True chordates are uniquely distinguished by four diagnostic features:

1. **Notochord:** A solid, flexible, rod-like skeletal structure running along the dorsal side during embryonic development.
2. **Dorsal Hollow Nerve Cord:** A single central nervous system strand located dorsally relative to the digestive tract.
3. **Pharyngeal Gill Slits:** Pairs of lateral openings or clefts in the wall of the pharynx, which function in respiration or filter feeding (retained as gills in fish or modified into alternative structures in higher terrestrial vertebrates during embryonic development).
4. **Post-anal Tail:** An elongation of the body extending past the anus.

Step 2: Evaluate the statement "Absence of gills"

Since **pharyngeal gill slits** are a defining baseline characteristic of chordates, stating that chordates are characterized by an *absence of gills* is factually incorrect. Many aquatic chordates (like fishes and protochordates) actively maintain functioning gills throughout their lives. Because the question explicitly asks for the feature that is **NOT** a characteristic of chordates, option (4) is the correct choice.

Quick Tip: Keep this comparative summary handy to instantly solve questions contrasting Chordates vs Non-Chordates:

Chordates	Non-Chordates
Notochord is present.	Notochord is absent.
Central Nervous System is **Dorsal, hollow, single.**	Central Nervous System is **Ventral, solid, double**
Pharyngeal **gill slits are present.**	Gill slits are absent.
Post-anal tail is present.	Post-anal tail is absent.

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110. Smooth endoplasmic reticulum ____________.

(1) is a site for the synthesis of carbohydrates

(2) has ribosomes attached to its surface

(3) is the major site for the synthesis of lipids

(4) is actively involved in protein synthesis

Correct Answer: (3) is the major site for the synthesis of lipids

Solution:

Concept: The endoplasmic reticulum (ER) is an extensive interconnected network of intracellular membrane-bound tubules and flattened sacs (cisternae) traversing the cytoplasm. It is structurally and functionally segregated into two distinct domains depending on the presence of membrane-bound translation machinery:

Step 1: Distinguish between RER and SER

- **Rough Endoplasmic Reticulum (RER):** Features outer membrane surfaces heavily studded with active **ribosomes**. This configuration specializes in synthesizing, folding, and sorting secretable or membrane-bound **proteins**.
- **Smooth Endoplasmic Reticulum (SER):** Lacks attached ribosomes on its outer face, giving it a smooth tubular appearance.

Step 2: Pinpoint the function of the Smooth Endoplasmic Reticulum (SER)

The SER contains specialized enzyme systems involved in metabolic processes. Its primary, well-documented cellular function is serving as the **major site for lipid synthesis** (including phospholipids, fatty acids, and cholesterol derivatives). In animal cells, the SER also synthesizes lipid-like steroid hormones (such as estrogen, progesterone, and testosterone) and helps detoxify drugs and metabolic toxins.

Step 3: Evaluate and rule out incorrect options

- **Option (1):** Complex carbohydrate processing or glycosylation occurs mainly inside the Golgi apparatus.
- **Option (2) & (4):** Possessing attached surface ribosomes and managing protein translation are defining characteristics exclusive to the **Rough** Endoplasmic Reticulum (RER).

Hence, option (3) is correct.

Quick Tip: Remember this clear division of labor for the Endoplasmic Reticulum:

$$\textbf{R}\text{ough ER (}\textbf{R}\text{ibosomes Present)} \implies \textbf{P}\text{rotein Synthesis}$$

$$\textbf{S}\text{mooth ER (}\textbf{S}\text{no Ribosomes)} \implies \textbf{L}\text{ipid \& Steroid Hormone Synthesis}$$

111.

Which of the following are characteristics of prokaryotic cells?

(a) Ribosomes are made of 50S and 30S subunits (b) They can have plasmids (c) They contain mesosome (d) They have peroxisomes

Choose the correct answer from the options given below :

(A) (a), (b) and (c) only

(B) (b) and (c) only

(C) (a) and (c) only

(D) (a), (c) and (d) only

Correct Answer: (1) (a), (b) and (c) only

Solution:

Concept:

Prokaryotic cells are the simplest and most primitive cellular organisms. They lack a true nucleus and membrane-bound organelles. Their genetic material remains in direct contact with the cytoplasm and is present in a nucleoid region. Bacteria, cyanobacteria and mycoplasma are examples of prokaryotes.

To identify the correct characteristics of prokaryotic cells, let us examine each statement individually.

Analysis of Statement (a): Ribosomes are made of 50S and 30S subunits

The ribosomes present in prokaryotic cells are of the 70S type.

A 70S ribosome consists of:

$$50S + 30S = 70S$$

where:

- 50S is the larger subunit.
- 30S is the smaller subunit.

These ribosomes are responsible for protein synthesis in bacteria and other prokaryotes.

Therefore, statement (a) is **correct**.

Analysis of Statement (b): They can have plasmids

Plasmids are small circular double-stranded DNA molecules that exist independently of the main bacterial chromosome.

They:

- Replicate independently.
- Often carry antibiotic resistance genes.
- Can be transferred from one bacterium to another.
- Are widely used in genetic engineering as vectors.

Since plasmids are commonly found in prokaryotes, statement (b) is **correct**.

Analysis of Statement (c): They contain mesosome

Mesosomes are infoldings of the plasma membrane reported in prokaryotic cells.
According to NCERT:

- Mesosomes are extensions of the plasma membrane.
- They help in cell wall formation.
- They assist in DNA replication and distribution to daughter cells.
- They increase the surface area of the plasma membrane.

Hence statement (c) is **correct**.

Analysis of Statement (d): They have peroxisomes
Peroxisomes are membrane-bound organelles.
They are present only in eukaryotic cells and contain enzymes involved in:

- Breakdown of hydrogen peroxide.
- Oxidative metabolism.
- Detoxification reactions.

Since prokaryotic cells lack membrane-bound organelles, they do not possess peroxisomes.
Therefore statement (d) is **incorrect**.

Thus:

$$(a),\ (b),\ (c)$$

are correct and

$$(d)$$

is incorrect.
Hence the correct answer is

$$\boxed{(1)\ (a),\ (b) \text{ and } (c) \text{ only}}$$

Quick Tip: Remember the key features of prokaryotes:

- 70S ribosomes (50S + 30S)
- Plasmids may be present
- Mesosomes present
- No membrane-bound organelles
- No mitochondria, ER, Golgi bodies or peroxisomes

---

112. Match List-I with List-II.

List-I		List-II	
A	Cristae	I	Flat membrane sacs in stroma of chloroplast
B	Cisternae	II	Infoldings in mitochondria
C	Thylakoids	III	Cell membrane
D	Phospholipid	IV	Disc-shaped sacs in Golgi apparatus

Choose the correct answer from the options given below :

(1) A-IV, B-III, C-I, D-II

(2) A-III, B-IV, C-I, D-II

(3) A-II, B-IV, C-I, D-III

(4) A-II, B-IV, C-III, D-I

Correct Answer: (3) A-II, B-IV, C-I, D-III

Solution:

Concept:

Different cellular organelles possess characteristic structural components. Proper identification of these structures is essential for understanding cell organization and function.

