NEET UG 2023 G5 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. Identify the pair of heterosporous pteridophytes among the following:

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

(D) Psilotum and Salvinia

Correct Answer: (C) Selaginella and Salvinia

Solution:

Step 1: Understanding the Question:
The question asks to identify a pair of pteridophytes that are heterosporous. Heterosporous plants produce two different types of spores: smaller microspores (male) and larger megaspores (female). This is in contrast to homosporous plants, which produce only one type of spore.

Step 2: Detailed Explanation:
Let's analyze the options:
1. **Equisetum:** It is a homosporous pteridophyte.
2. **Lycopodium:** Most species are homosporous (some are heterosporous, but generally it's considered homosporous in this context).
3. **Selaginella:** It is a classic example of a heterosporous pteridophyte.
4. **Salvinia:** It is an aquatic fern and is also heterosporous.
5. **Psilotum:** It is a homosporous pteridophyte.

Based on this analysis:
(A) Equisetum (homosporous) and Salvinia (heterosporous) - Incorrect pair.
(B) Lycopodium (homosporous) and Selaginella (heterosporous) - Incorrect pair.
(C) Selaginella (heterosporous) and Salvinia (heterosporous) - Correct pair.
(D) Psilotum (homosporous) and Salvinia (heterosporous) - Incorrect pair.

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

Quick Tip

Remember the key examples for heterospory in pteridophytes: *Selaginella, Salvinia, Marsilea,* and *Azolla.* Most other common pteridophytes like *Pteris, Dryopteris, Equisetum,* and *Lycopodium* are homosporous. This distinction is a precursor to the seed habit seen in higher plants.

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102. Cellulose does not form blue colour with Iodine because

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

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

Solution:

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

Step 2: Detailed Explanation:
The iodine test is specific for the presence of starch. Starch is a polymer of α-glucose and consists of two components: amylose and amylopectin. Amylose has a helical secondary structure. When iodine is added, the iodine molecules (I_2) get trapped inside these helices, forming a starch-iodine complex which appears blue-black in color.

Cellulose, on the other hand, is a linear polymer of β-glucose units linked by β-1,4 glycosidic bonds. It does not form a helical structure. Instead, the long, straight chains of cellulose are arranged parallel to each other, forming strong hydrogen bonds between them. This rigid, linear structure does not have the helical cavities necessary to trap iodine molecules. Therefore, cellulose cannot form the colored complex with iodine.

Let's evaluate the options:
(A) It does not break down in the presence of iodine.
(B) It is a polysaccharide, not a disaccharide.
(C) It is a linear molecule, not a helical one.
(D) This is the correct explanation. The absence of complex helices prevents the trapping of iodine molecules.

Step 3: Final Answer:
Cellulose does not give a blue color with iodine because its linear structure lacks the complex helices required to hold iodine molecules.

Quick Tip

Associate the starch-iodine test with the helical structure of amylose. Visualize the iodine molecules fitting into the coils of the helix. Since cellulose is a straight chain, there are no coils to trap the iodine.

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103. 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) Henking
(B) Thomas Hunt Morgan

(C) Sutton and Boveri
(D) Alfred Sturtevant

Correct Answer: (D) Alfred Sturtevant

Solution:

Step 1: Understanding the Question:
The question asks to identify the scientist who first used the frequency of genetic recombination to map the positions of genes on a chromosome.

Step 2: Detailed Explanation:
Let's review the contributions of the scientists listed:
- **Henking (1891):** Discovered the X chromosome while studying insect spermatogenesis, referring to it as the 'X-body'.
- **Thomas Hunt Morgan (early 1900s):** Through his work on *Drosophila melanogaster*, he provided experimental evidence for the chromosomal theory of inheritance, discovered linkage, and showed that genes are located on chromosomes.
- **Sutton and Boveri (1902):** Independently proposed the Chromosomal Theory of Inheritance, which states that genes are found at specific locations on chromosomes.
- **Alfred Sturtevant (1913):** He was a student in T.H. Morgan's lab. He hypothesized that the frequency of recombination between two linked genes is proportional to the physical distance between them on the chromosome. Using this principle, he constructed the first-ever genetic map for the X chromosome of *Drosophila*.

Therefore, Alfred Sturtevant was the first to use recombination frequency for gene mapping.

Step 3: Final Answer:
Alfred Sturtevant was the scientist who first utilized recombination frequencies to create a genetic map.

Quick Tip

Remember the hierarchy of discovery: Sutton & Boveri proposed the theory, Morgan provided the experimental proof with fruit flies, and Sturtevant (Morgan's student) took it a step further by creating the first gene map based on recombination frequencies.

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

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

(D) Development

Correct Answer: (C) Dedifferentiation

Solution:

Step 1: Understanding the Question:
The question describes a process in plant tissue culture where specialized, mature cells (leaf mesophyll) are induced to form an undifferentiated mass of cells called a callus. We need to identify the correct biological term for this process.

Step 2: Detailed Explanation:
Let's define the terms in the options:
- **Senescence:** The process of aging in living organisms.
- **Differentiation:** The process by which cells become specialized in structure and function. For example, a meristematic cell differentiating into a mesophyll cell.
- **Dedifferentiation:** The process by which mature, differentiated cells revert to a meristematic state, losing their specialization and regaining the capacity for cell division. This is exactly what happens when mesophyll cells form a callus.
- **Development:** The sum of all changes that an organism goes through during its life cycle, from germination to senescence. It is a very broad term.

The phenomenon described, where differentiated mesophyll cells form an undifferentiated callus, is correctly termed dedifferentiation.

Step 3: Final Answer:
The process of forming a callus from differentiated leaf mesophyll cells is called dedifferentiation.

