NEET UG 2023 H2 Botany Question Paper with Solutions

Time Allowed :3 Hour 20 Minutes	**Maximum Marks :**720	**Total Questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The Answer Sheet is this Test Booklet. When you are directed to open the Test Booklet, take the Answer Sheet and fill in the particulars in ORIGINAL Copy carefully with blue/black ball pen only.
2. The test is of 3 hours 20 minutes duration and the Test Booklet contains 200 multiple-choice questions (four options with a single correct answer) from Physics, Chemistry, and Biology (Botany and Zoology). 50 questions in each subject are divided into two Sections (A and B) as per details given below:
3. (a) Section A shall consist of 35 (Thirty-five) questions in each subject (Question Nos. 1 to 35, 51 to 85, 101 to 135 and 151 to 185).
4. (b) Section B shall consist of 15 (Fifteen) questions in each subject (Question Nos. 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In Section B, a candidate needs to attempt any 10 (Ten) questions out of 15 (Fifteen) in each subject.
5. Candidates are advised to read all 15 questions in each subject of Section B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, the first ten questions answered by the candidate shall be evaluated.
6. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. The maximum marks are 720.
7. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
8. On completion of the test, the candidate must hand over the Answer Sheet (ORIGINAL and OFFICE Copy) to the Invigilator before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.
9. Use of Electronic/Manual Calculator is prohibited.

Section A

101. What is the role of RNA polymerase III in the process of transcription in Eukaryotes?

(A) Transcription of precursor of mRNA
(B) Transcription of only snRNAs

(C) Transcription of rRNAs (28S, 18S and 5.8S)
(D) Transcription of tRNA, 5S rRNA and snRNA

Correct Answer: (D) Transcription of tRNA, 5S rRNA and snRNA

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific function of RNA polymerase III from the given options in the context of eukaryotic transcription.

Step 2: Detailed Explanation:
In eukaryotes, there are three distinct types of RNA polymerases, each responsible for transcribing different classes of RNA.

- **RNA Polymerase I:** Transcribes ribosomal RNAs (rRNAs), specifically the 28S, 18S, and 5.8S rRNA genes.
- **RNA Polymerase II:** Transcribes the precursor of messenger RNA (mRNA), known as heterogeneous nuclear RNA (hnRNA), as well as most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).
- **RNA Polymerase III:** Transcribes transfer RNA (tRNA), the 5S rRNA, and some small nuclear RNAs (snRNAs), such as the U6 snRNA.

Analyzing the options:
(A) Transcription of precursor of mRNA is the function of RNA Polymerase II.
(B) RNA Polymerase III transcribes some snRNAs, but not only snRNAs. RNA Polymerase II also transcribes snRNAs.
(C) Transcription of 28S, 18S, and 5.8S rRNAs is the function of RNA Polymerase I.
(D) This option correctly lists the main products synthesized by RNA Polymerase III: tRNA, 5S rRNA, and snRNA.

Step 3: Final Answer:
Based on the functions of the different RNA polymerases, the correct role of RNA polymerase III is the transcription of tRNA, 5S rRNA, and snRNA.

Quick Tip

Create a simple table to memorize the functions of the three eukaryotic RNA polymerases (I, II, and III) and the types of RNA they synthesize. This is a very common topic in competitive exams.

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102. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in

Solanaceae or Liliaceae.

(A) Monoadelphous and Monothecous anthers
(B) Epiphyllous and Dithecous anthers
(C) Diadelphous and Dithecous anthers
(D) Polyadelphous and epipetalous stamens

Correct Answer: (C) Diadelphous and Dithecous anthers

Solution:

Step 1: Understanding the Question:
The question asks for a characteristic feature of the stamens (androecium) that is unique to the family Fabaceae when compared to Solanaceae and Liliaceae.

Step 2: Detailed Explanation:
Let's analyze the stamen characteristics of the three families:

- **Fabaceae (Subfamily Papilionoideae):** The androecium typically consists of ten stamens. The characteristic arrangement is **diadelphous**, where the stamens are fused into two bundles, commonly in a (9)+1 pattern (nine stamens fused into a tube, one is free). The anthers are **dithecous** (two-lobed).
- **Solanaceae:** The androecium has five stamens which are **epipetalous** (attached to the petals). The anthers are dithecous.
- **Liliaceae:** The androecium has six stamens, arranged in two whorls of three (3+3). They are **epiphyllous** or epitepalous (attached to the tepals). The anthers are dithecous.

Now let's evaluate the options:
(A) Monoadelphous (stamens in one bundle) is found in families like Malvaceae.
(B) Epiphyllous condition is characteristic of Liliaceae.
(C) Diadelphous stamens are a hallmark of Fabaceae (specifically Papilionoideae) and are not found in Solanaceae or Liliaceae. Dithecous anthers are common to all three, but the diadelphous condition is specific.
(D) Polyadelphous (stamens in more than two bundles) is found in families like Rutaceae (e.g., Citrus). Epipetalous condition is found in Solanaceae.

Step 3: Final Answer:
The combination of diadelphous stamens and dithecous anthers is a specific characteristic of Fabaceae that distinguishes it from Solanaceae and Liliaceae.

Quick Tip

Floral formulas and key characteristics of androecium (stamen arrangement like monadelphous, diadelphous) and gynoecium are crucial for differentiating between major plant families. Focus on these unique features for quick identification.

103. In the equation GPP – R = NPP, GPP is Gross Primary Productivity, NPP is Net Primary Productivity. R here is

(A) Respiratory loss
(B) Reproductive allocation
(C) Photosynthetically active radiation
(D) Respiratory quotient

Correct Answer: (A) Respiratory loss

Solution:

Step 1: Understanding the Question:
The question provides a fundamental equation in ecology and asks to define the term 'R'.

Step 2: Key Formula or Approach:
The equation is NPP = GPP − R.

Step 3: Detailed Explanation:

- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (e.g., plants) and converted into chemical energy in the form of organic compounds through photosynthesis. It represents the total amount of photosynthesis.
- Producers must use some of this captured energy for their own life processes, such as growth, maintenance, and reproduction. The primary metabolic process that consumes this energy is **cellular respiration**.
- **Respiratory Loss (R):** This is the portion of GPP that is consumed by the producers for their own respiration. This energy is lost as heat.
- **Net Primary Productivity (NPP):** This is the remaining energy or biomass after respiratory losses have been subtracted from GPP. It is the energy that is available to the next trophic level (consumers).

Therefore, the term 'R' in the equation represents the energy lost through respiration by the producers.

Step 4: Final Answer:
'R' in the equation GPP - R = NPP stands for Respiratory loss.

Quick Tip

Think of it like a personal budget: GPP is your gross income, R (Respiration) is your essential living expenses, and NPP is your net income or savings (the amount available for others). This analogy helps in remembering the relationship between GPP, NPP, and R.

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104. Spraying of which of the following phytohormone on juvenile conifers helps in hastening the maturity period, that leads to early seed production?

(A) Zeatin
(B) Abscisic Acid
(C) Indole-3-butyric Acid
(D) Gibberellic Acid

Correct Answer: (D) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks to identify the plant hormone used to accelerate the maturation process in young conifer trees to promote early seed production.

Step 2: Detailed Explanation:
Let's review the primary functions of the listed phytohormones:

- **Zeatin:** A type of cytokinin, primarily involved in promoting cell division (cytokinesis), overcoming apical dominance, and delaying senescence.
- **Abscisic Acid (ABA):** Generally acts as an inhibitory hormone. It promotes seed dormancy, stomatal closure during water stress, and senescence.
- **Indole-3-butyric Acid (IBA):** A type of auxin, primarily used commercially to induce root formation in stem cuttings.
- **Gibberellic Acid (GA):** Gibberellins have a wide range of functions, including promoting stem elongation (bolting), breaking seed and bud dormancy, and promoting fruit development. A key commercial application is in forestry and plant breeding, where spraying GAs on juvenile conifers helps to overcome the long juvenile phase, thus hastening maturity and inducing early cone and seed production.

Therefore, Gibberellic Acid is the correct hormone for this purpose.

Step 3: Final Answer:
Spraying with Gibberellic Acid helps in hastening the maturity period of juvenile conifers.

Quick Tip

Associate one or two key commercial applications with each major plant hormone. For Gibberellin, remember "increasing fruit size in grapes" and "hastening maturity in conifers." This helps in quickly answering application-based questions.

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105. Axile placentation is observed in

(A) Tomato, Dianthus and Pea
(B) China rose, Petunia and Lemon
(C) Mustard, Cucumber and Primrose
(D) China rose, Beans and Lupin

Correct Answer: (B) China rose, Petunia and Lemon

Solution:

Step 1: Understanding the Question:
The question requires identifying the group of plants from the given options that all exhibit axile placentation.

Step 2: Detailed Explanation:
Axile placentation is a type of placentation where the placenta is axial and the ovules are attached to it in a multilocular ovary. The ovary is partitioned by septa into multiple chambers or locules.
Let's examine the placentation types in the plants listed in the options:

- **China rose (*Hibiscus*):** Belongs to the family Malvaceae. It has a syncarpous, superior, pentalocular ovary with axile placentation.
- **Petunia:** Belongs to the family Solanaceae. It has a bicarpellary, syncarpous, superior, bilocular ovary with a swollen placenta, showing axile placentation.
- **Lemon (*Citrus*):** Belongs to the family Rutaceae. It has a multicarpellary, syncarpous, superior ovary with multiple locules, showing axile placentation.

All three plants in option (B) have axile placentation.

Now, let's look at the other options to rule them out:

- (A) Pea (Fabaceae) has **marginal** placentation. *Dianthus* (Caryophyllaceae) has **free-central** placentation.
- (C) Mustard (Brassicaceae) has **parietal** placentation. Cucumber (Cucurbitaceae) also has **parietal** placentation. Primrose (Primulaceae) has **free-central** placentation.

- (D) Beans and Lupin (Fabaceae) have **marginal** placentation.

Step 3: Final Answer:
The correct combination of plants exhibiting axile placentation is China rose, Petunia, and Lemon.

Quick Tip

Drawing simple diagrams of placentation types (Marginal, Axile, Parietal, Free-central, Basal) and listing two common examples for each is an effective way to memorize this topic.

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106. Among eukaryotes, replication of DNA takes place in

(A) G_1 phase
(B) G_2 phase
(C) M phase
(D) S phase

Correct Answer: (D) S phase

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific phase of the eukaryotic cell cycle during which DNA replication occurs.

Step 2: Detailed Explanation:
The eukaryotic cell cycle is an ordered sequence of events that leads to cell division and the production of two daughter cells. It is divided into two main stages: Interphase and M phase.

- **Interphase:** The period of growth and preparation for cell division. It is subdivided into three phases:
  - **G_1 (Gap 1) phase:** The cell is metabolically active and grows in size. It synthesizes proteins and RNA.
  - **S (Synthesis) phase:** This is the phase where **DNA synthesis or replication** takes place. At the end of the S phase, each chromosome consists of two sister chromatids, and the total amount of DNA in the cell has doubled.
  - **G_2 (Gap 2) phase:** The cell continues to grow, and proteins required for mitosis are synthesized. The cell prepares for division.
- **M (Mitotic) phase:** This is the phase of actual cell division, which includes mitosis (nuclear division) and cytokinesis (cytoplasmic division).

Based on this, DNA replication specifically occurs during the S phase.

Step 3: Final Answer:
The replication of DNA in eukaryotes takes place in the S phase of the cell cycle.

Quick Tip

Remember the mnemonic "Go Sally Go, Make Children" for the cell cycle phases: G_1, S, G_2, M, Cytokinesis. The 'S' stands for Synthesis, which is the synthesis (replication) of DNA.