Let us match each term carefully.

A. Cristae

Cristae are inward foldings of the inner mitochondrial membrane.

They:

- Increase surface area.

- Contain ATP synthesizing enzymes.
- Are the sites of oxidative phosphorylation.

Therefore,

$$A \rightarrow II$$

B. Cisternae

Cisternae are flattened membrane-bound sacs that form the Golgi apparatus.
They are involved in:

- Packaging of proteins.
- Modification of biomolecules.
- Secretion.

Hence,

$$B \rightarrow IV$$

C. Thylakoids

Thylakoids are flattened membrane sacs present in the chloroplast stroma.
They contain:

- Chlorophyll pigments.
- Photosystems.
- Electron transport chain components.

Therefore,

$$C \rightarrow I$$

D. Phospholipid

The plasma membrane is primarily composed of phospholipid molecules arranged in a bilayer.
Thus,

$$D \rightarrow III$$

Combining all matches:

$$A - II, \quad B - IV, \quad C - I, \quad D - III$$

Hence the correct option is

$$\boxed{(3)}$$

Quick Tip: Remember these one-line associations:

- Cristae $\rightarrow$ Mitochondria
- Cisternae $\rightarrow$ Golgi apparatus
- Thylakoids $\rightarrow$ Chloroplast
- Phospholipid $\rightarrow$ Cell membrane

---

113. Which of the following statements related to pituitary gland are correct?

(a) It is divided anatomically into adenohypophysis and neurohypophysis (b) It secretes follicle stimulating hormone (c) It secretes melanocyte stimulating hormone (d) It does not secrete prolactin

Choose the correct answer from the options given below :

(A) (b) and (c) only

(B) (a) and (b) only

(C) (a), (b) and (c) only

(D) (c) and (d) only

Correct Answer: (3) (a), (b) and (c) only

Solution:

Concept:

The pituitary gland is known as the "master gland" because it regulates the activity of several other endocrine glands through its hormones.

It is attached to the hypothalamus and is located at the base of the brain.

Let us examine each statement.

Statement (a)

The pituitary gland is anatomically divided into:

- Adenohypophysis (anterior pituitary)
- Neurohypophysis (posterior pituitary)

Hence statement (a) is **correct**.

Statement (b)

Follicle Stimulating Hormone (FSH) is secreted by the anterior pituitary.

Functions of FSH include:

- Stimulating ovarian follicle development in females.
- Stimulating spermatogenesis in males.

Therefore statement (b) is **correct**.

Statement (c)

The pars intermedia of the pituitary gland secretes Melanocyte Stimulating Hormone (MSH).

MSH influences pigmentation processes.

Therefore statement (c) is **correct**.

Statement (d)

Prolactin is secreted by the anterior pituitary gland.

Its primary function is:

- Initiation and maintenance of milk production after childbirth.

Hence the statement that pituitary gland does not secrete prolactin is false.

Therefore statement (d) is **incorrect**.

Thus statements

$$(a),\ (b),\ (c)$$

are correct.

Hence the correct answer is

$$\boxed{(3)\ (a),\ (b) \text{ and } (c) \text{ only}}$$

Quick Tip: Important pituitary hormones:

- GH
- TSH
- ACTH
- FSH
- LH
- Prolactin
- MSH

Most of these are secreted by the anterior pituitary.

---

114. Which of the following statements regarding photorespiration are correct?

(A) Does not occur in C_3 plants (B) CO_2 is consumed and O_2 is generated (C) Phosphoglycolate is formed (D) No synthesis of ATP and NADPH

Choose the correct answer from the options given below :

(A) (a) and (b) only

(B) (a) and (d) only

(C) (c) and (d) only

(D) (b) and (d) only

Correct Answer: (3) (c) and (d) only

Solution:

Concept:

Photorespiration is a process initiated when the enzyme RuBisCO acts as an oxygenase instead of a carboxylase.

This generally occurs under conditions of:

- High oxygen concentration
- Low carbon dioxide concentration
- High temperature

The process involves chloroplasts, peroxisomes and mitochondria.

Let us analyze each statement.

Statement (a): Does not occur in C_3 plants

Photorespiration is actually a characteristic feature of C_3 plants.

C_4 plants largely avoid photorespiration through their carbon concentrating mechanism.

Therefore statement (a) is **incorrect**.

Statement (b): CO_2 is consumed and O_2 is generated

In photorespiration:

- Oxygen is consumed.
- Carbon dioxide is released.

Thus the given statement is exactly opposite to what occurs.

Hence statement (b) is **incorrect**.

Statement (c): Phosphoglycolate is formed

When RuBisCO acts as an oxygenase:

$$RuBP + O_2$$

produces

$$\text{3-PGA} + \text{2-phosphoglycolate}$$

Therefore phosphoglycolate is indeed formed.

Hence statement (c) is **correct**.

Statement (d): No synthesis of ATP and NADPH

Photorespiration is considered a wasteful process because:

- ATP is not produced.
- NADPH is not produced.
- Carbon dioxide is released.
- Previously fixed carbon is lost.

Therefore statement (d) is **correct**.

Hence only statements

$$(c) \text{ and } (d)$$

are correct.

Therefore the correct answer is

$$\boxed{(3)\ (c) \text{ and } (d) \text{ only}}$$

Quick Tip: Photorespiration is often called a wasteful pathway because:

- O_2 is consumed.
- CO_2 is released.
- ATP is not synthesized.
- NADPH is not synthesized.
- Fixed carbon is lost.

It is most prominent in C_3 plants.

115. Which of the following statements is incorrect?

(A) Fibrinogen is produced from fibrin

(B) Blood coagulates in response to an injury

(C) Blood clot consists of fibrins

(D) Fibrin is produced from fibrinogen

Correct Answer: (1) Fibrinogen is produced from fibrin

Solution:

Concept:

Blood coagulation or blood clotting is an extremely important protective mechanism of the human body. Whenever an injury causes damage to blood vessels, the body activates a sequence of biochemical reactions known as the clotting cascade. This process prevents excessive blood loss.