Quick Tip

Remember the sequence in plant tissue culture: 1. **Differentiation**: Forms the initial plant part (explant). 2. **Dedifferentiation**: The explant cells form a callus (undifferentiated mass). 3. **Redifferentiation**: The callus cells differentiate to form new organs like roots and shoots.

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

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

Correct Answer: (B) 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 known collectively 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 activities like deforestation, urbanization, and agriculture. It is considered the single most important driver of extinction because it directly removes the places where species live, find food, and reproduce.
2. **Over-exploitation:** This is the harvesting of species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting).
3. **Alien species invasions:** The introduction of non-native species into an ecosystem can disrupt the local food web, outcompete native species for resources, and introduce diseases, leading to extinctions.
4. **Co-extinctions:** This occurs when the extinction of one species causes the extinction of another species that depended on it (e.g., a host and its specific parasite).

Among these four, scientists widely agree that habitat loss and fragmentation is the most significant cause of species extinction worldwide.

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

Quick Tip

While all four components of 'The Evil Quartet' are significant threats, always remember that habitat loss is the leading cause. If a species has nowhere to live, it cannot survive. This is the foundational threat upon which others can act.

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

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

Correct Answer: (A) 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. This is a standard technique used in molecular biology.

Step 2: Detailed Explanation:
Agarose gel electrophoresis is a common method used to separate DNA fragments based on their size. However, DNA is colorless and not visible to the naked eye. To visualize the DNA bands in the gel, a fluorescent dye is used.
The most common dye is Ethidium Bromide (EtBr). EtBr works by intercalating, or inserting itself, between the base pairs of the DNA double helix. When the agarose gel containing the DNA and EtBr is exposed to ultraviolet (UV) radiation, the EtBr molecules absorb the UV light and fluoresce, emitting light in the visible spectrum. This fluorescence appears as a bright orange color. This allows researchers to see the separated DNA fragments as distinct orange bands.

Step 3: Final Answer:
DNA stained with ethidium bromide fluoresces with a bright orange color under UV radiation.

Quick Tip

This is a fundamental fact in molecular biology labs. Remember the combination: DNA + Ethidium Bromide (EtBr) + UV light = Bright Orange Bands. This is a frequently asked question in exams.

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the total number of ATP and $NADPH_2$ molecules required to synthesize one molecule of glucose via 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). The Calvin cycle must therefore turn 6 times to produce one glucose molecule. We need to determine the ATP and $NADPH_2$ consumption for a single turn and then multiply by 6.

Step 3: Detailed Explanation:
The Calvin cycle has three main stages for each molecule of CO_2 fixed:
1. **Carboxylation:** One molecule of CO_2 is fixed to one molecule of RuBP. No ATP or $NADPH_2$ is used here.
2. **Reduction:** The two molecules of 3-PGA formed are reduced to two molecules of glyceraldehyde-3-phosphate (G3P). This step uses **2 ATP** and **2 $NADPH_2$** per CO_2 molecule.
3. **Regeneration:** One molecule of RuBP is regenerated from G3P. This step uses **1 ATP** per CO_2 molecule.

So, for one turn of the Calvin cycle (fixing one CO_2):
- Total ATP used = 2 ATP (in reduction) + 1 ATP (in regeneration) = **3 ATP**.
- Total $NADPH_2$ used = **2 $NADPH_2$** (in reduction).

To synthesize one molecule of glucose (C_6), the cycle must turn 6 times.
- Total ATP required = 6 turns $\times$ 3 ATP/turn = **18 ATP**.
- Total $NADPH_2$ required = 6 turns $\times$ 2 $NADPH_2$/turn = **12 $NADPH_2$**.

Step 4: Final Answer:
The synthesis of one molecule of glucose requires 18 ATP and 12 $NADPH_2$.

Quick Tip

To avoid confusion, always calculate the energy requirement for a single CO_2 fixation first (3 ATP, 2 $NADPH_2$) and then multiply by the number of carbons in the final product (e.g., 6 for glucose). The options are often designed to confuse, so be precise with your calculation.

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

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

Correct Answer: (B) insect pollinated plants

Solution:

Step 1: Understanding the Question:
The question asks to identify the type of pollination associated with flowers that are large,

colorful, fragrant, and produce nectar.

Step 2: Detailed Explanation:
These characteristics are adaptations to attract pollinators. Let's analyze the pollination types:
- **Wind pollinated plants (Anemophily):** These plants do not need to attract pollinators. Their flowers are typically small, inconspicuous, not colorful, lack nectar and fragrance. They produce large amounts of lightweight pollen. Examples include grasses and maize.
- **Insect pollinated plants (Entomophily):** These plants rely on insects for pollination. To attract insects, their flowers have evolved to be large, brightly colored (especially in the blue-violet range visible to bees), fragrant, and they produce nectar as a food reward for the visiting insect.
- **Bird pollinated plants (Ornithophily):** These flowers are often large, brightly colored (typically red or orange), but usually lack a strong fragrance because birds have a poor sense of smell. They produce copious amounts of dilute nectar.
- **Bat pollinated plants (Chiropterophily):** These flowers are typically large, pale or white, open at night, and have a strong, musty, or fruity odor. They also produce abundant nectar.

The combination of all four traits - large, colorful, fragrant, and nectar-rich - is the classic suite of characteristics for insect-pollinated plants.

Step 3: Final Answer:
Large, colourful, fragrant flowers with nectar are characteristic features of insect pollinated plants.

Quick Tip

Create a mental table linking pollinating agents to floral characteristics. For example: Wind -¿ small, dull, no nectar/scent; Insects -¿ colorful, fragrant, nectar; Birds -¿ bright (often red), no scent, lots of nectar; Bats -¿ pale, nocturnal, musty scent.

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

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

Correct Answer: (D) Anaphase II

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific stage of meiosis where the centromere splits, allowing

sister chromatids to separate.