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107. How many ATP and $NADPH_2$ are required for the synthesis of one molecule of Glucose during Calvin cycle?

(A) 12 ATP and 16 $NADPH_2$
(B) 18 ATP and 16 $NADPH_2$
(C) 12 ATP and 12 $NADPH_2$
(D) 18 ATP and 12 $NADPH_2$

Correct Answer: (D) 18 ATP and 12 $NADPH_2$

Solution:

Step 1: Understanding the Question:
The question asks for the total number of ATP and NADPH molecules (written as $NADPH_2$) required to synthesize one molecule of glucose through the Calvin cycle.

Step 2: Key Formula or Approach:
The synthesis of one molecule of glucose ($C_6H_{12}O_6$) requires the fixation of 6 molecules of carbon dioxide (CO_2). We need to calculate the energy requirements for 6 turns of the Calvin cycle.

Step 3: Detailed Explanation:
The Calvin cycle has three main stages: Carboxylation, Reduction, and Regeneration. Let's analyze the requirements per molecule of CO_2 fixed:

- **Carboxylation:** Fixation of CO_2 to RuBP. No ATP or NADPH is used here.
- **Reduction:** The product of carboxylation (2 molecules of 3-PGA) is converted into triose phosphate. This step requires **2 ATP** and **2 NADPH** per CO_2 molecule.
- **Regeneration:** Regeneration of the initial CO_2 acceptor, RuBP. This step requires **1 ATP** per CO_2 molecule.

So, for every one molecule of CO_2 fixed, the total requirement is:
$2 \text{ ATP} + 1 \text{ ATP} = 3 \text{ ATP}$

2 NADPH

To produce one molecule of glucose (C_6), the cycle must turn 6 times (fixing 6 molecules of CO_2). Therefore, the total requirements are:

$$\text{Total ATP} = 6 \times 3 \text{ ATP} = 18 \text{ ATP}$$

$$\text{Total NADPH} = 6 \times 2 \text{ NADPH} = 12 \text{ NADPH}$$

Step 4: Final Answer:
The synthesis of one molecule of glucose requires 18 ATP and 12 NADPH.

Quick Tip

Memorize the energy input for one turn of the Calvin cycle: 3 ATP and 2 NADPH. To find the requirement for one glucose molecule (which has 6 carbons), simply multiply the per-turn values by 6.

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108. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: The first stage of gametophyte in the life cycle of moss is protonema stage.
Reason R: Protonema develops directly from spores produced in capsule.
In the light of the above statements, choose the most appropriate answer from the options given below:

(A) A is correct but R is not correct.
(B) A is not correct but R is correct.
(C) Both A and R are correct and R is the correct explanation of A.
(D) Both A and R are correct but R is NOT the correct explanation of A.

Correct Answer: (C) Both A and R are correct and R is the correct explanation of A.

Solution:

Step 1: Understanding the Question:
This is an assertion-reason question. We need to evaluate the truthfulness of both statements and determine if the reason correctly explains the assertion.

Step 2: Detailed Explanation:

- **Analysis of Assertion A:** The dominant phase in the life cycle of a moss is the gametophyte. This phase begins when a haploid spore germinates. The spore does not directly grow into the main leafy plant body. Instead, it first develops into a filamentous, creeping,

green, branched structure called the **protonema**. This is the juvenile gametophyte stage. The leafy stage, which bears the sex organs, develops later from buds on the protonema. Thus, the assertion that the protonema is the first stage of the gametophyte is **correct**.

- **Analysis of Reason R:** In the moss life cycle, the sporophyte develops from the zygote and remains attached to the gametophyte. The mature sporophyte consists of a foot, seta, and capsule. Within the capsule, meiosis occurs to produce haploid spores. These spores are released, and upon germination, they develop into the protonema. Thus, the reason that the protonema develops directly from spores produced in the capsule is also **correct**.

- **Evaluating the Relationship:** The reason states how the protonema is formed (from a spore). This directly explains why the protonema is considered the first stage of the gametophyte generation, as it is the immediate product of spore germination. Therefore, Reason R is the **correct explanation** of Assertion A.

Step 3: Final Answer:
Both Assertion A and Reason R are correct, and R provides the correct explanation for A.

Quick Tip

For Assertion-Reason questions, follow a three-step process: 1. Check if Assertion (A) is true. 2. Check if Reason (R) is true. 3. If both are true, ask "Is A true *because* of R?" to check if R is the correct explanation.

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109. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by

(A) Passive Transport
(B) Active Transport
(C) Osmosis
(D) Facilitated Diffusion

Correct Answer: (B) Active Transport

Solution:

Step 1: Understanding the Question:
The question asks for the name of the transport mechanism that moves ions across a membrane "against their concentration gradient."

Step 2: Detailed Explanation:
Transport of substances across a biological membrane can be categorized based on the direction of movement relative to the concentration gradient and the requirement of energy.

- **Passive Transport:** This type of transport involves the movement of substances **down** the concentration gradient (from a region of higher concentration to a region of lower concentration). It does not require metabolic energy (ATP). Facilitated diffusion and osmosis are types of passive transport.
- **Active Transport:** This process involves the movement of substances **against** their concentration gradient (from a region of lower concentration to a region of higher concentration). This is an "uphill" movement and requires the expenditure of metabolic energy, typically in the form of ATP. It also requires specific membrane proteins called carrier proteins or pumps.

The key phrase in the question is "against their concentration gradient," which is the defining characteristic of active transport.

Step 3: Final Answer:
The movement of ions against a concentration gradient is explained by Active Transport.

Quick Tip

The phrase "against the concentration gradient" is a direct giveaway for Active Transport. Associate this phrase with the requirement of energy (ATP) and carrier proteins. Conversely, "down the concentration gradient" implies passive transport, which does not require energy.

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110. Unequivocal proof that DNA is the genetic material was first proposed by

(A) Avery, Macleoid and McCarthy
(B) Wilkins and Franklin
(C) Frederick Griffith
(D) Alfred Hershey and Martha Chase

Correct Answer: (D) Alfred Hershey and Martha Chase

Solution:

Step 1: Understanding the Question:
The question asks to identify the scientists who provided the definitive and unambiguous ("unequivocal") proof that DNA is the genetic material.

Step 2: Detailed Explanation:
Let's review the contributions of the scientists listed:

- **Frederick Griffith (1928):** His experiment on *Streptococcus pneumoniae* demonstrated the "transforming principle," showing that genetic material could be transferred between bacteria. However, he did not identify what this material was.

- **Avery, Macleod, and McCarthy (1944):** They were the first to provide biochemical evidence that the transforming principle was DNA. By treating heat-killed virulent bacteria with enzymes that destroy protein, RNA, and DNA, they showed that only the treatment with DNase prevented transformation. While their evidence was strong, it was not universally accepted by the scientific community at the time, which still largely favored protein as the genetic material.
- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using bacteriophages (viruses that infect bacteria). They used radioactive isotopes to label the protein coat (^{35}S) and the DNA core (^{32}P) of the phages separately. They found that only the radioactive DNA (^{32}P) entered the host bacterial cell, while the protein coat remained outside. Since the DNA was sufficient to direct the synthesis of new viruses, this provided the conclusive and unequivocal proof that DNA is the genetic material.
- **Wilkins and Franklin:** Their work involved X-ray diffraction of DNA, which provided crucial data about the helical structure of DNA, but it did not prove its function as the genetic material.

Step 3: Final Answer:
The Hershey-Chase experiment is considered the unequivocal proof that DNA is the genetic material.

Quick Tip

Distinguish between the different levels of proof: Griffith showed transformation exists. Avery et al. identified the transforming substance as DNA. Hershey and Chase provided the definitive proof that was widely accepted.

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111. Which of the following stages of meiosis involves division of centromere?

(A) Anaphase II
(B) Telophase
(C) Metaphase I
(D) Metaphase II

Correct Answer: (A) Anaphase II

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific stage in meiosis where the centromeres split, leading to the separation of sister chromatids.

Step 2: Detailed Explanation:
Meiosis consists of two successive nuclear divisions, Meiosis I and Meiosis II.

- **Meiosis I (Reductional Division):**
  - **Metaphase I:** Homologous chromosome pairs (bivalents) align at the metaphase plate.
  - **Anaphase I:** Homologous chromosomes separate and move to opposite poles. Importantly, the **sister chromatids remain attached** at their centromeres. The centromeres **do not divide**.
- **Meiosis II (Equational Division):** This division is very similar to mitosis.
  - **Metaphase II:** Individual chromosomes (each still composed of two sister chromatids) align at the metaphase plate.
  - **Anaphase II:** The **centromeres of each chromosome divide**, and the sister chromatids separate, now considered individual chromosomes, and move to opposite poles.

Therefore, the division of the centromere occurs during Anaphase II.

Step 3: Final Answer:
The division of the centromere in meiosis occurs during Anaphase II.

Quick Tip

A key distinction to remember: Anaphase I separates homologous chromosomes, while Anaphase II separates sister chromatids. The separation of sister chromatids is only possible because of the division of the centromere. This event is what makes Meiosis II similar to mitosis.

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112. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: ATP is used at two steps in glycolysis.
Reason R: First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1,6-diphosphate.
In the light of the above statements, choose the correct answer from the options given below:

(A) A is true but R is false.
(B) A is false but R is true.
(C) Both A and R are true and R is the correct explanation of A.
(D) Both A and R are true but R is NOT the correct explanation of A.

Correct Answer: (C) Both A and R are true and R is the correct explanation of A.

Solution:

Step 1: Understanding the Question:
This is an assertion-reason question about the energy investment phase of glycolysis. We need to evaluate the truthfulness of both statements and their relationship.

Step 2: Detailed Explanation:

- **Analysis of Assertion A:** Glycolysis is a 10-step process. The first part is the "preparatory" or "energy investment" phase. In this phase, the cell invests energy to activate the glucose molecule. Specifically, two molecules of ATP are consumed. So, the assertion that ATP is used at two steps is **correct**.

- **Analysis of Reason R:** The reason details the specific steps where ATP is consumed.
  - **Step 1 of Glycolysis:** Glucose is phosphorylated to glucose-6-phosphate by the enzyme hexokinase. This reaction consumes one ATP molecule.
  - **Step 3 of Glycolysis:** Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate by the enzyme phosphofructokinase. This reaction consumes a second ATP molecule.

  The reason accurately describes these two ATP-consuming steps. Therefore, Reason R is also **correct**.

- **Evaluating the Relationship:** The reason (R) provides the precise details of the two steps where ATP is utilized, as mentioned in the assertion (A). It directly and fully explains the assertion. Therefore, Reason R is the **correct explanation** of Assertion A.

Step 3: Final Answer:
Both Assertion A and Reason R are true, and R is the correct explanation of A.

Quick Tip

Remember the two irreversible, regulatory, and ATP-consuming steps of glycolysis: the hexokinase reaction (Step 1) and the phosphofructokinase reaction (Step 3). These are crucial points in the pathway.

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113. Large, colourful, fragrant flowers with nectar are seen in :

(A) bat pollinated plants
(B) wind pollinated plants
(C) insect pollinated plants
(D) bird pollinated plants

Correct Answer: (C) insect pollinated plants

Solution:

Step 1: Understanding the Question:
The question describes a set of floral characteristics (large, colourful, fragrant, with nectar) and asks to identify the corresponding mode of pollination.