A protein called fibrinogen, which is soluble in blood plasma, gets converted into an insoluble protein called fibrin by the action of the enzyme thrombin. These fibrin threads form a mesh-like network that traps blood cells and ultimately forms the blood clot.

To answer this question, we need to understand the direction of conversion between fibrinogen and fibrin and identify which statement incorrectly represents this biological process.

Step 1: Understand the role of fibrinogen in blood clotting.

Fibrinogen is a soluble plasma protein present in circulating blood. It remains inactive under normal physiological conditions.

When tissue damage occurs, clotting factors become activated and eventually convert prothrombin into thrombin.

Thrombin then acts on fibrinogen and converts it into fibrin.

Thus, the biological pathway is

$$Fibrinogen \rightarrow Fibrin$$

and not the reverse process.

Step 2: Check Option (A).

Option (A) states

Fibrinogen is produced from fibrin

This is scientifically incorrect.

Fibrinogen is the precursor molecule and fibrin is produced from fibrinogen during coagulation.

Hence this statement reverses the actual biological process.

Therefore option (A) is incorrect.

Step 3: Verify the remaining options.

Option (B):

Blood coagulates in response to injury.

This is correct because clotting is a defense mechanism activated during vascular injury.

Option (C):

Blood clot consists of fibrins.

This is correct because fibrin forms thread-like fibers making the clot mesh.

Option (D):

Fibrin is produced from fibrinogen.

This is biologically correct.

Step 4: Determine final answer.

Since only Option (A) contradicts the actual blood clotting mechanism, it is the incorrect statement.

Hence,

$$\boxed{\text{Option (1)}}$$

Quick Tip: Remember the blood clotting conversion sequence as: Fibrinogen (soluble) → Fibrin (insoluble clot fibers). If reversed in options, it is incorrect.

---

116. Arrange the following taxonomic categories in ascending order.

(a) Genus (b) Class (c) Order (d) Phylum

(e) Family (f) Kingdom (g) Species

(A) (f), (c), (b), (g), (d), (e), (a)

(B) (g), (a), (e), (c), (b), (d), (f)

(C) (a), (c), (d), (g), (f), (b), (e)

(D) (g), (c), (d), (b), (e), (a), (f)

Correct Answer: (2)

Solution:

Concept:

Biological classification organizes organisms into hierarchical taxonomic categories based on similarities and evolutionary relationships.

Taxonomy follows a fixed hierarchy from smallest category to largest category.

The standard taxonomic sequence is

$$Species \rightarrow Genus \rightarrow Family \rightarrow Order \rightarrow Class \rightarrow Phylum \rightarrow Kingdom$$

Ascending order means moving from smallest level toward highest and broadest level.

Step 1: Recall taxonomic hierarchy.

The biological classification system groups organisms systematically.

The smallest taxonomic unit is species because members share maximum similarity.

Above species comes genus, then family, then order.

Higher categories include class, phylum, and finally kingdom.

Thus sequence becomes

$$Species < Genus < Family < Order < Class < Phylum < Kingdom$$

Step 2: Convert into given letter sequence.

Given letters:

Species = g

Genus = a

Family = e

Order = c

Class = b

Phylum = d

Kingdom = f

So required order is

$$(g), (a), (e), (c), (b), (d), (f)$$

Step 3: Match with options.

Checking options carefully

Option (B) exactly matches required sequence.

Therefore Option (2) is correct.

Step 4: State final answer.

Hence correct ascending arrangement is

$$Species \to Genus \to Family \to Order \to Class \to Phylum \to Kingdom$$

Thus

$$\boxed{\text{Option (2)}}$$

Quick Tip: Memorize taxonomy using shortcut: King Philip Came Over For Good Soup (Kingdom, Phylum, Class, Order, Family, Genus, Species) Reverse it for ascending order.

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117. Select the correct sequence of experiments that led to gradual understanding of photosynthesis in green plants.

(A) Production of glucose → role of air → release of oxygen → absorption spectra of chlorophyll a and b

(B) Absorption spectra of chlorophyll a and b → production of glucose → release of oxygen → role of air

(C) Role of air → release of oxygen → production of glucose → absorption spectra of chlorophyll a and b

(D) Release of oxygen → production of glucose → absorption spectra of chlorophyll a and b → role of air

Correct Answer: (3)

Solution:

Concept:
The understanding of photosynthesis developed gradually through contributions of many scientists.
Important discoveries happened chronologically.
Scientists first studied the role of air in plant growth, then oxygen release, then formation of glucose as food, and later chlorophyll absorption spectra.
Thus historical order matters.

Step 1: Identify earliest discovery.

Jan Ingenhousz and Joseph Priestley studied the role of air and showed plants restore air quality.
This established the role of air in photosynthesis.
Hence first stage:

$$\text{Role of air}$$

Step 2: Identify second discovery.

Further experiments showed that green plants release oxygen during photosynthesis.
This established oxygen evolution.
Hence second stage:

$$\text{Release of oxygen}$$

Step 3: Identify later discoveries.

Scientists later discovered that photosynthesis produces glucose as stored chemical energy.
Afterward, chlorophyll pigments were studied and their absorption spectra were determined.
Hence sequence becomes

$$\text{Role of air} \rightarrow \text{Release of oxygen} \rightarrow \text{Production of glucose} \rightarrow \text{Absorption spectra}$$

Step 4: Match options.

Option (C) matches perfectly.

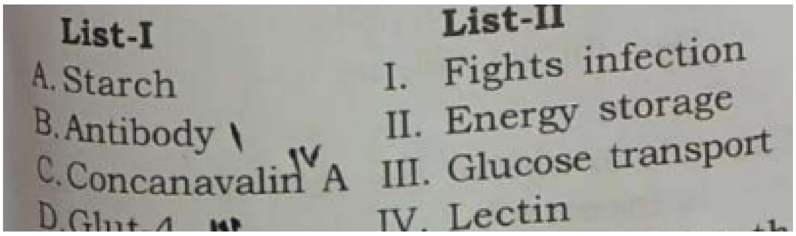
Therefore

$$\boxed{\text{Option (3)}}$$

Quick Tip: Historical order of photosynthesis discovery: Air role → Oxygen release → Food production → Chlorophyll absorption study.

---

118. Match List-I with List-II.



List-I	List-II
A. Starch	I. Fights infection
B. Antibody	II. Energy storage
C. Concanavalin A	III. Glucose transport
D. Glut-4	IV. Lectin

(A) A-II, B-I, C-IV, D-III

(B) A-I, B-II, C-IV, D-III

(C) A-II, B-I, C-III, D-IV

(D) A-I, B-II, C-III, D-IV

Correct Answer: (1)

Solution:

Concept:

Biological molecules and proteins have specialized functions.