Step 2: Detailed Explanation:
Let's review the key events of the meiotic stages:
- **Meiosis I:** This is the reductional division. - **Metaphase I:** Homologous chromosome pairs (bivalents) align at the metaphase plate. The centromeres do not divide. - **Anaphase I:** Homologous chromosomes separate and move to opposite poles. Sister chromatids remain attached at their centromeres.
- **Meiosis II:** This is the equational division, very similar to mitosis. - **Metaphase II:** Individual chromosomes (each with two sister chromatids) align at the metaphase plate. - **Anaphase II:** The centromeres of each chromosome finally divide. This allows the sister chromatids to separate and move to opposite poles. Once separated, they are considered individual chromosomes. - **Telophase I II:** Chromosomes decondense and nuclear envelopes reform. Division of centromeres does not occur in this stage.
Therefore, the division of the centromere occurs during Anaphase II of meiosis.

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

Quick Tip

A key difference between Meiosis I and Meiosis II is the behavior of centromeres. Remember: Anaphase I separates homologous chromosomes, but sister chromatids stay together (no centromere split). Anaphase II separates sister chromatids (centromere splits). Anaphase II is analogous to Anaphase of mitosis.

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

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

Correct Answer: (C) DNA

Solution:

Step 1: Understanding the Question:
The question concerns a specific step in the isolation and purification of DNA, which is a fundamental procedure in recombinant DNA technology. It asks what macromolecule is precipitated by adding chilled ethanol.

Step 2: Detailed Explanation:
The process of isolating DNA from cells involves several steps:
1. **Lysis:** Breaking open the cells to release their contents, including DNA.
2. **Removal of contaminants:** The cell lysate contains DNA, RNA, proteins, lipids, and polysaccharides. Enzymes are used to digest these contaminants. For example, Ribonuclease (RNase) is used to remove RNA, and Protease is used to remove proteins (like histones).
3. **DNA Precipitation:** After removing other macromolecules, the goal is to isolate the pure DNA. DNA is soluble in the aqueous solution, but it is insoluble in alcohol (like ethanol or isopropanol). When chilled ethanol is added to the solution, the DNA precipitates out of the solution, forming a visible mass of fine, white threads. This process is called ethanol precipitation. The low temperature reduces the solubility further. The precipitated DNA can then be physically separated from the solution, for example, by spooling it onto a glass rod.

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

Quick Tip

Remember the key phrase "chilled ethanol precipitation". It is a standard and very specific method for isolating DNA. The alcohol makes the DNA come out of solution so it can be collected.

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

Correct Answer: (B) Diadelphous and Dithecous anthers

Solution:

Step 1: Understanding the Question:
The question asks to identify a characteristic of the stamens (androecium) that is specific to the family Fabaceae and not found in Solanaceae or Liliaceae.

Step 2: Detailed Explanation:
Let's analyze the characteristics of stamens in these three families:
- **Fabaceae (Pea family):** The stamens are typically ten in number. A key feature is that they are often **diadelphous**, meaning they are fused into two bundles. The common arrangement is (9)+1, where nine stamens are fused to form a tube, and one is free. The anthers are

dithecous (having two lobes).
- **Solanaceae (Potato family):** The stamens are typically five in number. They are **epipetalous**, meaning they are attached to the petals. The anthers are dithecous. Fusion of stamens (adelphy) is not a characteristic feature.
- **Liliaceae (Lily family):** The stamens are typically six, arranged in two whorls of three. They are often **epiphyllous** (also called epitepalous), meaning they are attached to the tepals (undifferentiated petals and sepals). The anthers are dithecous.

Now let's evaluate the options based on this information:
(A) Epiphyllous and Dithecous anthers: Epiphyllous condition is characteristic of Liliaceae, not Fabaceae.
(B) Diadelphous and Dithecous anthers: The diadelphous condition ((9)+1) is a hallmark of many species in Fabaceae. This condition is not found in Solanaceae or Liliaceae. Dithecous anthers are common to all three, but the diadelphous condition is specific.
(C) Polyadelphous and epipetalous stamens: Polyadelphous (fused into many bundles) is seen in families like Rutaceae (Citrus). Epipetalous condition is seen in Solanaceae, not Fabaceae.
(D) Monoadelphous and Monothecous anthers: Monoadelphous (fused into one bundle) is seen in Malvaceae (China rose). Monothecous anthers (one lobe) are also seen in Malvaceae, not Fabaceae.

Step 3: Final Answer:
The combination of diadelphous stamens and dithecous anthers is specific to Fabaceae among the given choices.

Quick Tip

For floral formulas, remember these key stamen characteristics: Fabaceae -¿ Diadelphous ((9)+1); Solanaceae -¿ Epipetalous; Liliaceae -¿ Epiphyllous/Epitepalous; Malvaceae -¿ Monoadelphous and Monothecous. These are high-yield points for family-based questions.

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112. Axile placentation is observed in

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

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

Solution:

Step 1: Understanding the Question:
The question asks to identify the group of plants that all exhibit axile placentation. Placenta-

tion refers to the arrangement of ovules within the ovary.

Step 2: Detailed Explanation:
In **axile placentation**, the ovary is partitioned into two or more chambers (locules) by septa. The placenta, where the ovules are attached, is located on the central axis where the septa meet. A cross-section of an ovary with axile placentation looks like the segments of an orange or lemon.