Step 2: Detailed Explanation:
These characteristics are adaptations to attract specific pollinators. Let's analyze the typical features for each pollination syndrome:

- **Bat pollinated plants (Chiropterophily):** Flowers are typically large, strong, open at night, dull-colored (e.g., whitish or greenish), and have a strong, musty, or fermented fruity odor. They produce copious nectar.
- **Wind pollinated plants (Anemophily):** Flowers are small, inconspicuous, and lack bright colors, fragrance, and nectar. They produce large quantities of lightweight, non-sticky pollen.
- **Insect pollinated plants (Entomophily):** Flowers are adapted to attract insects. They are often **large** and/or grouped into inflorescences to be conspicuous, **colourful** (especially in blue, purple, yellow ranges), **fragrant** to attract insects from a distance, and produce **nectar** as a food reward. This perfectly matches the description in the question.
- **Bird pollinated plants (Ornithophily):** Flowers are usually large, tubular, brightly colored (often red, orange, or yellow), but typically lack a strong scent as birds have a poor sense of smell. They produce abundant, watery nectar.

Step 3: Final Answer:
The combination of large size, bright colours, fragrance, and nectar is characteristic of insect-pollinated flowers.

Quick Tip

Create a table comparing the floral characteristics (size, color, scent, nectar) for different pollination agents (wind, water, insects, birds, bats). This makes it easy to compare and contrast the different pollination syndromes.

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114. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year :

(A) 1986
(B) 2002
(C) 1985

(D) 1992

Correct Answer: (D) 1992

Solution:

Step 1: Understanding the Question:
This is a fact-based question asking for the year of the Earth Summit, where the Convention on Biological Diversity was established.

Step 2: Detailed Explanation:
The United Nations Conference on Environment and Development (UNCED), popularly known as the **Earth Summit** or the Rio Summit, was held in Rio de Janeiro, Brazil.
This landmark event took place from June 3 to June 14, **1992**.
One of the most significant outcomes of this summit was the signing of the Convention on Biological Diversity (CBD), a multilateral treaty with objectives to conserve biological diversity, ensure the sustainable use of its components, and promote the fair and equitable sharing of benefits arising out of the utilization of genetic resources.
The other years listed are incorrect: 2002 was the World Summit on Sustainable Development in Johannesburg (Rio+10).

Step 3: Final Answer:
The Earth Summit was held in Rio de Janeiro in 1992.

Quick Tip

For environmental studies, create a timeline of major international agreements and conferences. Key dates to remember include: Montreal Protocol (1987), Earth Summit (1992), Kyoto Protocol (1997), and Paris Agreement (2015).

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115. The thickness of ozone in a column of air in the atmosphere is measured in terms of :

(A) Decameter
(B) Kilobase
(C) Dobson units
(D) Decibels

Correct Answer: (C) Dobson units

Solution:

Step 1: Understanding the Question:
The question asks for the standard unit used to measure the thickness of the atmospheric ozone layer.

Step 2: Detailed Explanation:
Let's define the units given in the options:

- **Decameter (dam):** A unit of length in the metric system, equal to 10 meters.
- **Kilobase (kb):** A unit of length for DNA or RNA molecules, equal to 1000 base pairs.
- **Dobson Unit (DU):** This is the standard unit for measuring the total amount of ozone in a vertical column of air. One Dobson Unit represents the amount of ozone that would form a layer 0.01 mm thick at standard temperature (0°C) and pressure (1 atm). The average thickness of the ozone layer is about 300 DU.
- **Decibels (dB):** A logarithmic unit used to measure the intensity of sound.

From the definitions, it is clear that Dobson Units are specifically used for measuring ozone concentration in the atmosphere.

Step 3: Final Answer:
The thickness of the ozone layer is measured in Dobson units.

Quick Tip

Associate specific scientific units with the quantities they measure. For environmental issues, remember: Ozone thickness -¿ Dobson Units (DU), Sound pollution -¿ Decibels (dB), Particulate matter size -¿ Micrometers (µm).

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116. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as :

(A) Development
(B) Senescence
(C) Differentiation
(D) Dedifferentiation

Correct Answer: (D) Dedifferentiation

Solution:

Step 1: Understanding the Question:
The question describes a process in plant tissue culture where specialized cells (leaf mesophyll) are induced to form an undifferentiated mass of cells (callus) and asks for the correct term for

this process.

Step 2: Detailed Explanation:
Let's define the terms related to cell specialization in plants:

- **Differentiation:** The process by which cells derived from meristems mature and acquire specific structures and functions. A leaf mesophyll cell is an example of a differentiated cell, specialized for photosynthesis.
- **Dedifferentiation:** The process by which mature, differentiated, non-dividing cells revert to a meristematic state and regain the ability to divide. In tissue culture, when a piece of a differentiated plant organ (explant), like a leaf, is placed on a suitable nutrient medium, its cells undergo dedifferentiation to form a callus, which is an unorganized, undifferentiated mass of dividing cells.
- **Redifferentiation:** The process where the dedifferentiated cells of the callus once again differentiate to form specialized cells, tissues, and organs, eventually regenerating a whole plant.

The phenomenon described in the question, where specialized mesophyll cells form a callus, is a classic example of dedifferentiation.

Step 3: Final Answer:
The formation of callus from leaf mesophyll cells is called dedifferentiation.

Quick Tip

Remember the sequence in plant tissue culture: Explant (Differentiated) → Callus (Dedifferentiation) → Plantlet (Redifferentiation). Understanding this sequence of differentiation, dedifferentiation, and redifferentiation is key to understanding plant totipotency and tissue culture.

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117. Given below are two statements:
Statement I: Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.
Statement II: Exarch condition is the most common feature of the root system.
In the light of the above statements, choose the correct answer from the options given below:

(A) Statement I is correct but Statement II is false.
(B) Statement I is incorrect but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

Correct Answer: (B) Statement I is incorrect but Statement II is true.

Solution:

Step 1: Understanding the Question:
We need to evaluate the correctness of two statements related to the arrangement of xylem in plants.

Step 2: Detailed Explanation:

- **Analysis of Statement I:** The terms 'endarch' and 'exarch' refer to the pattern of development of **primary xylem**, not secondary xylem.
  - **Endarch:** The protoxylem (the first-formed primary xylem) is located towards the center (pith), and the metaxylem (the later-formed primary xylem) is located towards the periphery. This condition is characteristic of stems.
  - **Exarch:** The protoxylem is located towards the periphery, and the metaxylem is towards the center. This condition is characteristic of roots.

  Since the statement specifies "secondary xylem," it is **incorrect**. Secondary xylem is formed by the vascular cambium and does not follow this developmental pattern.

- **Analysis of Statement II:** As defined above, the exarch arrangement of primary xylem is the defining characteristic of the vascular bundles in the roots of vascular plants. Therefore, this statement is **correct**.

Step 3: Final Answer:
Statement I is incorrect because the terms describe primary xylem, while Statement II is correct as the exarch condition is typical for roots.

Quick Tip

Use a mnemonic: **Ex**arch is in roots (**ex**it from the plant base), and **En**darch is in stems (**en**tering the main plant body from below). Remember that these terms apply only to primary xylem arrangement.

---

118. What is the function of tassels in the corn cob?

(A) To disperse pollen grains
(B) To protect seeds
(C) To attract insects
(D) To trap pollen grains

Correct Answer: (D) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the function of the "tassels in the corn cob." It's important to clarify the terminology. In maize (corn), the tassel and the cob are separate structures. The tassel is the male inflorescence at the top of the plant. The cob is the female inflorescence that develops ears. The long, silky threads emerging from the cob are the styles and stigmas, collectively known as the "silk." The question incorrectly refers to the silk as "tassels in the corn cob." We will answer based on the function of the silk.

Step 2: Detailed Explanation:

- **The Tassel:** The actual tassel is the male inflorescence located at the apex of the corn plant. Its function is to produce and **disperse pollen grains** into the wind. So, option (A) describes the function of the real tassel.
- **The Silk (on the Cob):** The corn cob is the female inflorescence. Each potential kernel on the cob develops a long, thread-like structure called the silk, which is the stigma and style. The silks emerge from the tip of the husk. Their feathery and sticky nature provides a large surface area designed to effectively **trap the wind-borne pollen grains** released from the tassels. Each strand of silk must be pollinated for its corresponding kernel to develop.

Given the options and the likely intent of the poorly worded question, the function referred to is that of the silk.

Step 3: Final Answer:
The function of the silk (referred to as tassels in the question) on the corn cob is to trap pollen grains.

Quick Tip

Be aware of common but botanically inaccurate terms in questions. For corn/maize: Tassel (top of plant) = male flower, disperses pollen. Silk (on the ear/cob) = female stigma/style, traps pollen.

---

119. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?

(A) Diplotene
(B) Diakinesis
(C) Zygotene
(D) Pachytene

Correct Answer: (D) Pachytene

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific substage of meiotic Prophase I where recombination nodules appear.

Step 2: Detailed Explanation:
Prophase I is the longest phase of meiosis and is divided into five substages:

1. **Leptotene:** Chromatin fibers condense to form visible chromosomes.
2. **Zygotene:** Homologous chromosomes pair up in a process called synapsis, forming bivalents. The synaptonemal complex begins to form.
3. **Pachytene:** Synapsis is complete. The paired chromosomes (bivalents) become shorter and thicker. This is the stage where **crossing over** (the exchange of genetic material between non-sister chromatids of homologous chromosomes) occurs. The sites where crossing over happens are marked by the appearance of protein complexes called **recombination nodules**.
4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate. They remain attached at the points of crossing over, forming X-shaped structures called chiasmata.
5. **Diakinesis:** The chromosomes become fully condensed, and the chiasmata terminalize (move to the ends of the chromatids). The nuclear envelope breaks down.

Therefore, recombination nodules are a characteristic feature of the pachytene stage.

Step 3: Final Answer:
The appearance of recombination nodules occurs during the Pachytene substage of Prophase I.

Quick Tip

Use the mnemonic "Lazy Zebra Pounces Daringly Daily" for the stages of Prophase I: Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis. Associate Pachytene with "P" for pairing being complete and "crossing over" occurring.

---

120. Identify the pair of heterosporous pteridophytes among the following:

(A) Psilotum and Salvinia
(B) Equisetum and Salvinia
(C) Lycopodium and Selaginella
(D) Selaginella and Salvinia

Correct Answer: (D) Selaginella and Salvinia

Solution:

Step 1: Understanding the Question:
The question requires the identification of a pair of pteridophytes where both members are heterosporous.

Step 2: Detailed Explanation:
Pteridophytes can be classified based on the types of spores they produce:

- **Homosporous Pteridophytes:** They produce only one type of spore, which germinates to form a bisexual (monoecious) gametophyte. The majority of pteridophytes are homosporous. Examples include *Psilotum*, *Lycopodium*, *Equisetum*, and most ferns like *Dryopteris*.
- **Heterosporous Pteridophytes:** They produce two distinct types of spores: smaller microspores (which develop into male gametophytes) and larger megaspores (which develop into female gametophytes). This condition is considered a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples are *Selaginella*, *Salvinia*, *Azolla*, and *Marsilea*.

Now let's analyze the options:
(A) *Psilotum* is homosporous, while *Salvinia* is heterosporous.
(B) *Equisetum* is homosporous, while *Salvinia* is heterosporous.
(C) *Lycopodium* is homosporous, while *Selaginella* is heterosporous.
(D) Both *Selaginella* and *Salvinia* are classic examples of heterosporous pteridophytes.

Step 3: Final Answer:
The correct pair of heterosporous pteridophytes is *Selaginella* and *Salvinia*.

Quick Tip

Memorize the four main examples of heterosporous pteridophytes: *Selaginella*, *Salvinia*, *Azolla*, and *Marsilea*. Any other pteridophyte you encounter in standard exams (like *Lycopodium*, *Equisetum*, *Pteris*, *Dryopteris*) is likely to be homosporous.