Correct matching depends on understanding each molecule individually.

Starch stores energy.

Antibodies defend against infection.

Concanavalin A is lectin.

GLUT-4 transports glucose.

Step 1: Match starch.

Starch is the storage carbohydrate in plants.
Hence

$$A \to II$$

Step 2: Match antibody.

Antibodies are proteins produced by immune system against pathogens.
Their main role is defense against infection.
Hence

$$B \to I$$

Step 3: Match remaining terms.

Concanavalin A is a lectin protein.
Thus

$$C \to IV$$

GLUT-4 is glucose transporter protein.
Thus

$$D \to III$$

Step 4: Final arrangement.

Complete match:

$$A - II,\ B - I,\ C - IV,\ D - III$$

Thus answer is

$$\boxed{\text{Option (1)}}$$

Quick Tip: Remember: Starch = Storage Antibody = Infection defense GLUT-4 = Glucose transport Concanavalin A = Lectin

---

119. The number of vertebrae in a human is

(A) 206

(B) 7

(C) 12

(D) 26

Correct Answer: (4) 26

Solution:

Concept:

The human vertebral column forms the central supporting axis of the body.

In early life humans possess 33 vertebrae, but some fuse during adulthood.

Thus adults effectively have 26 vertebral bones.

Step 1: Understand vertebral divisions.

The vertebral column consists of

7 cervical vertebrae

12 thoracic vertebrae

5 lumbar vertebrae

5 sacral fused vertebrae

4 coccygeal fused vertebrae

Step 2: Calculate total in adults.

Since sacral and coccygeal regions fuse,

Adult count becomes

$$24 + 1 + 1 = 26$$

Step 3: Check options.

206 = total bones of body

7 = cervical only

12 = thoracic only

26 = adult vertebral column

Hence answer

$$\boxed{\text{Option (4)}}$$

Quick Tip: Remember: 33 vertebrae in young age 26 bones in adult vertebral column after fusion.

---

120. Endomembrane system includes

(A) Golgi complex, chloroplast, peroxisomes and vacuole

(B) Endoplasmic reticulum, Golgi complex, lysosomes and vacuole

(C) Endoplasmic reticulum, chloroplast, peroxisomes and vacuole

(D) Mitochondria, chloroplast, peroxisomes and vacuole

Correct Answer: (2)

Solution:

Concept:
The endomembrane system is a group of membrane-bound organelles working together in synthesis, packaging, modification and transport of cellular substances.
Organelles included are interconnected functionally.
However mitochondria, chloroplast and peroxisomes function independently and are excluded.
Step 1: Identify organelles included in endomembrane system.

The endomembrane system consists of

Endoplasmic reticulum

Golgi apparatus

Lysosomes

Vacuoles

These work together in protein transport and secretion.

Step 2: Understand excluded organelles.

Mitochondria produce ATP.

Chloroplast performs photosynthesis.

Peroxisomes perform oxidation reactions.

These function separately.

Hence not included.

Step 3: Check options carefully.

Only Option (B) contains correct components.

$$ER + Golgi + Lysosome + Vacuole$$

Step 4: Final answer.

Therefore correct answer is

$$\boxed{\text{Option (2)}}$$

Quick Tip: Endomembrane System = ER + Golgi + Lysosome + Vacuole. Never include mitochondria, chloroplast or peroxisomes.

---

121. Length of the stem at time 0 is 20 cm. The arithmetic growth rate is 30 cm per day. What is the length of the stem at the end of the 7th day?

(A) 460 cm

(B) 50 cm

(C) 170 cm

(D) 230 cm

Correct Answer: (4) 230 cm

Solution:

Concept:
Arithmetic growth refers to a pattern of growth in which increase occurs by a constant amount during equal intervals of time. In biological growth patterns, arithmetic growth means the organism increases by a fixed quantity each day rather than increasing proportionally.
The mathematical relation used for arithmetic growth is

$$L_t = L_0 + rt$$

where

$$L_t = \text{Length after time } t$$

$$L_0 = \text{Initial length}$$

$$r = \text{Growth rate}$$

$$t = \text{Time}$$

Since the increase is constant every day, we directly substitute values into the formula.
Step 1: Identify all quantities given in the question.

The problem states:
Initial stem length at time zero

$$L_0 = 20\ cm$$

Arithmetic growth rate

$$r = 30\ cm/day$$

Time duration

$$t = 7\ days$$

We now substitute these values into the arithmetic growth formula.

Step 2: Apply arithmetic growth formula.

The formula is

$$L_t = L_0 + rt$$

Substituting values

$$L_t = 20 + (30 \times 7)$$

Multiplication gives

$$L_t = 20 + 210$$

Step 3: Calculate final length.

Adding the two terms

$$L_t = 230\ cm$$

This means after seven days, the stem length becomes 230 centimeters.

Step 4: Match with answer options.

Checking options:

460 cm $\rightarrow$ incorrect

50 cm $\rightarrow$ incorrect

170 cm $\rightarrow$ incorrect

230 cm $\rightarrow$ correct

Therefore correct answer is

$$\boxed{230\ cm}$$

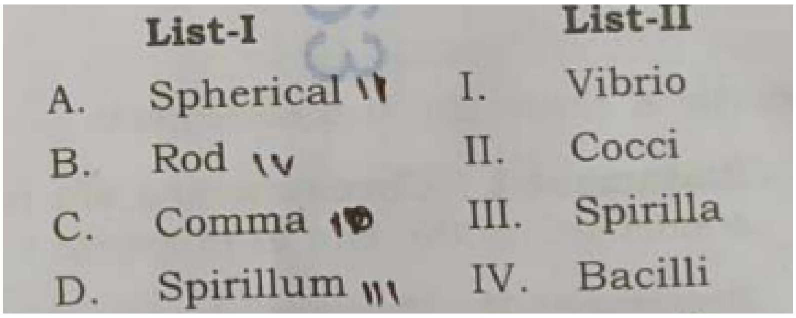
Hence

Option (4)

Quick Tip: Arithmetic growth means constant increase per unit time. Always use formula $L_t = L_0 + rt$ where growth rate remains fixed.

122.

Match List-I with List-II.



	List-I		List-II
A.	Spherical II	I.	Vibrio
B.	Rod IV	II.	Cocci
C.	Comma I	III.	Spirilla
D.	Spirillum III	IV.	Bacilli

(A) A-II, B-IV, C-I, D-III

(B) A-I, B-III, C-II, D-IV

(C) A-III, B-II, C-I, D-IV

(D) A-II, B-I, C-IV, D-III

Correct Answer: (1)

Solution:

Concept:

Bacteria are classified on the basis of shape. Morphological classification is one of the simplest methods of bacterial categorization.