Let's examine the placentation types for the plants in each option:
- **(A) China rose, Petunia and Lemon:** - **China rose** (Hibiscus, family Malvaceae): Shows axile placentation. - **Petunia** (family Solanaceae): Shows axile placentation. - **Lemon** (Citrus, family Rutaceae): Shows axile placentation. This group is consistent.
- **(B) Mustard, Cucumber and Primrose:** - **Mustard** (Brassica, family Brassicaceae): Shows parietal placentation. - **Cucumber** (Cucurbita, family Cucurbitaceae): Shows parietal placentation. - **Primrose** (Primula, family Primulaceae): Shows free-central placentation. This group is inconsistent.
- **(C) China rose, Beans and Lupin:** - **China rose**: Shows axile placentation. - **Beans** and **Lupin** (family Fabaceae): Show marginal placentation. This group is inconsistent.
- **(D) Tomato, Dianthus and Pea:** - **Tomato** (Lycopersicon, family Solanaceae): Shows axile placentation. - **Dianthus** (family Caryophyllaceae): Shows free-central placentation. - **Pea** (Pisum, family Fabaceae): Shows marginal placentation. This group is inconsistent.
Step 3: Final Answer:
The correct group of plants, all of which exhibit axile placentation, is China rose, Petunia, and Lemon.

Quick Tip

Memorize at least one clear example for each type of placentation: - **Marginal**: Pea (Fabaceae) - **Axile**: Tomato, China rose, Lemon - **Parietal**: Mustard, Argemone, Cucumber - **Free-central**: Dianthus, Primrose - **Basal**: Sunflower, Marigold (Asteraceae) Visualizing a cross-section of these fruits/ovaries helps in remembering.

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

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

Correct Answer: (C) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the function of the "tassels" in a corn cob. It's important to correctly

identify the parts. The corn plant has a male inflorescence (the tassel at the top) and a female inflorescence (the ear or cob, which develops into the fruit). The question seems to confuse "tassels" with the "silks" emerging from the corn cob. The tassel is the pollen-producing structure at the top of the plant. The silks are the structures emerging from the tip of the ear/cob. Given the options, the question is most likely referring to the silks of the corn cob, not the tassel at the top of the plant.

Step 2: Detailed Explanation:
Let's clarify the terminology and function: - **Tassel:** This is the male inflorescence located at the apex of the corn plant. Its function is to produce and **disperse pollen grains** (Option D). - **Corn Cob (Ear):** This is the female inflorescence. - **Silks:** These are the long, thread-like styles that emerge from the tip of the cob. Each silk is connected to a potential kernel (ovule). The ends of the silks are feathery and sticky. Their function is to **trap the airborne pollen grains** (Option C) released from the tassels.
Since the question asks about the "tassels in the corn cob" and provides "To trap pollen grains" as an option, it is using incorrect terminology but referring to the function of the silks. The silks are the part of the female flower (on the cob) responsible for trapping pollen. If the question strictly meant the tassel (male flower), the answer would be (D) to disperse pollen. However, the context "in the corn cob" points towards the silks. The answer key confirms the intended question is about the silks.
Therefore, the function of the silks (referred to as tassels in the question) is to trap pollen grains.

Step 3: Final Answer:
The structures emerging from the corn cob (the silks, which the question calls tassels) function to trap pollen grains.

Quick Tip

Be aware of potential ambiguities in questions. In corn (maize), the Tassel is the male flower at the top (disperses pollen), and the Silk is the female style on the cob (traps pollen). Maize is wind-pollinated (anemophilous), so the silks are long and feathery to effectively catch wind-borne pollen.

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

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

Correct Answer: (C) Pachytene

Solution:

Step 1: Understanding the Question:
The question asks to identify the substage of Prophase I of meiosis where recombination nodules are observed. Recombination nodules are the sites where crossing over occurs.

Step 2: Detailed Explanation:
Prophase I is the longest phase of meiosis and is divided into five substages:
1. **Leptotene:** Chromosomes start to condense and become visible.
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) are clearly visible as tetrads (four chromatids). This is the stage where **crossing over** (exchange of genetic material between non-sister chromatids of homologous chromosomes) occurs. The sites of crossing over are marked by the appearance of **recombination nodules**.
4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate from each other, except at the points of crossing over. These X-shaped structures are called chiasmata.
5. **Diakinesis:** Chromosomes become fully condensed. The chiasmata terminalize (move towards the ends of the chromatids), and the nuclear envelope breaks down.

Therefore, recombination nodules, which mediate crossing over, appear during the pachytene stage.

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

Quick Tip

Use a mnemonic to remember the order of Prophase I stages: "Lazy Zebra Painted Dotted Diagrams" (Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis). Associate Pachytene with "packing" together and "patching" (crossing over).

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

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

Correct Answer: (B) Dobson units

Solution:

Step 1: Understanding the Question:
The question asks for the unit of measurement for the thickness of the ozone layer in the atmosphere.

Step 2: Detailed Explanation:
Let's analyze the units given in the options:
- **Kilobase (kb):** A unit of length for DNA or RNA molecules, equal to 1000 base pairs. Not used for atmospheric measurements.
- **Dobson Units (DU):** This is the standard unit used to measure the total amount of ozone in a vertical column of the atmosphere. One Dobson Unit is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at a temperature of 0 degrees Celsius and a pressure of 1 atmosphere.
- **Decibels (dB):** A logarithmic unit used to measure sound level or the power level of an electrical signal.
- **Decameter (dam):** A unit of length equal to 10 meters. Not used for measuring atmospheric gas concentration.

The correct unit for measuring the thickness of the ozone layer is the Dobson Unit, named after Gordon Dobson, who was a pioneer in ozone research.

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

Quick Tip

Associate "Ozone" with "Dobson". The thinning of the ozone layer over Antarctica is often described as the "ozone hole," which is defined as an area where the ozone column thickness is less than 220 Dobson Units.

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

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

Correct Answer: (B) 680 nm

Solution:

Step 1: Understanding the Question:
The question asks for the specific wavelength of light at which the reaction center of Photosys-

tem II (PS II) shows its maximum absorption.