---

121. The reaction centre in PS II has an absorption maxima at

(A) 660 nm
(B) 780 nm
(C) 680 nm
(D) 700 nm

Correct Answer: (C) 680 nm

Solution:

Step 1: Understanding the Question:
The question asks for the specific wavelength of maximum light absorption for the reaction center of Photosystem II (PS II).

Step 2: Detailed Explanation:
The light-harvesting complexes in photosynthesis are organized into two photosystems: Photosystem I (PS I) and Photosystem II (PS II). Each photosystem consists of antenna molecules and a special reaction center. The reaction center is a specific chlorophyll *a* molecule that gets excited and initiates the electron transport chain.

- **Photosystem II (PS II):** The reaction center chlorophyll *a* in PS II has an absorption peak or maximum at a wavelength of **680 nm**. Hence, it is called **P680**.
- **Photosystem I (PS I):** The reaction center chlorophyll *a* in PS I has an absorption peak at a wavelength of **700 nm**. Hence, it is called **P700**.

The question specifically asks about PS II.

Step 3: Final Answer:
The reaction centre in PS II has an absorption maximum at 680 nm.

Quick Tip

A simple way to remember is that PS II (P680) comes before PS I (P700) in the Z-scheme of electron transport, and its wavelength (680 nm) is shorter than that of PS I (700 nm). Associate the number in the photosystem name with the wavelength.

---

122. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are :

(A) Synergids, Zygote and Primary endosperm nucleus
(B) Synergids, antipodals and Polar nuclei
(C) Synergids, Primary endosperm nucleus and zygote
(D) Antipodals, synergids, and primary endosperm nucleus

Correct Answer: (A) Synergids, Zygote and Primary endosperm nucleus

Solution:

Step 1: Understanding the Question
The question asks to identify a set of structures from a fertilized embryo sac that are, in order,

haploid (n), diploid (2n), and triploid (3n).

Step 2: Detailed Explanation
Let's analyze the ploidy of the different structures within an angiosperm embryo sac after fertilization:

- **Haploid (n) structures:** Before fertilization, the egg cell, synergids, and antipodals are all haploid. After fertilization, the synergids and antipodals typically degenerate, but they are still considered haploid structures of the embryo sac.
- **Diploid (2n) structure:** The zygote is formed by the fusion of a haploid male gamete (n) and the haploid egg cell (n). Thus, the zygote is diploid (2n).
- **Triploid (3n) structure:** The Primary Endosperm Nucleus (PEN) is formed by the fusion of the second haploid male gamete (n) with the diploid central cell (which contains two polar nuclei, n + n). This process, known as triple fusion, results in a triploid (3n) nucleus.

Now, let's evaluate the options based on the required sequence (haploid, diploid, triploid):
(A) **Synergids (n)**, **Zygote (2n)**, and **Primary endosperm nucleus (3n)**. This sequence correctly matches the ploidy levels n, 2n, and 3n.
(B) Synergids (n), antipodals (n), and Polar nuclei (n+n, diploid but not a single fertilized structure). This sequence is incorrect.
(C) Synergids (n), Primary endosperm nucleus (3n), and zygote (2n). The order of diploid and triploid structures is incorrect.
(D) Antipodals (n), synergids (n), and primary endosperm nucleus (3n). This option lacks a diploid structure.

Step 3: Final Answer
The correct sequence of haploid, diploid, and triploid structures is Synergids, Zygote, and Primary endosperm nucleus.

Quick Tip

A common point of confusion is the ploidy of the central cell versus the PEN. The central cell before fertilization contains two polar nuclei (n+n), making it diploid. After fusion with a male gamete (n), it becomes the Primary Endosperm Cell with a triploid (3n) PEN.

---

123. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :
Assertion A: Late wood has fewer xylary elements with narrow vessels.
Reason R : Cambium is less active in winters.
In the light of the above statements, choose the correct answer from the options given below :

(A) A is true but R is false.
(B) A is false but R is true.
(C) Both A and R are true and R is the correct explanation of A.
(D) Both A and R are true but R is NOT the correct explanation of A.

Correct Answer: (C) Both A and R are true and R is the correct explanation of A.

Solution:

Step 1: Understanding the Question
This is an Assertion-Reason question. We need to evaluate the truthfulness of both statements and determine if the Reason correctly explains the Assertion.

Step 2: Detailed Explanation
Analyzing Assertion A:
In temperate regions, the activity of the vascular cambium is not uniform throughout the year.

- **Spring wood (or early wood):** In spring, the cambium is very active and produces a large number of xylary elements with wider vessels to meet the high water demand for growth.
- **Autumn wood (or late wood):** In autumn/winter, the cambium becomes less active. It produces fewer xylary elements, and the vessels are narrower and thick-walled.

So, the statement "Late wood has fewer xylary elements with narrow vessels" is **true**.

Analyzing Reason R:
The activity of the cambium is influenced by physiological and environmental factors, such as temperature and daylight. In winters, conditions are generally unfavorable for growth (low temperature, shorter days), which leads to a decrease in the cambium's metabolic activity.
So, the statement "Cambium is less active in winters" is also **true**.

Connecting Reason and Assertion:
The reduced activity of the cambium in winter (Reason R) is the direct cause for the formation of late wood, which is characterized by fewer xylary elements and narrow vessels (Assertion A). Therefore, the Reason is the correct explanation for the Assertion.

Step 3: Final Answer
Both Assertion A and Reason R are true, and R is the correct explanation of A.

Quick Tip

Remember the contrast: Spring wood is light-colored and has lower density, while late wood is darker and denser. These two types of wood appear as concentric circles, forming an annual ring which can be used to estimate the age of a tree.

124. The phenomenon of pleiotropism refers to

(A) a single gene affecting multiple phenotypic expression.
(B) more than two genes affecting a single character.
(C) presence of several alleles of a single gene controlling a single crossover.
(D) presence of two alleles, each of the two genes controlling a single trait.

Correct Answer: (A) a single gene affecting multiple phenotypic expression.

Solution:

Step 1: Understanding the Question
The question asks for the definition of pleiotropism.

Step 2: Detailed Explanation
Pleiotropy is a genetic phenomenon where a single gene influences two or more seemingly unrelated phenotypic traits. The underlying mechanism is that the gene codes for a product (e.g., an enzyme or protein) that is involved in multiple metabolic pathways or has multiple functions within the cell.
A classic example is phenylketonuria (PKU) in humans. A single gene defect leads to the inability to metabolize the amino acid phenylalanine. This single genetic change results in multiple phenotypes, including mental retardation, reduced skin and hair pigmentation, and eczema.
Let's evaluate the given options:
(A) **a single gene affecting multiple phenotypic expression.** - This is the precise definition of pleiotropy.
(B) **more than two genes affecting a single character.** - This describes polygenic inheritance, which is the opposite of pleiotropy.
(C) **presence of several alleles of a single gene...** - This describes multiple allelism.
(D) **presence of two alleles, each of the two genes...** - This describes the standard Mendelian inheritance for a single trait controlled by a gene with two alleles.

Step 3: Final Answer
Based on the definition, pleiotropism is when a single gene affects multiple phenotypic expressions.

Quick Tip

To avoid confusion, create a simple chart:

- **Pleiotropy:** 1 Gene $\rightarrow$ Many Traits (e.g., PKU)
- **Polygenic Inheritance:** Many Genes $\rightarrow$ 1 Trait (e.g., skin color, height)

125. Cellulose does not form blue colour with Iodine because

(A) It does not contain complex helices and hence cannot hold iodine molecules.
(B) It breakes down when iodine reacts with it.
(C) It is a disaccharide.
(D) It is a helical molecule.

Correct Answer: (A) It does not contain complex helices and hence cannot hold iodine molecules.

Solution:

Step 1: Understanding the Question
The question asks for the structural reason why cellulose does not give a positive result (blue color) in the iodine test, unlike starch.

Step 2: Detailed Explanation
The iodine test is used to detect the presence of starch. The principle behind this test lies in the structure of the polysaccharide.

- **Starch (specifically Amylose):** Starch is a polymer of α-glucose. Its amylose component forms a helical (coiled) secondary structure. When iodine is added, iodine molecules (as I_3^- and I_5^- ions) fit inside this helix, forming a starch-iodine complex. This complex absorbs light at a specific wavelength, resulting in a characteristic blue-black color.
- **Cellulose:** Cellulose is a polymer of β-glucose, linked by β-1,4 glycosidic bonds. This type of linkage results in a straight, linear chain rather than a helix. Multiple cellulose chains are packed parallel to each other, forming strong microfibrils.

Because cellulose has a linear structure and does not form helices, there is no space for iodine molecules to get trapped. Therefore, the color-forming complex is not created, and cellulose does not turn blue with iodine.

Let's evaluate the options:
(A) **It does not contain complex helices and hence cannot hold iodine molecules.** - This is the correct explanation.
(B) **It breakes down when iodine reacts with it.** - This is incorrect. Iodine does not break down cellulose.
(C) **It is a disaccharide.** - This is incorrect. Cellulose is a polysaccharide.
(D) **It is a helical molecule.** - This is incorrect. Cellulose is a linear molecule; starch (amylose) is helical.

Step 3: Final Answer
The correct reason is that cellulose lacks the helical structure necessary to trap iodine molecules.

Quick Tip

Remember the structural difference between starch and cellulose based on their glucose isomers:

- **Starch:** α-glucose polymer $\rightarrow$ Helical structure $\rightarrow$ Traps iodine $\rightarrow$ Blue color.
- **Cellulose:** β-glucose polymer $\rightarrow$ Linear structure $\rightarrow$ Cannot trap iodine $\rightarrow$ No color change.

---

126. Frequency of recombination between gene pairs on same chromosome as a measure of the distance between genes to map their position on chromosome, was used for the first time by

(A) Alfred Sturtevant
(B) Henking
(C) Thomas Hunt Morgan
(D) Sutton and Boveri

Correct Answer: (A) Alfred Sturtevant

Solution:

Step 1: Understanding the Question
The question asks to identify the scientist who first utilized the frequency of genetic recombination to create a genetic map.

Step 2: Detailed Explanation
Let's review the contributions of the scientists listed:

- **Thomas Hunt Morgan:** Working with *Drosophila melanogaster*, Morgan and his group provided experimental evidence for the chromosomal theory of inheritance. They discovered phenomena like linkage (genes on the same chromosome tend to be inherited together) and recombination (the process that breaks linkages).
- **Alfred Sturtevant:** He was a student in T.H. Morgan's lab. Sturtevant hypothesized that the frequency of recombination between two linked genes is proportional to the physical distance between them on the chromosome. In 1913, he used recombination data to construct the first-ever genetic map, showing the linear arrangement of genes on a chromosome.
- **Henking:** In 1891, Henking discovered the X chromosome, referring to it as the "X-body," while studying insect spermatogenesis.
- **Sutton and Boveri:** Independently, they formulated the Boveri-Sutton chromosomal theory of inheritance (around 1902-1903), which states that chromosomes are the carriers of genetic material.

While Morgan's lab laid the groundwork, it was Alfred Sturtevant who first conceptualized and applied the idea of using recombination frequencies to map gene positions.

Step 3: Final Answer
Alfred Sturtevant was the first to use recombination frequency for gene mapping.

Quick Tip

Associate the scientists with their key concepts:

- **Morgan:** Linkage and Recombination
- **Sturtevant:** Gene Mapping (using recombination frequency)
- **Sutton & Boveri:** Chromosomal Theory of Inheritance

Remember that Sturtevant was Morgan's student.

---

127. Given below are two statements :
Statement I: The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height.
Statement II: Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) Statement I is correct but Statement II is incorrect.
(B) Statement I is incorrect but Statement II is correct.
(C) Both Statement I and Statement II are correct.
(D) Both Statement I and Statement II are incorrect.