Different bacterial shapes have specific scientific names.

The major bacterial forms include spherical bacteria, rod-shaped bacteria, comma-shaped bacteria and spiral-shaped bacteria.

Understanding these shapes helps us correctly match the terms.

Step 1: Identify spherical bacteria.

Spherical bacteria are known as cocci.

They are round or globe-shaped bacterial cells.

Examples include Streptococcus and Staphylococcus.

Therefore

$$A \to II$$

Step 2: Identify rod-shaped bacteria.

Rod-shaped bacteria are scientifically called bacilli.

These elongated bacterial cells include organisms such as Lactobacillus.

Thus

$$B \to IV$$

Step 3: Identify comma-shaped bacteria.

Comma-shaped bacteria are known as vibrio.

A well-known example is Vibrio cholerae which causes cholera.

Hence

$$C \to I$$

Step 4: Identify spiral-shaped bacteria.

Spiral bacteria are called spirilla.

These organisms possess twisted spiral structure.

Therefore

$$D \to III$$

Final matching becomes

$$A - II,\ B - IV,\ C - I,\ D - III$$

Thus answer is

$\boxed{\text{Option (1)}}$

Quick Tip: Remember bacterial shapes: Cocci = Spherical Bacilli = Rod shaped Vibrio = Comma shaped Spirilla = Spiral shaped

---

123. The number of action potentials generated by sino-atrial node (SAN) in a healthy human is ______ per minute.

(A) 120 – 140

(B) 28 – 30

(C) 70 – 75

(D) 100 – 110

Correct Answer: (3) 70 – 75

Solution:

Concept:

The sinoatrial node (SAN) is called the natural pacemaker of the human heart. It is a specialized group of cardiac muscle fibers located in the right atrium.

Its main function is to generate electrical impulses automatically. These electrical impulses initiate each heartbeat.

The rate at which SAN generates impulses determines the normal heart rate.

In healthy adults, SAN generates approximately 70 to 75 electrical impulses every minute.

Step 1: Understand the role of sinoatrial node.

The human heart contains specialized tissues responsible for generating rhythmic impulses.

The sinoatrial node is the primary pacemaker.

Its impulse spreads through atria causing atrial contraction.

Because SAN starts every heartbeat, its firing rate determines heartbeat frequency.

Step 2: Recall normal physiological rate.

According to human physiology,

SAN generates approximately

$$70 - 75$$

action potentials every minute.

Each impulse initiates one heartbeat.

Therefore resting heart rate remains approximately within this range.

Step 3: Examine wrong options.

120–140 $\rightarrow$ much higher than normal resting rate

28–30 $\rightarrow$ abnormally low

100–110 $\rightarrow$ higher than normal physiological average

70–75 $\rightarrow$ correct physiological range

Step 4: Final conclusion.

Thus normal impulse generation rate of SAN is

$$70 - 75$$

Hence correct answer is

$$\boxed{\text{Option (3)}}$$

Quick Tip: SAN = Natural pacemaker of heart. Normal firing rate = 70–75 impulses per minute. This controls normal resting heart rhythm.

---

124. Match List-I with List-II.

	List-I		List-II
A.	Family	I.	Sapindales
B.	Genus	II.	Dicotyledonae
C.	Class	III.	Anacardiaceae
D.	Phylum	IV.	Angiospermae
E.	Order	V.	*Mangifera*

Choose the correct answer from the options given below:

(A) A-III, B-V, C-II, D-IV, E-I

(B) A-I, B-V, C-II, D-IV, E-III

(C) A-II, B-I, C-III, D-IV, E-V

(D) A-II, B-III, C-V, D-I, E-IV

Correct Answer: (1) A-III, B-V, C-II, D-IV, E-I

Solution:

Concept: Biological classification arranges organisms in a hierarchical system from broader categories to more specific categories. The taxonomic hierarchy is generally:

$$Kingdom \rightarrow Phylum \rightarrow Class \rightarrow Order \rightarrow Family \rightarrow Genus \rightarrow Species$$

Each category helps in organizing organisms according to similarities and evolutionary relationships. To solve matching questions, we identify the correct taxonomic level associated with each biological term.

Step 1: Identify Family.

Family is a taxonomic category placed above genus and below order.

Among the given terms:

$$\text{Anacardiaceae}$$

is a family. Therefore,

$$A \rightarrow III$$

Step 2: Identify Genus.

Genus is a group of closely related species.

The term

$$\textit{Mangifera}$$

belongs to genus classification (example: Mango belongs to genus Mangifera). Therefore,

$$B \rightarrow V$$

Step 3: Identify Class.

Class is a category above order and below phylum/division.

The term

$$\text{Dicotyledonae}$$

represents a class of flowering plants having two cotyledons. Hence,

$$C \rightarrow II$$

Step 4: Identify Phylum.

Phylum (or Division in plants) is a major category below kingdom.

The term

$$\text{Angiospermae}$$

belongs to a major plant division/phylum containing flowering plants. Therefore,

$$D \rightarrow IV$$

Step 5: Identify Order.

Order is a taxonomic rank between class and family.

The term

$$\text{Sapindales}$$

is a plant order. Hence,

$$E \to I$$

Step 6: Final arrangement.

Thus we obtain

$$A - III,\ B - V,\ C - II,\ D - IV,\ E - I$$

which exactly matches option (1).

$$\boxed{\text{Correct Answer} = \text{Option (1)}}$$

Quick Tip: Remember the biological hierarchy in sequence:

Kingdom → Phylum → Class → Order → Family → Genus → Species

Learning this order helps solve matching questions quickly.

---

125. Which of the following is not a part of human central neural system?

(A) Pericardium

(B) Arachnoid

(C) Dura mater

(D) Pia mater

Correct Answer: (1) Pericardium

Solution:

Concept: The human central nervous system (CNS) consists mainly of:

$$\text{Brain} + \text{Spinal Cord}$$

These structures are protected by three connective tissue membranes called meninges. They are:

- Dura mater

- Arachnoid mater
- Pia mater

Any structure unrelated to these protective membranes cannot be part of CNS.

Step 1: Study Pericardium.

Pericardium is a double-layered membrane surrounding the heart.

Its function is to protect the heart and reduce friction during heartbeats.

It belongs to the circulatory system, not nervous system.

Hence, Pericardium is not part of CNS.

Step 2: Study Arachnoid mater.

Arachnoid mater is the middle protective membrane surrounding brain and spinal cord.