Step 2: Detailed Explanation:
In photosynthesis, there are two photosystems, PS I and PS II, which work in series. Each photosystem consists of a reaction center surrounded by light-harvesting complexes (antenna molecules).
- **Photosystem I (PS I):** The reaction center of PS I is a special chlorophyll *a* molecule called **P700**, which has an absorption peak at 700 nm (far-red light).
- **Photosystem II (PS II):** The reaction center of PS II is a special chlorophyll *a* molecule called **P680**, which shows maximum absorption at a wavelength of 680 nm (red light).

The names P680 and P700 directly correspond to their absorption maxima in nanometers.

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

Quick Tip

Remember that PS II comes before PS I in the electron transport chain (Z-scheme), even though its number is higher. Associate PS II with the lower wavelength (680 nm) and PS I with the higher wavelength (700 nm). A simple trick: II comes before I in the alphabet if you read backwards, just like 680 comes before 700.

---

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) related to the life cycle of mosses. We need to evaluate if both statements are true and if the reason correctly explains the assertion.

Step 2: Detailed Explanation:
- **Analysis of Assertion (A):** "The first stage of gametophyte in the life cycle of moss is protonema stage." The life cycle of a moss begins when a haploid spore germinates. This spore does not directly grow into the leafy moss plant. Instead, it develops into a filamentous, green, branching structure called the protonema. This protonema is the juvenile stage of the gametophyte. Later, buds develop on the protonema which grow into the mature, leafy gametophyte. So, the assertion is **correct**.

- **Analysis of Reason (R):** "Protonema develops directly from spores produced in capsule." The sporophyte of a moss consists of a foot, seta, and a capsule. Within the capsule, meiosis occurs to produce haploid spores. When these spores are released and land on a suitable substrate, they germinate and develop directly into the protonema. So, the reason is also **correct**.

- **Evaluating the link between A and R:** The reason explains the origin of the protonema. Since the protonema develops directly from the germinating spore (which is the starting point after meiosis), it logically follows that the protonema is the first stage of the gametophyte's development. Therefore, the Reason (R) is the correct explanation for the Assertion (A).

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

Quick Tip

Remember the two distinct stages in the moss gametophyte: the initial, juvenile **protonema stage** (creeping, green, branched, and filamentous) and the subsequent, mature **leafy stage** which bears the sex organs. The protonema always arises from the spore.

---

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

(A) Transcription of only snRNAs
(B) Transcription of rRNAs (28S, 18S and 5.8S)
(C) Transcription of tRNA, 5S rRNA and snRNA
(D) Transcription of precursor of mRNA

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

Solution:

Step 1: Understanding the Question:
The question asks for the specific function of RNA polymerase III in eukaryotic transcription. Eukaryotes have three distinct RNA polymerases, each responsible for transcribing different types of RNA.

Step 2: Detailed Explanation:
The roles of the three eukaryotic RNA polymerases are as follows:
- **RNA Polymerase I:** Located in the nucleolus, it is responsible for transcribing the large ribosomal RNA (rRNA) genes. This includes the precursors for the 28S, 18S, and 5.8S rRNAs.
- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes all protein-coding genes to produce the precursor of messenger RNA (pre-mRNA or hnRNA). It also transcribes most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).
- **RNA Polymerase III:** Located in the nucleoplasm, it is responsible for transcribing the genes for transfer RNA (tRNA), the 5S ribosomal RNA (a component of the large ribosomal subunit), and some other small RNAs, including some small nuclear RNAs (snRNAs) like U6 snRNA.

Let's check the options:
(A) Transcription of only snRNAs - Incorrect. It transcribes tRNA and 5S rRNA as well.
(B) Transcription of rRNAs (28S, 18S and 5.8S) - Incorrect. This is the function of RNA Polymerase I.
(C) Transcription of tRNA, 5S rRNA and snRNA - Correct. This accurately describes the main products of RNA Pol III.
(D) Transcription of precursor of mRNA - Incorrect. This is the function of RNA Polymerase II.

Step 3: Final Answer:
The role of RNA polymerase III is the transcription of tRNA, 5S rRNA, and some snRNAs.

Quick Tip

Use the mnemonic "1, 2, 3 - R, M, T" to remember the main product of each polymerase: RNA Pol **I** -¿ **r**RNA, RNA Pol **II** -¿ **m**RNA, RNA Pol **III** -¿ **t**RNA. This covers the primary function and helps differentiate them quickly. Remember that Pol III also makes 5S rRNA.

---

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

(A) 2002
(B) 1985
(C) 1992
(D) 1986

Correct Answer: (C) 1992

Solution:

Step 1: Understanding the Question:
This is a factual recall question asking for the year of the Earth Summit held in Rio de Janeiro,

where the Convention on Biological Diversity (CBD) was established.

Step 2: Detailed Explanation:
The United Nations Conference on Environment and Development (UNCED), popularly known as the **Earth Summit**, was held in Rio de Janeiro, Brazil, from June 3 to 14, **1992**. This summit was a landmark event for environmental protection and sustainable development. One of its key outcomes was the opening for signature of the Convention on Biological Diversity (CBD), an international legally binding treaty with three main goals: the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.
Other important dates:
- **2002:** The World Summit on Sustainable Development was held in Johannesburg.

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

Quick Tip

Remember these key environmental summit years: - **1972**: Stockholm Conference (First major conference on international environmental issues) - **1987**: Montreal Protocol (on substances that deplete the Ozone Layer) - **1992**: Rio Earth Summit (Convention on Biological Diversity, UNFCCC) - **1997**: Kyoto Protocol (to reduce greenhouse gas emissions) - **2002**: Johannesburg Earth Summit (focus on sustainable development)

---

120. The phenomenon of pleiotropism refers to

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the definition of pleiotropism (or pleiotropy).