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

Solution:

Step 1: Understanding the Question
The question requires an evaluation of two statements related to the physiological effects of transpiration in plants.

Step 2: Detailed Explanation
Analysis of Statement I:
The ascent of sap in plants is primarily explained by the Cohesion-Tension-Transpiration Pull model.

- **Transpiration Pull:** Evaporation of water from leaf surfaces creates a negative pressure potential or tension in the xylem.

- **Cohesion:** Water molecules stick to each other due to hydrogen bonds.
- **Adhesion:** Water molecules stick to the walls of the xylem vessels.

These three forces together create a continuous, unbroken column of water that is pulled up from the roots to the leaves. This force is remarkably strong, capable of pulling water to the tops of the tallest trees on Earth, such as the Coast Redwood (*Sequoia sempervirens*), which can exceed 115 meters. Therefore, the statement that this force can lift water over 130 meters is considered physiologically correct and plausible. So, **Statement I is correct**.

Analysis of Statement II:
Transpiration is the process of water evaporation from the plant surface, mainly through stomata on the leaves. Evaporation is a cooling process because it requires energy, which is absorbed from the leaf in the form of latent heat of vaporization. By dissipating this heat, transpiration prevents the leaves from becoming dangerously hot, especially under intense sunlight. A cooling effect of 10 to 15 degrees Celsius is a well-documented and significant benefit of transpiration. So, **Statement II is correct**.

Step 3: Final Answer
Since both statements accurately describe key functions of transpiration, the correct option is that both Statement I and Statement II are correct.

Quick Tip

Transpiration is often called a 'necessary evil'. It is 'evil' because it leads to significant water loss, but it is 'necessary' for three key reasons: creating transpiration pull for water and mineral absorption, supplying water for photosynthesis, and cooling the leaf surface.

---

128. Upon exposure to UV radiation, DNA stained with ethidium bromide will show

(A) Bright yellow colour
(B) Bright orange colour
(C) Bright red colour
(D) Bright blue colour

Correct Answer: (B) Bright orange colour

Solution:

Step 1: Understanding the Question
The question asks about the appearance of DNA stained with ethidium bromide when viewed under UV light, a standard technique in molecular biology.

Step 2: Detailed Explanation
The process of visualizing DNA after agarose gel electrophoresis involves the following steps:

- **Staining:** The gel containing the separated DNA fragments is soaked in a solution of ethidium bromide (EtBr). EtBr is an intercalating agent, meaning it inserts itself between the stacked base pairs of the DNA double helix.
- **Visualization:** The stained gel is then placed on a UV transilluminator, which is a light box that emits ultraviolet radiation.
- **Fluorescence:** When the DNA-EtBr complex absorbs UV radiation (around 300-360 nm), the ethidium bromide molecule becomes excited and then emits light of a longer wavelength (fluoresces) in the visible spectrum.
- **Color:** The emitted light is in the orange-red part of the spectrum, appearing as bright orange or sometimes reddish-orange bands against a dark background.

Therefore, DNA stained with ethidium bromide fluoresces with a bright orange color under UV radiation.

Step 3: Final Answer
The correct observation is a bright orange colour.

Quick Tip

Ethidium bromide is a powerful mutagen and carcinogen, so appropriate safety precautions (gloves, lab coat, UV-protective eyewear) must always be used when handling it. Safer alternatives like SYBR Green are now commonly used, which fluoresce with a green color.

---

129. Which micronutrient is required for splitting of water molecule during photosynthesis?

(A) magnesium
(B) copper
(C) manganese
(D) molybdenum

Correct Answer: (C) manganese

Solution:

Step 1: Understanding the Question
The question asks to identify the micronutrient that is essential for the photolysis (splitting) of water during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation
The splitting of water molecules occurs in Photosystem II (PS II) and is a critical step in photosynthesis. It releases electrons (e^-), protons (H^+), and oxygen (O_2). The reaction is:

$$2H_2O \rightarrow 4H^+ + 4e^- + O_2$$

This reaction is catalyzed by a protein complex called the Oxygen-Evolving Complex (OEC), which is associated with PS II. The active site of the OEC contains a cluster of four Manganese (Mn) ions and one Calcium (Ca^{2+}) ion. Chloride (Cl^-) ions are also required as cofactors.
The manganese ions are crucial as they cycle through different oxidation states, which facilitates the transfer of electrons from water molecules, leading to their eventual splitting and the release of oxygen.
Let's look at the roles of the other options:

- **Magnesium (Mg):** A macronutrient that is the central atom of the chlorophyll molecule. It is essential for trapping light energy but not for water splitting.
- **Copper (Cu):** A component of plastocyanin, an electron carrier protein that transfers electrons between the cytochrome b6f complex and Photosystem I.
- **Molybdenum (Mo):** Primarily involved in nitrogen metabolism (as a component of nitrate reductase and nitrogenase).

Step 3: Final Answer
Manganese (Mn) is the essential micronutrient for the splitting of water during photosynthesis.

Quick Tip

To remember the key minerals in photosynthesis, use this mnemonic: "Mighty good (Mg) chlorophyll catches light, but Man (Mn) can (Ca) clean (Cl) water." This helps recall that Mg is in chlorophyll, while Mn, Ca, and Cl are involved in water splitting.

---

130. Which hormone promotes internode/petiole elongation in deep water rice?

(A) Ethylene
(B) 2, 4-D
(C) GA_3
(D) Kinetin

Correct Answer: (A) Ethylene

Solution:

Step 1: Understanding the Question
The question asks to identify the plant hormone responsible for the rapid elongation of stems (internodes) and leaf stalks (petioles) in deep water rice varieties when they are submerged.

Step 2: Detailed Explanation
Deep water rice is adapted to grow in flood-prone areas. When submerged in water, these plants exhibit rapid internodal elongation to keep their leaves above the water surface for gas exchange and photosynthesis. This response is primarily triggered by the gaseous hormone, ethylene.
Here's the mechanism:

- When the plant is submerged, ethylene, which is naturally produced by the plant, gets trapped in the plant tissues because its diffusion into the air is blocked by the surrounding water.
- This accumulation of ethylene acts as a signal.
- The increased ethylene concentration enhances the plant's sensitivity to another hormone, gibberellin (like GA_3), or promotes gibberellin synthesis.
- Gibberellin then directly promotes cell division and elongation in the internodes, causing the stem to grow rapidly.

While gibberellin (GA_3) is the hormone that directly causes the elongation, ethylene is the primary trigger for this specific adaptive response in submerged deep water rice. Therefore, ethylene is considered the promoter of this phenomenon.
Let's review the other options:

- **2, 4-D:** A synthetic auxin, often used as a herbicide at high concentrations.
- **GA_3 (Gibberellic acid):** It does cause stem elongation (e.g., bolting) and is the downstream effector in this process, but ethylene is the initial signal.
- **Kinetin:** A cytokinin, primarily involved in promoting cell division and delaying senescence. It generally inhibits stem elongation.

Step 3: Final Answer
Ethylene is the hormone that promotes internode/petiole elongation in deep water rice.

Quick Tip

For questions about hormonal regulation in specific environmental responses, remember the primary trigger. In the case of deep water rice submergence, the key event is the entrapment of gaseous ethylene, which initiates the entire elongation cascade.

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131. Identify the correct statements :
A. Detrivores perform fragmentation.
B. The humus is further degraded by some microbes during mineralization.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
D. The detritus food chain begins with living organisms.
E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the correct answer from the options given below :

(A) C, D, E only
(B) D, E, A only
(C) A, B, C only
(D) B, C, D only

Correct Answer: (C) A, B, C only

Solution:

Step 1: Understanding the Question
The question asks to identify the correct statements related to the process of decomposition in an ecosystem.

Step 2: Detailed Explanation
Let's analyze each statement:
A. Detrivores perform fragmentation. This statement is **correct**. Detritivores, such as earthworms, break down detritus (dead organic matter) into smaller particles. This process is called fragmentation.
B. The humus is further degraded by some microbes during mineralization. This statement is **correct**. Humus is a dark amorphous substance that is highly resistant to microbial action and decomposes at an extremely slow rate. Eventually, it is degraded by some microbes, and this process, called mineralization, releases inorganic nutrients back into the soil.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching. This statement is **correct**. Leaching is the process by which water-soluble nutrients, such as nitrates and phosphates, percolate through the soil horizons and can become unavailable to plants.
D. The detritus food chain begins with living organisms. This statement is **incorrect**. The detritus food chain (DFC) begins with dead organic matter (detritus). The grazing food chain (GFC) begins with living organisms (producers).
E. Earthworms break down detritus into smaller particles by a process called catabolism. This statement is **incorrect**. The process of breaking down detritus into smaller particles by earthworms is called fragmentation, not catabolism. Catabolism refers to the enzymatic degradation of detritus into simpler inorganic substances by bacteria and fungi.

Step 3: Final Answer
Based on the analysis, statements A, B, and C are correct. Therefore, the correct option is (3).

Quick Tip

Remember the five key processes of decomposition in order: Fragmentation, Leaching, Catabolism, Humification, and Mineralization. Differentiating between fragmentation (physical breakdown by detritivores) and catabolism (chemical breakdown by microbes) is crucial.

132. In gene gun method used to introduce alien DNA into host cells, microparticles of _____ metal are used.

(A) Tungsten or gold
(B) Silver
(C) Copper
(D) Zinc

Correct Answer: (A) Tungsten or gold

Solution:

Step 1: Understanding the Question
The question asks about the specific metals used for coating DNA in the gene gun (biolistics) method of genetic transformation.

Step 2: Detailed Explanation
The gene gun method, also known as biolistics, is a physical method for introducing foreign DNA into cells.
The principle involves:

1. Coating the DNA of interest onto the surface of microscopic particles of a heavy metal.
2. These microparticles are then accelerated to a very high velocity.
3. The high-velocity particles are fired at the target cells or tissues, penetrating the cell wall and cell membrane to deliver the DNA into the cells.

The metals used must be dense, to have enough momentum to penetrate the cells, and chemically inert, so they do not react with the DNA or cellular components. The most commonly used metals for these microprojectiles are **gold (Au)** and **tungsten (W)**.

Step 3: Final Answer
Therefore, tungsten or gold are the metals used in the gene gun method.

Quick Tip

Associate the gene gun (biolistics) method with "bullets" made of gold or tungsten. This physical method is particularly useful for transforming plant cells, which have a rigid cell wall that can be difficult to bypass with other methods.

133. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out

(A) Histones
(B) Polysaccharides
(C) RNA
(D) DNA

Correct Answer: (D) DNA

Solution:

Step 1: Understanding the Question
The question asks which biomolecule is precipitated out of a solution by adding chilled ethanol during the process of DNA isolation.

Step 2: Detailed Explanation
The process of isolating DNA from cells involves several steps:

1. **Lysis of cells:** Breaking open the cells to release the cellular contents, including DNA.
2. **Removal of contaminants:** The cell lysate contains DNA, RNA, proteins (like histones), lipids, and polysaccharides. Enzymes are used to digest these contaminants.
   - Proteases digest proteins.
   - Ribonuclease (RNase) digests RNA.
3. **Precipitation of DNA:** After removing other macromolecules, the solution contains purified DNA. DNA is soluble in aqueous solutions but is insoluble in alcohols like ethanol or isopropanol. When chilled ethanol is added to the aqueous solution of DNA, the DNA precipitates out of the solution as a mass of fine, white threads. This process is called ethanol precipitation.

The precipitated DNA can then be spooled out from the solution.

Step 3: Final Answer
The addition of chilled ethanol causes the DNA to precipitate.

Quick Tip

A key step in any DNA extraction protocol is the final precipitation with alcohol. Remember that DNA is insoluble in alcohol, which allows for its separation from the soluble components of the cell lysate. The use of chilled ethanol enhances the precipitation process.