It forms part of meninges. Therefore it belongs to CNS protection.

Step 3: Study Dura mater.

Dura mater is the outer tough protective covering around brain and spinal cord.

It protects the central nervous system from injury. Hence it is part of CNS protective covering.

Step 4: Study Pia mater.

Pia mater is the innermost delicate membrane directly attached to brain and spinal cord.

It supplies nourishment and protection. Therefore it is also part of CNS.

Step 5: Compare all options.

Three options belong to meninges of CNS:

$$\text{Arachnoid, Dura mater, Pia mater}$$

One option belongs to heart:

$$\text{Pericardium}$$

Thus the incorrect one is

$$\boxed{\text{Pericardium}}$$

$$\boxed{\text{Correct Answer} = \text{Option (1)}}$$

Quick Tip: Three meninges protecting CNS:

Outer = Dura mater

Middle = Arachnoid mater

Inner = Pia mater

Pericardium protects heart, not brain.

---

126. Given below are two statements:

Statement I: Chromosomes are fully condensed at the end of prophase I.

Statement II: Meiosis I resembles mitosis.

Choose the most appropriate answer from the options given below:

(A) Statement I is incorrect, but Statement II is true

(B) Both Statement I and Statement II are true

(C) Both Statement I and Statement II are false

(D) Statement I is correct, but Statement II is false

Correct Answer: (4) Statement I is correct, but Statement II is false

Solution:

Concept: Meiosis is a special type of cell division producing haploid cells from diploid parent cells. It occurs in two stages:

$$\text{Meiosis I and Meiosis II}$$

Meiosis I is called reduction division because chromosome number becomes half.

Mitosis produces identical daughter cells without reduction in chromosome number.

Step 1: Analyze Statement I.

Prophase I is the first stage of meiosis I.

It consists of five sub-stages:

- Leptotene
- Zygotene
- Pachytene
- Diplotene
- Diakinesis

During the final stage called diakinesis, chromosomes become maximally shortened and fully condensed.
Thus chromosomes are fully condensed at end of prophase I.
So Statement I is correct.
Step 2: Analyze Statement II.

Meiosis I involves:

- Synapsis of homologous chromosomes
- Crossing over
- Separation of homologous chromosomes
- Reduction in chromosome number

These processes do not occur in mitosis.
Therefore meiosis I is fundamentally different from mitosis.
Step 3: Understand which stage resembles mitosis.

Meiosis II resembles mitosis because in both divisions:

- Sister chromatids separate
- Chromosome number remains unchanged during division
- Similar spindle behavior occurs

Hence saying "Meiosis I resembles mitosis" is incorrect.
Step 4: Evaluate statements.

Statement I $\rightarrow$ True

Statement II $\rightarrow$ False

Thus correct conclusion becomes

$$\boxed{\text{Statement I is correct but Statement II is false}}$$

$$\boxed{\text{Correct Answer} = \text{Option (4)}}$$

Quick Tip: Remember:

Meiosis I = Reduction division (different from mitosis)

Meiosis II = Equational division (resembles mitosis)

A common exam trick is confusing Meiosis I and Meiosis II.

---

127. Match List-I with List-II.

List-I	List-II
A. Marginal placentation	I. *Argemone*
B. Axile placentation	II. Tomato
C. Parietal placentation	III. *Primrose*
D. Free central placentation	IV. Pea

(A) A-IV, B-II, C-I, D-III

(B) A-II, B-IV, C-I, D-III

(C) A-IV, B-II, C-III, D-I

(D) A-IV, B-III, C-I, D-II

Correct Answer: (1)

Solution:

Concept:

Placentation refers to the arrangement of ovules inside the ovary of a flower. It is an important characteristic used in plant morphology and classification.

Different plants possess different arrangements of ovules depending upon the structure of the ovary.

The important placentation types include marginal, axile, parietal and free central placentation.

To solve matching questions, we must know representative examples of each type.

Step 1: Understand marginal placentation.

In marginal placentation, the placenta forms a ridge along the ventral suture of the ovary.

Ovules develop along this ridge.

A common example is pea.

Thus

$$A \rightarrow IV$$

Step 2: Understand axile placentation.

In axile placentation, ovules are attached to a central axis and the ovary is divided into multiple chambers.

A common example is tomato.

Hence

$$B \rightarrow II$$

Step 3: Understand parietal placentation.

In parietal placentation, ovules are attached to the inner wall of the ovary.

The ovary usually remains unilocular.

Argemone shows parietal placentation.

Therefore

$$C \rightarrow I$$

Step 4: Understand free central placentation.

In free central placentation, ovules develop on a central axis but septa are absent.

Primrose is a classic example.

Thus

$$D \rightarrow III$$

Final matching becomes

$$A-IV,\ B-II,\ C-I,\ D-III$$

Therefore correct answer is

$$\boxed{\text{Option (1)}}$$

Quick Tip: Remember examples: Marginal = Pea Axile = Tomato Parietal = Argemone Free Central = Primrose

---

128. Symbiotic association between fungi and algae are called ______.

(A) Chrysophytes

(B) Lichens

(C) Sponges

(D) Mycorrhiza

Correct Answer: (2) Lichens

Solution:

Concept:
Symbiosis is a biological relationship in which two different organisms live together and both may benefit from each other.
A classic example is the association between algae and fungi.
The algal component performs photosynthesis and provides food, while fungal component absorbs water and minerals and offers protection.
This combined association is known as lichen.
Step 1: Understand role of algae in symbiosis.

Algae contain chlorophyll.

They perform photosynthesis using sunlight.

As a result, they synthesize carbohydrates.

This food supports both partners.

Step 2: Understand role of fungus.

Fungi do not perform photosynthesis.

They absorb water and minerals from surroundings.

They also provide shelter and protection to algal cells.

Thus both organisms benefit.

Step 3: Identify correct biological term.

The combined structure of algae and fungi is called lichen.

This is a stable mutualistic association.

The term mycorrhiza refers to fungus-root association, not algae-fungus association.

Step 4: Eliminate wrong options.

Chrysophytes = protists

Sponges = animals

Mycorrhiza = fungi + roots

Lichens = fungi + algae

Hence correct answer is

$$\boxed{\text{Option (2)}}$$

Quick Tip: Lichen = Fungus + Alga Mycorrhiza = Fungus + Plant root Do not confuse these two associations.

---

129. Which of the following is not a prokaryote?

(A) Fungi

(B) Bacteria

(C) Blue green algae

(D) Mycoplasma

Correct Answer: (1) Fungi

Solution:

Concept:

Living organisms are divided into prokaryotic and eukaryotic organisms based on cellular organization.