Step 2: Detailed Explanation:
Let's define the genetic terms:
- **Pleiotropy:** This occurs when a single gene influences multiple, seemingly unrelated phenotypic traits. The gene product (e.g., an enzyme or protein) may participate in several metabolic pathways or have effects on different cell types, leading to a cascade of effects throughout the organism. A classic example is the gene for phenylketonuria (PKU) in humans, which causes

mental retardation, reduced hair and skin pigmentation.
- **Polygenic Inheritance:** This is the opposite of pleiotropy. It occurs when a single phenotypic trait is controlled by the cumulative effect of two or more genes. Examples include human skin color, height, and weight.

Now let's evaluate the options:
(A) more than two genes affecting a single character - This describes polygenic inheritance.
(B) presence of several alleles of a single gene... - This describes multiple allelism.
(C) presence of two alleles, each of the two genes... - This is confusingly worded but does not describe pleiotropy.
(D) a single gene affecting multiple phenotypic expression - This is the correct definition of pleiotropism.

Step 3: Final Answer:
Pleiotropism is the phenomenon where a single gene affects multiple phenotypic expressions.

Quick Tip

Think of the prefixes: **Pleio-** means "many" and **-tropy** means "effects". So, one gene has many effects. In contrast, **Poly-** means "many" and **-genic** means "genes". So, many genes affect one trait. This helps distinguish pleiotropy from polygenic inheritance.

---

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

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

Correct Answer: (C) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks which plant hormone can be used to speed up the maturation process in juvenile conifers to promote early seed production.

Step 2: Detailed Explanation:
Let's review the functions of the given phytohormones:
- **Abscisic Acid (ABA):** Primarily a stress hormone, it is involved in stomatal closure, seed dormancy, and abscission. It generally acts as a growth inhibitor.
- **Indole-3-butyric Acid (IBA):** This is an auxin. Auxins are primarily involved in cell elongation, apical dominance, and rooting of stem cuttings. They do not hasten maturity.

- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including stem elongation (bolting), breaking seed dormancy, and promoting flowering and fruit development. A key commercial application is spraying juvenile conifers with GAs to overcome the juvenile phase and induce early flowering and seed production. This is particularly useful in breeding programs and for commercial seed producers.
- **Zeatin:** This is a type of cytokinin. Cytokinins promote cell division, help overcome apical dominance, and delay senescence. They do not typically hasten maturity.

Based on these functions, gibberellic acid is the hormone used to accelerate the maturity period in juvenile conifers.

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

Quick Tip

Associate Gibberellins with "growth promotion" in several ways: increasing fruit size (grapes), elongating stems (sugarcane), malting process (brewing), and overcoming juvenility (conifers). This specific application in conifers is a commonly cited example.

---

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

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

Solution:

Step 1: Understanding the Question:
The question presents two statements about the effects of transpiration in plants. We need to determine the correctness of each statement.

Step 2: Detailed Explanation:
- **Analysis of Statement I:** "The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height."

This statement refers to the Cohesion-Tension theory of water ascent. The evaporation of water from leaves (transpiration) creates a negative pressure potential or tension (the "pull") in the xylem. Due to the cohesive forces between water molecules and adhesive forces between water and xylem walls, this pull is transmitted down the entire water column. This mechanism is incredibly powerful and is indeed capable of lifting water to the tops of the tallest trees, such as the coast redwood (*Sequoia sempervirens*), which can exceed 115 meters. Therefore, lifting water over 130 meters is theoretically and practically possible by this force. This statement is **correct**.

- **Analysis of Statement II:** "Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling."
Transpiration is the evaporation of water from the plant surface, primarily leaves. Evaporation is a cooling process because it requires energy (latent heat of vaporization), which is drawn from the leaf tissue itself. This prevents the leaves from overheating, especially in direct sunlight and high temperatures. This evaporative cooling effect can lower the leaf temperature by 10 to 15 degrees Celsius compared to the surrounding air. This statement is also **correct**.

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

Quick Tip

Remember the dual major roles of transpiration: 1. Driving Force: It creates the "transpiration pull" for water absorption and ascent. 2. Thermoregulation: It cools the plant through evaporative cooling. Both statements highlight these crucial functions.

---

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

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

Correct Answer: (A) Active Transport

Solution:

Step 1: Understanding the Question:
The question asks to identify the transport mechanism that moves ions across a membrane from a region of lower concentration to a region of higher concentration, which is "against their concentration gradient".

Step 2: Detailed Explanation:
Let's analyze the different transport mechanisms:
- **Passive Transport:** This is the movement of substances across a membrane down the concentration gradient (from high to low concentration) without the expenditure of cellular energy. Simple diffusion is a type of passive transport.
- **Osmosis:** A specific type of passive transport involving the movement of water across a semipermeable membrane from a region of high water potential to low water potential.
- **Facilitated Diffusion:** Another type of passive transport where substances move down the concentration gradient with the help of carrier proteins. It does not require metabolic energy.
- **Active Transport:** This process moves substances (like ions) against their concentration gradient (from low to high concentration). This "uphill" movement requires the expenditure of metabolic energy, typically in the form of ATP, and involves specific membrane proteins called pumps.

Since the question specifies movement "against their concentration gradient," the correct answer is Active Transport.

Step 3: Final Answer:
The movement of ions against a concentration gradient is carried out by active transport.

Quick Tip

Remember the key difference: Passive processes (diffusion, osmosis, facilitated diffusion) are "downhill" and require no energy. Active transport is "uphill" and always requires energy (ATP). The phrase "against the concentration gradient" is a direct indicator of active transport.

---

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

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

Solution:

Step 1: Understanding the Question:
The question presents two statements about the arrangement of xylem in plants and asks to evaluate their correctness.