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134. Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species?

(A) Alien species invasions
(B) Co-extinctions
(C) Habitat loss and fragmentation
(D) Over exploitation for economic gain

Correct Answer: (C) Habitat loss and fragmentation

Solution:

Step 1: Understanding the Question
The question asks to identify the primary cause of species extinction from the four major causes, collectively known as 'The Evil Quartet'.

Step 2: Detailed Explanation
'The Evil Quartet' refers to the four major causes of biodiversity loss:

1. **Habitat loss and fragmentation:** This involves the destruction or division of natural habitats due to human activities like deforestation, urbanization, and agriculture. When an organism's habitat is destroyed or fragmented into small, isolated patches, its population size decreases, genetic diversity is lost, and it becomes more vulnerable to extinction. This is universally recognized by conservation biologists as the single most important cause of extinction. For example, the deforestation of tropical rainforests is leading to the extinction of a vast number of species.
2. **Over-exploitation:** This refers to harvesting a renewable resource to the point of diminishing returns. Overhunting, overfishing, and illegal trade in wildlife have led to the extinction or endangerment of many species, such as the Steller's sea cow and the passenger pigeon.
3. **Alien species invasions:** When non-native species are introduced into a new ecosystem, they can outcompete native species for resources, introduce diseases, or alter the habitat, leading to the decline and extinction of native species. The introduction of the Nile perch into Lake Victoria is a classic example.
4. **Co-extinctions:** This occurs when the extinction of one species leads to the extinction of another species that was dependent on it, such as a host-specific parasite or a plant and its obligate pollinator.

Among these four, habitat loss and fragmentation affects the largest number of species across all taxa and is considered the leading driver of the current biodiversity crisis.

Step 3: Final Answer
Habitat loss and fragmentation is the most important cause of species extinction.

Quick Tip

When asked about the *most important* cause of biodiversity loss, the answer is almost always habitat loss and fragmentation. While the other causes are significant, the sheer scale of habitat destruction globally has the most widespread and devastating impact.

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135. Expressed Sequence Tags (ESTs) refers to

(A) All genes whether expressed or unexpressed.
(B) Certain important expressed genes.
(C) All genes that are expressed as RNA.
(D) All genes that are expressed as proteins.

Correct Answer: (C) All genes that are expressed as RNA.

Solution:

Step 1: Understanding the Question
The question asks for the definition of Expressed Sequence Tags (ESTs) in the context of genomics.

Step 2: Detailed Explanation
Expressed Sequence Tags (ESTs) are a tool used in molecular genetics to identify transcribed regions of a genome. Here's how they relate to gene expression:

1. The first step of gene expression is transcription, where a gene (a segment of DNA) is copied into a messenger RNA (mRNA) molecule.
2. To create ESTs, scientists first isolate all the mRNA from a specific cell or tissue type.
3. This mRNA is then converted back into DNA using an enzyme called reverse transcriptase. The resulting DNA is called complementary DNA (cDNA).
4. Short sequences from the ends of these cDNA molecules are then determined. These short sequences are the ESTs.

Because ESTs are derived from mRNA, they represent portions of genes that are actively being transcribed, i.e., "expressed as RNA". This approach allows scientists to get a snapshot of all the genes that are active in a particular cell at a particular time.

Now let's evaluate the options:
(A) All genes whether expressed or unexpressed. - Incorrect. ESTs only represent expressed genes.
(B) Certain important expressed genes. - Incorrect. The method, in principle, identifies all expressed genes, not just "certain important" ones.
(C) **All genes that are expressed as RNA.** - Correct. This is the precise definition. If a gene is transcribed into RNA, it can be captured as an EST.

(D) All genes that are expressed as proteins. - Incorrect. While many RNAs are translated into proteins, some functional RNAs (like rRNA, tRNA) are not. ESTs represent transcription (DNA $\rightarrow$ RNA), not translation (RNA $\rightarrow$ protein).

Step 3: Final Answer
ESTs refer to all genes that are expressed as RNA.

Quick Tip

The key to understanding ESTs is in the name itself. "Expressed" means transcribed into RNA. "Sequence Tags" means they are short pieces of sequence that act as markers or tags for those expressed genes. This was a major approach used in the Human Genome Project to identify genes.

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136. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :
Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.
Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.
In the light of the above statements, choose the correct answer from the options given below :

(A) A is true but R is false.
(B) A is false but R is true.
(C) Both A and R are true and R is the correct explanation of A.
(D) Both A and R are true but R is NOT the correct explanation of A.

Correct Answer: (A) A is true but R is false.

Solution:

Step 1: Understanding the Question
This is an Assertion-Reason question about pollination and fertilization in gymnosperms. We need to evaluate both statements and their relationship.

Step 2: Detailed Explanation
Analyzing Assertion A:
"In gymnosperms the pollen grains are released from the microsporangium and carried by air currents."
This statement is **true**. Gymnosperms are predominantly wind-pollinated (anemophilous). Their pollen grains are light, produced in large quantities, and often winged (e.g., in *Pinus*) to facilitate dispersal by air currents from the male cones (which contain microsporangia).

Analyzing Reason R:
"Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed."
This statement is **false**. Let's break it down:

- Air currents carry the pollen grains to the ovule, where they land on the micropyle, not directly on the archegonium.
- After pollination, the pollen grain germinates and **forms a pollen tube**.
- This pollen tube grows through the nucellus towards the archegonium.
- The pollen tube then discharges the male gametes near the egg cell within the archegonium, leading to fertilization.

The key error in the statement is that a "pollen tube is not formed". The formation of a pollen tube (siphonogamy) is a characteristic feature of seed plants, including gymnosperms and angiosperms.

Step 3: Final Answer
Since Assertion A is true and Reason R is false, the correct option is (1).

Quick Tip

A common misconception is about the pollen tube in different plant groups. Remember:

- Bryophytes & Pteridophytes: No pollen tube; require water for flagellated sperm to swim.
- Gymnosperms & Angiosperms (Spermatophytes): Pollen tube is formed to deliver non-motile (or motile in some primitive gymnosperms) male gametes to the egg. This adaptation makes them independent of water for fertilization.

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137. Identify the correct statements :
A. Lenticels are the lens-shaped openings permitting the exchange of gases.
B. Bark formed early in the season is called hard bark.
C. Bark is a technical term that refers to all tissues exterior to vascular cambium.
D. Bark refers to periderm and secondary phloem.
E. Phellogen is single-layered in thickness.
Choose the correct answer from the options given below :

(A) A, B and D only
(B) B and C only
(C) B, C and E only
(D) A and D only

Correct Answer: (D) A and D only

Solution:

Step 1: Understanding the Question
The question asks to identify the correct statements about plant anatomy, specifically related to bark and associated structures.

Step 2: Detailed Explanation
Let's analyze each statement:
A. Lenticels are the lens-shaped openings permitting the exchange of gases. This statement is **correct**. Lenticels are porous tissues consisting of cells with large intercellular spaces in the periderm of secondarily thickened organs. They serve as a pathway for the direct exchange of gases between the internal tissues and the atmosphere.
B. Bark formed early in the season is called hard bark. This statement is **incorrect**. Bark formed early in the season (spring) is called 'early' or 'soft' bark. Bark formed late in the season (autumn) is called 'late' or 'hard' bark.
C. Bark is a technical term that refers to all tissues exterior to vascular cambium. This statement is **incorrect**. "Bark" is generally considered a non-technical term. While it does refer to all tissues outside the vascular cambium, calling it a "technical term" is debatable and often considered incorrect in formal botany. More importantly, statement D provides a more precise composition. In the context of multiple-choice questions where one must choose the *best* set of correct answers, this statement is often excluded in favor of more precise ones.
D. Bark refers to periderm and secondary phloem. This statement is **correct**. Botanically, bark is composed of two main regions: the inner bark, which is the living secondary phloem, and the outer bark, which is the periderm (and any dead tissues outside it). This is a standard and accurate description of the components of bark.
E. Phellogen is single-layered in thickness. This statement is **incorrect**. Phellogen (cork cambium) is a meristematic tissue and is typically composed of a few layers of cells, not just a single layer.

Step 3: Final Answer
Based on the analysis, statements A and D are correct. Therefore, the correct option is (4).

Quick Tip

For questions on bark, remember the hierarchy:

- **Bark** = All tissues outside the vascular cambium.
- **Bark components** = Secondary Phloem (Inner Bark) + Periderm (Outer Bark).
- **Periderm** = Phellogen (cork cambium) + Phellem (cork) + Phelloderm (secondary cortex).

Statements describing the components (like D) are often preferred over broad locational definitions (like C).

138. Match List I with List II :
List I
A. Oxidative decarboxylation
B. Glycolysis
C. Oxidative phosphorylation
D. Tricarboxylic acid cycle
List II
I. Citrate synthase
II. Pyruvate dehydrogenase
III. Electron transport system
IV. EMP pathway
Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question
The question requires matching key processes and pathways of cellular respiration (List I) with their associated enzymes, alternate names, or locations (List II).

Step 2: Detailed Explanation
Let's match each item from List I to its correct counterpart in List II.
A. Oxidative decarboxylation: This is a specific type of reaction where a carboxyl group is removed from a molecule, forming CO_2, and the molecule is oxidized. In cellular respiration, this term most famously refers to the conversion of pyruvate to acetyl-CoA, a reaction catalyzed by the **Pyruvate dehydrogenase** complex. Thus, **A matches II**.
B. Glycolysis: This is the metabolic pathway that converts glucose into pyruvate. It is also known as the **EMP pathway**, named after its discoverers Gustav Embden, Otto Meyerhof, and Jakub Karol Parnas. Thus, **B matches IV**.
C. Oxidative phosphorylation: This is the process where the energy released by the oxidation of molecules is used to generate ATP. It takes place in the **Electron transport system (ETS)** or electron transport chain located on the inner mitochondrial membrane. Thus, **C matches III**.
D. Tricarboxylic acid (TCA) cycle: Also known as the Krebs cycle. The very first step of this cycle is the condensation of acetyl-CoA with oxaloacetate to form citrate. This reaction is catalyzed by the enzyme **Citrate synthase**. Thus, **D matches I**.

Step 3: Final Answer
The correct matching is: A $\rightarrow$ II, B $\rightarrow$ IV, C $\rightarrow$ III, D $\rightarrow$ I. This corresponds to option (2).

Quick Tip

For cellular respiration matching questions, create a mental flowchart: Glycolysis (EMP pathway) → Pyruvate → Oxidative Decarboxylation (Pyruvate Dehydrogenase) → Acetyl-CoA → TCA Cycle (starts with Citrate Synthase) → Electron Transport System (site of Oxidative Phosphorylation).

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139. How many different proteins does the ribosome consist of?

(A) 40
(B) 20
(C) 80
(D) 60

Correct Answer: (C) 80

Solution:

Step 1: Understanding the Question
The question asks for the approximate number of different proteins that make up a ribosome. The question is general and doesn't specify prokaryotic or eukaryotic, but the options guide us towards the eukaryotic ribosome.

Step 2: Detailed Explanation
Ribosomes are complex molecular machines, found within all living cells, that serve as the site of biological protein synthesis (translation). They are composed of ribosomal RNA (rRNA) and ribosomal proteins.

- **Prokaryotic Ribosome (70S):** It consists of a 50S large subunit and a 30S small subunit. It contains about 55 different proteins.
- **Eukaryotic Ribosome (80S):** It consists of a 60S large subunit and a 40S small subunit. It is larger and more complex than the prokaryotic ribosome. The 60S subunit contains about 49 proteins, and the 40S subunit contains about 33 proteins. The total number of different proteins is approximately 49 + 33 = 82.