Prokaryotic organisms lack a true nucleus and membrane-bound organelles.

Eukaryotic organisms possess a true nucleus and organized membrane-bound cell structures.

To solve this question, we must identify which organism belongs to eukaryotes.

Step 1: Understand characteristics of prokaryotes.

Prokaryotes possess

No true nucleus

No membrane-bound organelles

Circular DNA

Simple cell organization

Examples include bacteria, cyanobacteria and mycoplasma.

Step 2: Check bacteria and blue green algae.

Bacteria are classical prokaryotic organisms.

Blue green algae are cyanobacteria.

Cyanobacteria also lack true nucleus.

Thus both are prokaryotes.

Step 3: Check mycoplasma.

Mycoplasma are smallest living cells.

They lack cell wall but are still prokaryotic organisms.

Hence they are prokaryotes.

Step 4: Check fungi.

Fungi possess

True nucleus

Membrane-bound organelles

Complex cell organization

Thus fungi are eukaryotic organisms.

Hence fungi are not prokaryotes.

Therefore answer is

$$\boxed{\text{Option (1)}}$$

Quick Tip: Prokaryotes include: Bacteria Cyanobacteria (blue green algae) Mycoplasma
Fungi are always eukaryotic.

---

130. The pigment responsible for the red colour of ripe tomato is

(A) Xanthophyll

(B) Lycopene

(C) Chlorophyll

(D) Anthocyanin

Correct Answer: (2) Lycopene

Solution:

Concept:
Plants contain different types of pigments that are responsible for absorbing light and producing characteristic colours in fruits, flowers, and leaves. These pigments belong to different chemical groups and each pigment performs specific biological functions.
The major plant pigments include chlorophyll, carotenoids, xanthophylls, anthocyanins and lycopene.
Tomato changes colour during ripening because chlorophyll gradually breaks down and another pigment accumulates in high concentration.
The red colour in ripe tomato is mainly due to the carotenoid pigment called lycopene.
Step 1: Understand the process of fruit ripening.

During fruit ripening, chemical changes occur inside fruit tissues.
Green fruits initially contain chlorophyll, which is responsible for green coloration.

As ripening begins, chlorophyll molecules degrade and become reduced in concentration.

At the same time, other pigments begin accumulating.

Thus colour transformation occurs because pigment composition changes during maturation.

Step 2: Study the function of lycopene.

Lycopene is a red carotenoid pigment.

It is commonly found in tomato and several other red fruits.

Its major characteristic is strong red pigmentation.

It also functions as an antioxidant and protects plant tissues from oxidative damage.

In tomatoes, high lycopene concentration gives the characteristic bright red colour.

Thus

$$\text{Tomato red colour} \rightarrow \text{Lycopene}$$

Step 3: Eliminate incorrect options carefully.

Option (A) Xanthophyll

Xanthophyll produces yellow coloration, not red.

Option (C) Chlorophyll

Chlorophyll is responsible for green colour in leaves and immature fruits.

Option (D) Anthocyanin

Anthocyanin produces red, purple or blue coloration in flowers and some fruits but not specifically tomato red pigmentation.

Only lycopene matches correctly.

Step 4: Determine final answer logically.

Since ripe tomato obtains its red colour because of accumulation of lycopene pigment, the correct answer becomes

$$\boxed{\text{Lycopene}}$$

Therefore

$$\boxed{\text{Option (2)}}$$

Quick Tip: Remember important pigments: Chlorophyll = Green Xanthophyll = Yellow Carotene = Orange Lycopene = Red (Tomato) Anthocyanin = Purple/Blue/Red in flowers and fruits

---

131. Which of the following statement is correct regarding enzymes?

(A) Enzymes are consumed permanently after reaction

(B) Enzymes lower activation energy of reaction

(C) Enzymes increase activation energy of reaction

(D) Enzymes are inorganic compounds

Correct Answer: (2) Enzymes lower activation energy of reaction

Solution:

Concept:

Enzymes are biological catalysts that accelerate biochemical reactions occurring inside living organisms. Almost every metabolic reaction inside cells depends upon enzymes.

A catalyst is a substance that increases reaction speed without being permanently consumed during the reaction.

For any chemical reaction to begin, reactant molecules must overcome an energy barrier called activation energy.

Enzymes function by lowering this activation energy barrier so reactions proceed rapidly under normal physiological conditions.

Step 1: Understand what activation energy means.

Before reactants can convert into products, molecules require a minimum amount of energy.

This minimum threshold energy is called activation energy.

It allows reactant molecules to reach a transition state from where products can form.

If activation energy is very high, reaction occurs slowly.

If activation energy decreases, reaction speed increases.

Thus activation energy directly controls reaction rate.

Step 2: Understand role of enzymes in biochemical reactions.

Enzymes bind temporarily with substrate molecules at a specialized region called active site.

This enzyme-substrate complex helps arrange reactants in favorable orientation.

As a result, less energy is required for molecules to react.

Therefore enzyme reduces activation energy.

Mathematically the relationship can be summarized as

$$\text{Lower activation energy} \rightarrow \text{Faster reaction}$$

Hence enzyme accelerates reaction speed.

Step 3: Check incorrect options one by one.

Option (A)

It says enzymes are permanently consumed.

This is incorrect because enzymes remain chemically unchanged after reaction and can be reused repeatedly.

Option (C)

It says enzymes increase activation energy.

This is incorrect because increased activation energy would slow reactions.

Enzymes do the opposite.

Option (D)

It says enzymes are inorganic compounds.

This is incorrect because most enzymes are proteins, which are organic biomolecules.

Hence options A, C and D are wrong.

Step 4: Identify correct statement and conclude.

Option (B) states enzymes lower activation energy.

This exactly describes catalytic action of enzymes.

Therefore correct answer is

$$\boxed{\text{Enzymes lower activation energy of reaction}}$$

Hence

$$\boxed{\text{Option (2)}}$$

Quick Tip: Enzyme rule to remember: Enzymes speed up reactions by lowering activation energy. They are biological catalysts and are not consumed permanently during reactions.

---

132. Which of the following are characteristic features of Solanaceae family?

(a) Flowers are bisexual and actinomorphic

(b) Calyx have five sepals and are united

(c) Androecium have five stamens and are epipetalous

(d) Ovary is inferior

Choose the correct answer from the options given below:

(A) (b), (c) and (d) only

(B) (a), (b) and (c) only

(C) (d) only

(D) (a) and (b) only

Correct Answer: (2)

Solution:

Concept:
Solanaceae is an important family of flowering plants that includes economically important plants such as tomato, potato, brinjal, chilli and tobacco.
Each plant family possesses characteristic floral features used for identification and classification.
The floral formula and flower morphology of Solanaceae help determine whether a statement about floral parts is correct or incorrect.
Important characteristics include bisexual flowers, radial symmetry, united sepals, epipetalous stamens and superior ovary.