Step 2: Detailed Explanation:
- **Analysis of Statement I:** "Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body."
The terms 'endarch' and 'exarch' describe the pattern of development of **primary xylem**, not secondary xylem. - **Exarch:** Protoxylem (the first formed xylem) is towards the periphery (outside) and metaxylem (later formed xylem) is towards the center. - **Endarch:** Protoxylem is towards the center (pith) and metaxylem is towards the periphery. Since these terms apply to primary xylem, Statement I is **incorrect**.

- **Analysis of Statement II:** "Exarch condition is the most common feature of the root system."
In the vascular bundle of roots, the development of xylem is centripetal, meaning the protoxylem is located towards the outer side (pericycle) and the metaxylem towards the center. This arrangement is known as the exarch condition. In contrast, stems typically exhibit an endarch condition. Therefore, Statement II is **true**.

Step 3: Final Answer:
Statement I is incorrect because endarch and exarch refer to primary xylem. Statement II is correct as the exarch condition is characteristic of roots.

Quick Tip

A simple way to remember is: **Ex**arch is for roots (towards the **ex**terior) and **En**darch is for stems (towards the **en**terior/center). These terms only describe the arrangement of primary xylem.

---

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

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

Correct Answer: (B) manganese

Solution:

Step 1: Understanding the Question:
The question asks to identify the micronutrient that plays a crucial role in the photolysis (split-

ting) of water during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation:
The splitting of water molecules ($2H_2O \rightarrow 4H^+ + 4e^- + O_2$) occurs in Photosystem II (PS II) and is essential for releasing oxygen and providing electrons to the photosynthetic electron transport chain. This reaction is catalyzed by the Oxygen-Evolving Complex (OEC).
- The core of the OEC contains a cluster of four **manganese** (Mn) ions, along with one calcium (Ca) ion. These manganese ions are essential for the catalytic cycle of water oxidation.
- **Copper** (Cu) is a component of plastocyanin, an electron carrier in the electron transport chain.
- **Molybdenum** (Mo) is a component of enzymes like nitrate reductase and nitrogenase, crucial for nitrogen metabolism.
- **Magnesium** (Mg) is a central component of the chlorophyll molecule, essential for absorbing light energy. It is a macronutrient, not a micronutrient in this context.

Therefore, manganese (Mn) is the specific micronutrient required for the splitting of water. Chloride ions (Cl^-) are also involved in this process.

Step 3: Final Answer:
Manganese is the micronutrient required for the splitting of water during photosynthesis.

Quick Tip

Remember the key roles of essential minerals in photosynthesis: **Mg** in chlorophyll for light capture, and **Mn** in PS II for water splitting. This is a frequently tested concept.

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) about ATP consumption in glycolysis and a Reason (R) specifying the steps. We need to evaluate if both are true and if R correctly explains A.

Step 2: Detailed Explanation:
- **Analysis of Assertion (A):** "ATP is used at two steps in glycolysis."
Glycolysis is a 10-step process. The first part is the "energy investment phase" where ATP is consumed to activate the glucose molecule. Indeed, two molecules of ATP are consumed in this phase. So, Assertion A is **true**.

- **Analysis of 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."
Let's look at the specific steps of the energy investment phase: - **Step 1:** Glucose is phosphorylated to glucose-6-phosphate by the enzyme hexokinase. This step consumes one ATP molecule. - **Step 3:** Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate by the enzyme phosphofructokinase-1. This step consumes a second ATP molecule. The Reason R accurately describes these two steps. So, Reason R is also **true**.

- **Evaluating the link between A and R:** The Assertion states that ATP is used at two steps. The Reason correctly identifies exactly those two steps where ATP is used. Therefore, the Reason (R) is the correct explanation for the Assertion (A).

Step 3: Final Answer:
Both Assertion A and Reason R are true, and R correctly explains A.

Quick Tip

Remember the two "priming" reactions in the energy investment phase of glycolysis: Step 1 (Hexokinase) and Step 3 (Phosphofructokinase). These are the only two steps where ATP is consumed.

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127. Identify the correct statements :
A. Detritivores 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) D, E, A only
(B) A, B, C only
(C) B, C, D only

(D) C, D, E only

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

Solution:

Step 1: Understanding the Question:
The question asks to identify the correct statements from a list of five related to the process of decomposition.

Step 2: Detailed Explanation:
Decomposition involves several processes: fragmentation, leaching, catabolism, humification, and mineralization. Let's evaluate each statement:
- **A. Detritivores perform fragmentation.** Detritivores, such as earthworms and termites, break down detritus (dead organic matter) into smaller particles. This process is called fragmentation. This statement is **correct**.
- **B. The humus is further degraded by some microbes during mineralization.** Humus is a dark, amorphous substance that is highly resistant to microbial action and decomposes slowly. It is eventually degraded by microbes, releasing inorganic nutrients back into the soil. This release of inorganic nutrients is called mineralization. This statement is **correct**.
- **C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.** Leaching is the process by which water-soluble substances (like inorganic nutrients released during decomposition) are washed down through the soil profile and may become unavailable to plants. This statement is **correct**.
- **D. The detritus food chain begins with living organisms.** This is incorrect. The detritus food chain begins with dead organic matter (detritus). The grazing food chain begins with living organisms (producers).
- **E. Earthworms break down detritus into smaller particles by a process called catabolism.** Earthworms break down detritus into smaller particles, but this process is called fragmentation. Catabolism refers to the enzymatic degradation of detritus into simpler inorganic substances by bacteria and fungi. This statement is **incorrect**.

The correct statements are A, B, and C.

Step 3: Final Answer:
The only correct statements are A, B, and C.

Quick Tip

Differentiate the key terms in decomposition: - **Fragmentation:** Physical breakdown by detritivores (e.g., earthworm). - **Catabolism:** Chemical/enzymatic breakdown by microbes (bacteria, fungi). - **Leaching:** Washing away of soluble nutrients. - **Humification:** Formation of humus. - **Mineralization:** Release of inorganic nutrients from humus.