Looking at the options provided:
(A) 40
(B) 20
(C) 80
(D) 60
The value '80' is the closest approximation to the actual number of proteins (around 82) found in a eukaryotic 80S ribosome. This is the standard value often cited in textbooks.

Step 3: Final Answer
A eukaryotic ribosome consists of approximately 80 different proteins.

Quick Tip

When a question about cellular components like ribosomes is asked without specifying prokaryote vs. eukaryote, and the options include values for both, consider the context. Often, the question implicitly refers to the eukaryotic version. Remember the number 80 for eukaryotic ribosome proteins and 70S/80S for the sedimentation coefficients.

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140. Given below are two statements :
Statement I: Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually.
Statement II: In general, carnivores are more adversely affected by competition than herbivores.
In the light of the above statements, choose the correct answer from the options given below :

(A) Statement I is correct but Statement II is false.
(B) Statement I is incorrect but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

Correct Answer: (A) Statement I is correct but Statement II is false.

Solution:

Step 1: Understanding the Question
The question presents two statements related to ecological competition and asks to evaluate their correctness.

Step 2: Detailed Explanation
Analysis of Statement I:
"Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually."
This statement is a precise and accurate definition of the Competitive Exclusion Principle, which Gause formulated based on his experiments with *Paramecium* species. When two species compete for the exact same limited resources (i.e., occupy the same niche), one will be slightly more efficient and will eventually outcompete and eliminate the other. Thus, **Statement I is correct**.

Analysis of Statement II:
"In general, carnivores are more adversely affected by competition than herbivores."
This statement is a broad generalization that is generally considered **false**. Competition can be intense at all trophic levels. Herbivores often face strong competition for limited plant resources. Carnivores also face intense competition for prey and territory. There is no general rule that one group is more adversely affected than the other. In fact, some ecological theories suggest that competition is often stronger at lower trophic levels (among producers and herbivores) because resources are more uniformly distributed and contested. Therefore, making a blanket statement that carnivores are *more* affected is not scientifically supported.

Step 3: Final Answer
Statement I is correct, but Statement II is false.

Quick Tip

Be wary of absolute or overly broad generalizations in ecology questions, such as "always," "never," or "more than." Ecological interactions are complex and context-dependent. Statement II is an example of such a questionable generalization. The definition in Statement I, however, is a foundational principle and is reliably correct.

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141. Match List I with List II :

List I	**List II**
A. Cohesion	**I. More attraction in liquid phase**
B. Adhesion	**II. Mutual attraction among water molecules**
C. Surface tension	**III. Water loss in liquid phase**
D. Guttation	**IV. Attraction towards polar surfaces**

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question
This question requires matching terms related to the physical properties of water and plant water relations (List I) with their correct definitions or descriptions (List II).

Step 2: Detailed Explanation
Let's match each term in List I with its description in List II.
A. Cohesion: This is the force of attraction between molecules of the same substance. For

water, it is the **mutual attraction among water molecules** due to hydrogen bonding. Thus, **A matches II**.
B. Adhesion: This is the force of attraction between molecules of different substances. In plants, it refers to the **attraction of water molecules towards polar surfaces**, such as the lignocellulosic walls of the xylem vessels. Thus, **B matches IV**.
C. Surface tension: This is a property of liquids where the surface tends to shrink into the minimum surface area possible. It arises because water molecules at the surface are more attracted to each other in the liquid phase than to the molecules in the air (gas phase). This results in **more attraction in the liquid phase** at the surface. Thus, **C matches I**.
D. Guttation: This is the exudation of xylem sap from the tips of leaves of some vascular plants. It is essentially **water loss in liquid phase**, as opposed to transpiration which is water loss in vapor phase. Thus, **D matches III**.

Step 3: Final Answer
The correct set of matches is A-II, B-IV, C-I, D-III. This corresponds to option (3).

Quick Tip

Remember the 'Co-' prefix in Cohesion means 'together', so it's attraction between like molecules (water-water). 'Ad-' in Adhesion means 'to', so it's attraction to something else (water-xylem wall). These two forces, along with surface tension, are responsible for the high tensile strength of water columns in plants.

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142. Which one of the following statements is NOT correct?

(A) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body.
(B) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels.
(C) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms.
(D) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.

Correct Answer: (D) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.

Solution:

Step 1: Understanding the Question
The question asks to identify the incorrect statement among the given options related to water pollution and its ecological consequences.

Step 2: Detailed Explanation
Let's analyze each statement:
(A) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body. This statement is **correct**. Water hyacinth is an invasive aquatic weed that thrives in nutrient-rich (eutrophic) waters. Its rapid growth covers the water surface, blocking sunlight and depleting dissolved oxygen, which severely disrupts the aquatic ecosystem.
(B) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels. This statement is **correct**. This phenomenon is called biomagnification or biological magnification. Non-biodegradable toxic substances like heavy metals (mercury) and pesticides (DDT) accumulate in tissues and their concentration increases as they move up the food chain.
(C) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms. This statement is **correct**. When sewage with high organic content is discharged into water, decomposer microorganisms multiply rapidly. Their respiration consumes a large amount of dissolved oxygen, leading to a sharp drop in oxygen levels (increased Biological Oxygen Demand - BOD), which can cause mass mortality of fish and other aquatic life.
(D) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries. This statement is **incorrect**. Algal blooms are caused by an excess of nutrients (like nitrates and phosphates), a condition known as eutrophication, not just organic matter. These blooms drastically **deteriorate** water quality by imparting color and odor, and more importantly, when the algae die, their decomposition by bacteria consumes vast amounts of dissolved oxygen, leading to hypoxic or anoxic conditions that cause widespread fish kills. Thus, algal blooms are detrimental to fisheries, not promotional.

Step 3: Final Answer
The incorrect statement is (D).

Quick Tip

Eutrophication and algal blooms are always associated with negative consequences for aquatic ecosystems. Any statement suggesting they "improve" water quality or "promote" fisheries is a major red flag and likely the incorrect statement you are looking for.

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143. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :
Assertion A: A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.
Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.
In the light of the above statements, choose the correct answer from the options given below :

(A) A is true but R is false.
(B) A is false but R is true.
(C) Both A and R are true and R is the correct explanation of A.
(D) Both A and R are true but R is NOT the correct explanation of A.

Correct Answer: (C) Both A and R are true and R is the correct explanation of A.

Solution:

Step 1: Understanding the Question
This is an Assertion-Reason question that asks about the morphological nature of a flower. We need to determine if both statements are true and if the reason correctly explains the assertion.

Step 2: Detailed Explanation
Analyzing Assertion A:
"A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem."
This statement is **true**. Homology studies have established that a flower is structurally a modified, determinate shoot, specialized for reproduction. The transition from vegetative growth to reproductive growth involves the transformation of the shoot apical meristem into a floral meristem.

Analyzing Reason R:
"Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves."
This statement is **true**. A typical shoot consists of nodes (where leaves arise) and internodes (the stem region between nodes). In a flower, the axis (thalamus or receptacle) becomes condensed, and the internodes do not elongate. The successive nodes on this condensed axis bear modified leaves, which are the floral appendages: sepals, petals, stamens, and carpels.

Connecting Reason and Assertion:
The assertion states that a flower is a modified shoot. The reason explains *how* it is modified: the internodes are condensed, and the appendages are modified leaves (floral parts). This explanation directly supports and clarifies the assertion. Therefore, the reason is the correct explanation for the assertion.

Step 3: Final Answer
Both A and R are true, and R is the correct explanation of A.

Quick Tip

Remember the evidence for the flower being a modified shoot: the thalamus is a condensed axis (stem), and the floral parts (sepals, petals, stamens, carpels) are homologous to leaves. This is a fundamental concept in plant morphology.

144. Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

(A) Lipase
(B) Dinitrogenase
(C) Succinic dehydrogenase
(D) Amylase

Correct Answer: (C) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question
The question asks to identify the specific enzyme that is inhibited by malonate (spelled here as 'melonate'), leading to the inhibition of bacterial growth.

Step 2: Detailed Explanation
Malonate is a classic example of a competitive inhibitor. Inhibition of enzyme activity disrupts metabolic pathways, which can inhibit the growth of or kill an organism like a bacterium.

- **Target Enzyme:** The enzyme targeted by malonate is **Succinic dehydrogenase**.
- **Metabolic Pathway:** Succinic dehydrogenase is a crucial enzyme in the Citric Acid Cycle (Krebs Cycle), a central pathway of cellular respiration. It catalyzes the oxidation of succinate to fumarate.
- **Mechanism of Inhibition:** Malonate has a molecular structure that is very similar to succinate, the natural substrate of the enzyme. Because of this structural similarity (it is a structural analogue), malonate can bind to the active site of succinic dehydrogenase. However, the enzyme cannot act on malonate. By occupying the active site, malonate prevents the actual substrate, succinate, from binding. This is known as competitive inhibition.
- **Effect on Bacteria:** By inhibiting the Krebs cycle, malonate drastically reduces the cell's ability to produce ATP through aerobic respiration, thereby inhibiting its growth and proliferation.

Step 3: Final Answer
Malonate inhibits the enzyme succinic dehydrogenase.

Quick Tip

The relationship between succinate, succinic dehydrogenase, and malonate is a textbook example of competitive inhibition. Remember: Substrate = Succinate, Enzyme = Succinic Dehydrogenase, Competitive Inhibitor = Malonate. The similarity in structure is the key to this mechanism.

145. Match List I with List II :

List I		List II	
A.	M Phase	I.	Proteins are synthesized
B.	G_2 Phase	II.	Inactive phase
C.	Quiescent stage	III.	Interval between mitosis and initiation of DNA replication
D.	G_1 Phase	IV.	Equational division

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching the phases of the cell cycle (List I) with their corresponding descriptions or key events (List II).

Step 2: Key Concepts:
The cell cycle consists of two main phases: Interphase (G_1, S, G_2) and M Phase (Mitosis).
- **G_1 Phase (Gap 1):** The interval between mitosis and the initiation of DNA replication. The cell is metabolically active and grows.
- **S Phase (Synthesis):** DNA replication occurs.
- **G_2 Phase (Gap 2):** The cell continues to grow, and proteins are synthesized in preparation for mitosis.
- **M Phase (Mitosis):** The cell divides its nucleus (karyokinesis) and cytoplasm (cytokinesis). Mitosis is also called equational division because the chromosome number in the daughter cells remains the same as in the parent cell.
- **Quiescent Stage (G_0):** Cells that do not divide further exit the G_1 phase to enter an inactive state called the quiescent stage. They remain metabolically active but no longer proliferate unless called on to do so.

Step 3: Detailed Explanation:
Let's match each item from List I with the correct description from List II.
- **A. M Phase:** This is the phase of actual cell division. Mitosis is known as equational division because the number of chromosomes in the parent and progeny cells is the same. Thus, A matches with IV.

- **B. G_2 Phase:** This phase follows the S phase. During this time, proteins, such as tubulin for spindle fiber formation, are synthesized in preparation for mitosis. Thus, B matches with I.
- **C. Quiescent stage (G_0):** This is a non-dividing stage where cells are metabolically active but have exited the cell cycle. It is considered an inactive phase with respect to proliferation. Thus, C matches with II.
- **D. G_1 Phase:** This is the gap or interval between the previous M phase and the S phase (initiation of DNA replication). Thus, D matches with III.

Step 4: Final Answer:
The correct matching is: A-IV, B-I, C-II, D-III. This corresponds to option (A).

Quick Tip

To solve cell cycle questions, create a simple diagram of the cycle ($G_1 \rightarrow S \rightarrow G_2 \rightarrow M$) and list the key event for each phase. Remember that G_0 is an exit from G_1.

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146. Which of the following combinations is required for chemiosmosis?