Step 1: Examine flower symmetry and sexuality.

Plants belonging to Solanaceae family generally possess bisexual flowers.
Bisexual means both male reproductive organ (androecium) and female reproductive organ (gynoecium) occur in same flower.
These flowers are also actinomorphic.
Actinomorphic means flower can be divided into two equal halves along multiple planes.

Hence statement (a) is correct.

$$(a) = \text{Correct}$$

Step 2: Study calyx structure carefully.

The calyx is composed of sepals.
In Solanaceae family, calyx usually consists of five sepals.
These sepals are fused together, meaning gamosepalous condition exists.
Thus statement (b) correctly describes floral morphology.
Therefore

$$(b) = \text{Correct}$$

Step 3: Check androecium characteristics.

Androecium represents male reproductive part.
In Solanaceae family, androecium consists of five stamens.
These stamens are epipetalous.
Epipetalous means stamens remain attached to petals.
This is a key identifying characteristic of this family.
Hence statement (c) is also correct.
Thus

$$(c) = \text{Correct}$$

Step 4: Analyze ovary position.

In Solanaceae family, ovary is superior.
Superior ovary means floral parts arise below ovary.
The statement says ovary is inferior.
This is incorrect.
Hence

$$(d) = \text{Incorrect}$$

Step 5: Choose correct combination.

Correct statements are

$$(a), (b), (c)$$

Thus correct option becomes

$$\boxed{\text{Option (2)}}$$

Quick Tip: Solanaceae family characteristics: Bisexual flowers Actinomorphic symmetry 5 united sepals 5 epipetalous stamens Superior ovary

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133. Given below are two statements:

Statement I : When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry.

Statement II : In phylum Echinodermata, both adults and larvae are radially symmetrical.

Choose the most appropriate answer.

(A) Statement I is incorrect but Statement II is correct

(B) Both Statement I and Statement II are correct

(C) Both Statement I and Statement II are incorrect

(D) Statement I is correct but Statement II is incorrect

Correct Answer: (4)

Solution:

Concept:

Symmetry in biology refers to arrangement of body parts relative to an axis or plane.

Radial symmetry occurs when many planes passing through central axis divide organism into similar halves.

Echinoderms show an interesting developmental pattern.

Adults are radially symmetrical whereas larvae are bilaterally symmetrical.

Thus one statement may be correct while another may be false.

Step 1: Understand radial symmetry definition.

Radial symmetry means body parts arranged around a central axis.

Any plane passing through central axis divides organism into similar halves.

Examples include starfish and jellyfish.

The definition given in Statement I correctly explains radial symmetry.

Hence

$$Statement\ I = \text{Correct}$$

Step 2: Understand symmetry in echinoderms.

Echinodermata includes starfish, sea urchins and sea cucumber.

Adult echinoderms possess radial symmetry.

However larvae do not show radial symmetry.

Larvae are bilaterally symmetrical.

This difference is important in evolutionary biology.

Step 3: Evaluate Statement II carefully.

Statement II says both adult and larval forms are radially symmetrical.

This is incorrect because larval forms are bilateral.

Thus statement II is false.

$$Statement\ II = \text{Incorrect}$$

Step 4: Determine correct option.

Final conclusion:

Statement I $\rightarrow$ Correct

Statement II $\rightarrow$ Incorrect

Hence correct option is

$$\boxed{\text{Option (4)}}$$

Quick Tip: Echinoderm symmetry trick: Larva = Bilateral symmetry Adult = Radial symmetry Do not confuse both stages.

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134. The correct sequence of adult cell cycle phases is

(A) S-M-G2-G1

(B) G1-G2-S-M

(C) G1-M-G2-S

(D) G1-S-G2-M

Correct Answer: (4)

Solution:

Concept:

Cell cycle is the sequence of events by which a cell grows, replicates DNA and divides into daughter cells.

The adult cell cycle is divided into interphase and mitotic phase.

Interphase includes G1 phase, S phase and G2 phase.

This is followed by M phase where actual cell division occurs.

Thus sequence must follow exact chronological order.

Step 1: Understand G1 phase.

G1 phase is first growth phase.

Cell synthesizes proteins and increases size.

Metabolic activity remains high.

Thus cycle begins with G1.

Step 2: Understand S phase.

S phase stands for synthesis phase.

DNA replication occurs during this phase.

Chromosomes duplicate preparing cell for division.

Thus S phase follows G1.

Step 3: Understand G2 phase.

G2 phase is second growth phase.

Cell synthesizes proteins required for mitosis.

Cell prepares final machinery for division.

Hence G2 comes after S phase.

Step 4: Understand M phase.

M phase means mitotic division.

Actual separation into daughter cells occurs here.

Thus final sequence becomes

$$G1 \rightarrow S \rightarrow G2 \rightarrow M$$

Hence answer is

$$\boxed{\text{Option (4)}}$$

Quick Tip: Cell cycle order: G1 = Growth S = DNA synthesis G2 = Preparation M = Cell division

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135. In frogs, the number of pairs of cranial nerves arising from the brain are _______.

(A) 12

(B) 6

(C) 9

(D) 10

Correct Answer: (4) 10

Solution:

Concept:

Cranial nerves are nerves that arise directly from the brain.

They control sensory functions, movement and coordination of different body parts.

Different vertebrates possess different numbers of cranial nerve pairs.

Humans possess twelve pairs, while frogs possess ten pairs.

Knowledge of comparative anatomy helps answer this question.

Step 1: Understand cranial nerves.

Cranial nerves originate directly from brain tissue.

They carry impulses for sensation and motor control.

These nerves help regulate vision, smell, hearing, swallowing and muscular movement.

Step 2: Compare frog and human anatomy.

Human beings possess

$$12$$

pairs of cranial nerves.

Frogs possess fewer cranial nerves compared with mammals.

Standard zoological classification shows frogs possess

$$10$$

pairs.

Step 3: Check options carefully.

$12 \rightarrow$ human value

$6 \rightarrow$ incorrect

$9 \rightarrow$ incorrect

$10 \rightarrow$ correct frog value

Step 4: Final conclusion.

Since frog anatomy includes ten cranial nerve pairs, correct answer becomes

$$\boxed{10}$$

Therefore

$$\boxed{\text{Option (4)}}$$

Quick Tip: Remember comparative anatomy: Humans = 12 pairs cranial nerves Frog = 10 pairs cranial nerves

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