(A) proton pump, electron gradient, ATP synthase
(B) proton pump, electron gradient, NADP synthase
(C) membrane, proton pump, proton gradient, ATP synthase
(D) membrane, proton pump, proton gradient, NADP synthase

Correct Answer: (C) membrane, proton pump, proton gradient, ATP synthase

Solution:

Step 1: Understanding the Question:
The question asks to identify the essential components required for the process of chemiosmosis.

Step 2: Key Concepts:
Chemiosmosis is the movement of ions across a semipermeable membrane down their electrochemical gradient. In the context of cellular respiration and photosynthesis, it refers specifically to the generation of ATP. The key requirements for chemiosmosis are:
1. **A Membrane:** A semipermeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is necessary to establish and maintain a concentration gradient.
2. **A Proton Pump:** Proteins that actively transport protons (H^+) across the membrane, creating a proton gradient. This process is powered by the energy from electron transport.
3. **A Proton Gradient:** A higher concentration of protons on one side of the membrane compared to the other. This gradient stores potential energy.
4. **ATP Synthase:** An enzyme complex embedded in the membrane that allows protons to flow back down their concentration gradient. The energy released from this flow is used to synthesize ATP from ADP and inorganic phosphate (Pi).

Step 3: Detailed Explanation:
Let's analyze the given options based on these requirements:
- **(A) proton pump, electron gradient, ATP synthase:** This option is incomplete as it misses the essential membrane required to maintain the gradient. The electron gradient itself is part of the electron transport chain that powers the proton pump, but the proton gradient is the direct energy source.
- **(B) proton pump, electron gradient, NADP synthase:** This is incorrect. NADP synthase (or $NADP^+$ reductase) is involved in the light-dependent reactions of photosynthesis but not in ATP synthesis via chemiosmosis. The correct enzyme is ATP synthase.
- **(C) membrane, proton pump, proton gradient, ATP synthase:** This option includes all four essential components for chemiosmosis: the membrane to create a separate compartment, the pump to create the gradient, the gradient itself as the energy source, and the ATP synthase enzyme to produce ATP.
- **(D) membrane, proton pump, proton gradient, NADP synthase:** This is incorrect due to the mention of NADP synthase instead of ATP synthase for the purpose of chemiosmosis-driven ATP generation.

Step 4: Final Answer:
The correct combination of components required for chemiosmosis is listed in option (C).

Quick Tip

Remember the four pillars of chemiosmosis: Membrane, Pump, Gradient, and Synthase (ATP Synthase). Any option missing one of these, or replacing one with an incorrect component, will be wrong.

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147. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence.
A. Insertion of recombinant DNA into the host cell.
B. Cutting of DNA at specific location by restriction enzyme.
C. Isolation of desired DNA fragment.
D. Amplification of gene of interest using PCR.
Choose the correct answer from the options given below :

(A) C, B, D, A
(B) B, D, A, C
(C) B, C, D, A
(D) C, A, B, D

Correct Answer: (A) C, B, D, A

Solution:

Step 1: Understanding the Question:
The question asks for the correct chronological order of the main steps involved in recombinant DNA (rDNA) technology.

Step 2: Key Concepts:
Recombinant DNA technology involves the following fundamental steps:
1. **Isolation of DNA:** The genetic material (DNA) containing the gene of interest must first be isolated from the source organism.
2. **Cutting DNA:** Restriction enzymes are used to cut both the isolated DNA (to get the gene of interest) and the vector DNA (e.g., plasmid) at specific recognition sites.
3. **Ligation:** The gene of interest is joined (ligated) with the vector DNA using the enzyme DNA ligase to form recombinant DNA.
4. **Amplification:** The gene of interest can be amplified to create many copies using the Polymerase Chain Reaction (PCR). This step is usually done after isolating the gene fragment.
5. **Transformation/Insertion:** The recombinant DNA is introduced into a suitable host cell (like a bacterium).
6. **Selection and Screening:** The host cells are grown in culture, and those containing the recombinant DNA are identified and selected.

Step 3: Detailed Explanation:
Let's arrange the given steps (A, B, C, D) in the correct logical sequence:
- **Step C: Isolation of desired DNA fragment.** This is the very first step. You need to obtain the genetic material you want to work with.
- **Step B: Cutting of DNA at specific location by restriction enzyme.** Once the DNA is isolated, you use restriction enzymes to excise the gene of interest. The vector DNA is also cut with the same enzyme.
- **Step D: Amplification of gene of interest using PCR.** After isolating the gene fragment, it's often necessary to make many copies of it to have enough material for ligation and subsequent steps. PCR is the standard method for this amplification.
- **Step A: Insertion of recombinant DNA into the host cell.** After the gene of interest is ligated into a vector (forming the recombinant DNA), this new molecule is introduced into a host cell for replication and expression.

Step 4: Final Answer:
The correct sequence of steps is C $\rightarrow$ B $\rightarrow$ D $\rightarrow$ A. This corresponds to option (A).

Quick Tip

Remember the rDNA process as a recipe: First, get your ingredients (Isolate DNA - C). Second, prepare them (Cut with enzymes - B). Third, make more of the key ingredient if needed (Amplify with PCR - D). Finally, put it all together in the "oven" (Insert into host - A).

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148. Which of the following statements are correct about Klinefelter's Syndrome?

A. This disorder was first described by Langdon Down (1866).
B. Such an individual has overall masculine development. However, the feminine development is also expressed.
C. The affected individual is short statured.
D. Physical, psychomotor and mental development is retarded.
E. Such individuals are sterile.
Choose the correct answer from the options given below :

(A) B and E only
(B) A and E only
(C) A and B only
(D) C and D only

Correct Answer: (A) B and E only

Solution:

Step 1: Understanding the Question:
The question asks to identify the correct statements describing Klinefelter's Syndrome from a given list.

Step 2: Key Concepts:
Klinefelter's Syndrome is a genetic disorder caused by the presence of an extra X chromosome in males. The karyotype is typically 47, XXY. Key features include:
- **Cause:** Aneuploidy of sex chromosomes (trisomy).
- **Phenotype:** Individuals are male.
- **Development:** They have overall masculine development but also show some feminine characteristics (e.g., gynaecomastia, which is the development of breasts). They are typically tall with long limbs.
- **Reproductive Health:** The testes are small, and the individuals are sterile due to azoospermia (absence of sperm).
- **Cognitive Development:** Intelligence is usually within the normal range, though some may have learning disabilities.

Step 3: Detailed Explanation:
Let's evaluate each statement:
- **A. This disorder was first described by Langdon Down (1866):** This is incorrect. Langdon Down described Down's Syndrome. Klinefelter's Syndrome was first described by Dr. Harry Klinefelter in 1942.
- **B. Such an individual has overall masculine development. However, the feminine development is also expressed:** This is correct. The presence of a Y chromosome determines the male sex, but the extra X chromosome leads to the expression of some female characteristics like gynaecomastia.
- **C. The affected individual is short statured:** This is incorrect. Individuals with Klinefelter's Syndrome are typically taller than average, not short statured. Short stature is characteristic of Turner's Syndrome (45, XO).

- **D. Physical, psychomotor and mental development is retarded:** This is an overstatement and generally incorrect. While there can be some learning or speech difficulties, severe mental retardation is not a typical feature.
- **E. Such individuals are sterile:** This is correct. The presence of an extra X chromosome impairs testicular development, leading to hypogonadism and sterility.

Step 4: Final Answer:
The correct statements are B and E. Therefore, option (A) is the correct choice.

Quick Tip

For genetic disorders, focus on the chromosomal abnormality and its key phenotypic consequences. For Klinefelter's (XXY), remember "tall, sterile male with some female traits." For Turner's (XO), remember "short, sterile female."

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149. Match List I with List II :

List I		List II	
A.	Iron	I.	Synthesis of auxin
B.	Zinc	II.	Component of nitrate reductase
C.	Boron	III.	Activator of catalase
D.	Molybdenum	IV.	Cell elongation and differentiation

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching micronutrients (List I) with their specific roles or functions in plants (List II).

Step 2: Key Concepts:
- **Iron (Fe):** An important constituent of proteins involved in electron transfer like ferredoxin and cytochromes. It is essential for chlorophyll formation and is an activator for the enzyme catalase.
- **Zinc (Zn):** Activates various enzymes, especially carboxylases. It is also required for the synthesis of auxin, a plant growth hormone.

- **Boron (B):** Required for uptake and utilization of Ca^{2+}, membrane functioning, pollen germination, cell elongation, cell differentiation, and carbohydrate translocation.
- **Molybdenum (Mo):** A component of several enzymes, including nitrogenase and nitrate reductase, both of which participate in nitrogen metabolism.

Step 3: Detailed Explanation:
Let's match each micronutrient with its function:
- **A. Iron:** It is a crucial part of the enzyme catalase, which breaks down hydrogen peroxide. So, A matches with III (Activator of catalase).
- **B. Zinc:** It is required for the biosynthesis of the plant hormone auxin (specifically, Indole-3-acetic acid or IAA). So, B matches with I (Synthesis of auxin).
- **C. Boron:** It plays a key role in cell elongation and cell differentiation, among other functions. So, C matches with IV (Cell elongation and differentiation).
- **D. Molybdenum:** It is a key component of the enzyme nitrate reductase, which is vital for nitrogen assimilation in plants. So, D matches with II (Component of nitrate reductase).

Step 4: Final Answer:
The correct set of matches is A-III, B-I, C-IV, D-II. This corresponds to option (A).

Quick Tip

For mineral nutrition questions, create a flashcard for each essential element with its key functions and deficiency symptoms. Focus on unique roles, like Mo in nitrate reductase, Zn in auxin synthesis, and Mg in chlorophyll.

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150. Match List I with List II :

List I (Interaction)		**List II (Species A and B)**	
A.	Mutualism	I.	+(A), O(B)
B.	Commensalism	II.	-(A), O(B)
C.	Amensalism	III.	+(A), -(B)
D.	Parasitism	IV.	+(A), +(B)

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question asks to match the type of ecological interaction (List I) with its symbolic representation (List II), where '+' indicates benefit, '-' indicates harm, and 'O' indicates no effect.

Step 2: Key Concepts:
Ecological interactions describe the relationships between different species in an ecosystem.
- **Mutualism:** An interaction where both species benefit (+, +). Example: Lichens (algae and fungi).
- **Commensalism:** An interaction where one species benefits, and the other is unaffected (+, O). Example: An orchid growing on a mango tree.
- **Amensalism:** An interaction where one species is harmed, and the other is unaffected (-, O). Example: Penicillium secreting penicillin, which kills bacteria.
- **Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other (the host) (+, -). Example: Ticks on a dog.
- **Competition:** An interaction where both species are harmed (-, -).
- **Predation:** An interaction where one species (the predator) benefits and the other (the prey) is harmed (+, -).

Step 3: Detailed Explanation:
Let's match the interactions in List I with the representations in List II.
- **A. Mutualism:** Both species benefit. This is represented by (+, +) or +(A), +(B). Thus, A matches with IV.
- **B. Commensalism:** One species benefits, the other is unaffected. This is represented by (+, O) or +(A), O(B). Thus, B matches with I.
- **C. Amensalism:** One species is harmed, the other is unaffected. This is represented by (-, O) or -(A), O(B). Thus, C matches with II.
- **D. Parasitism:** One species benefits, and the other is harmed. This is represented by (+, -) or +(A), -(B). Thus, D matches with III.

Step 4: Final Answer:
The correct matching is A-IV, B-I, C-II, D-III. This corresponds to option (D).

Quick Tip

Create a simple table to memorize population interactions. Use columns for Interaction Type, Species A, Species B, and an Example. This visual aid makes it easy to recall the (+, -, O) combinations.