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) about the structure of late wood and a Reason (R) about cambial activity in winter. We must determine if they are true and if R explains A.

Step 2: Detailed Explanation:
- **Analysis of Assertion (A):** "Late wood has fewer xylary elements with narrow vessels."
In temperate regions, the cambium's activity varies with the seasons. The wood formed during the autumn or winter season is called autumn wood or **late wood**. This wood is characterized by having smaller, narrower vessels and thicker walls compared to the wood formed in spring. It generally has fewer xylary elements. So, Assertion A is **true**.

- **Analysis of Reason (R):** "Cambium is less active in winters."
The activity of the vascular cambium is influenced by physiological and environmental factors like temperature and water availability. In winter, conditions are unfavorable (cold, less daylight), leading to a significant decrease in the cambium's activity. So, Reason R is **true**.

- **Evaluating the link between A and R:** The reduced activity of the cambium during winter (Reason) is the direct cause for the formation of late wood with its specific characteristics—fewer xylary elements and narrow, thick-walled vessels (Assertion). Therefore, the Reason (R) is the correct explanation for the 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 contrast: - **Spring wood (Early wood):** Cambium is very active -¿ many, large, wide vessels. - **Autumn wood (Late wood):** Cambium is less active -¿ fewer, small, narrow vessels. The combination of these two forms an annual ring.

---

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to identify a sequence of structures from a fertilized embryo sac that are haploid (n), diploid (2n), and triploid (3n), in that specific order.

Step 2: Detailed Explanation:
Let's determine the ploidy level of the structures found in a fertilized embryo sac:
- **Haploid (n) structures:** - **Synergids:** These are cells of the egg apparatus. They are haploid. After fertilization, they degenerate. - **Antipodals:** These cells are at the chalazal end and are also haploid. They also degenerate after fertilization. - **Diploid (2n) structure:** - **Zygote:** Formed by the fusion of one male gamete (n) and the egg cell (n). It develops into the embryo. It is diploid. - **Triploid (3n) structure:** - **Primary Endosperm Nucleus (PEN):** Formed by the fusion of the second male gamete (n) with the central cell containing the secondary nucleus (2n, formed from the fusion of two polar nuclei). The PEN develops into the endosperm. It is triploid.
Now we need to find an option that lists a haploid, a diploid, and a triploid structure in sequence (n, 2n, 3n).
- (A) Synergids (n), antipodals (n), Polar nuclei (n+n). Not n, 2n, 3n.
- (B) Synergids (n), Primary endosperm nucleus (3n), zygote (2n). The order is n, 3n, 2n. Incorrect.
- (C) Antipodals (n), synergids (n), primary endosperm nucleus (3n). Not n, 2n, 3n.
- (D) **Synergids (n)**, **Zygote (2n)**, and **Primary endosperm nucleus (3n)**. This sequence matches the required n, 2n, 3n order.

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

Quick Tip

Double fertilization is the key to understanding ploidy in a fertilized embryo sac. Remember: 1. **Syngamy:** male gamete (n) + egg (n) -¿ Zygote (2n) 2. **Triple Fusion:** male gamete (n) + central cell (2n) -¿ PEN (3n) All other maternal cells in the embryo sac (synergids, antipodals) are haploid (n).

---

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

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

Correct Answer: (D) Ethylene

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific plant hormone responsible for promoting rapid stem elongation in deep water rice plants when they are submerged.

Step 2: Detailed Explanation:
- **2, 4-D:** This is a synthetic auxin, primarily used as a herbicide to control broad-leaf weeds.
- **GA_3 (Gibberellic Acid):** This hormone is well-known for promoting stem elongation (bolting) in many plants.
- **Kinetin:** This is a cytokinin, which primarily promotes cell division and is involved in delaying senescence.
- **Ethylene:** This is a gaseous hormone with various effects. In semi-aquatic plants like deep water rice, submergence of the plant leads to the accumulation of ethylene in the tissues. This trapped ethylene then triggers a significant and rapid increase in internodal elongation, helping the leaves and upper parts of the plant to remain above the water surface for gas exchange and photosynthesis. While gibberellins are involved in the elongation process, ethylene is the primary trigger in this specific adaptation.

Therefore, ethylene is the hormone that directly promotes this rapid elongation in deep water rice.

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

Quick Tip

While both gibberellins and ethylene can cause stem elongation, remember the specific context: for "deep water rice" or "submerged plants," the key trigger is **ethylene**. This is a classic example of ethylene's role in plant adaptation.

---

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

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

Correct Answer: (C) Alfred Hershey and Martha Chase

Solution:

Step 1: Understanding the Question:
The question asks to identify the scientists who provided the definitive or "unequivocal" proof that DNA, and not protein, is the genetic material.

Step 2: Detailed Explanation:
Let's review the timeline of key experiments:
- **Frederick Griffith (1928):** Performed the transformation experiment with *Streptococcus pneumoniae*. He showed that a "transforming principle" from dead virulent bacteria could make non-virulent bacteria virulent, but he did not identify the nature of this principle.
- **Avery, Macleoid, and McCarthy (1944):** They extended Griffith's work and used biochemical methods to show that the transforming principle was DNA. While their evidence was strong, it was not universally accepted by the scientific community, as many still believed protein was the more likely candidate for genetic material.
- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using T2 bacteriophage, a virus that infects bacteria. They used radioactive isotopes to label the phage's DNA and protein separately. - They labeled the DNA with radioactive phosphorus (^{32}P) because DNA contains phosphorus but protein does not.
- They labeled the protein coat with radioactive sulfur (^{35}S) because proteins contain sulfur (in some amino acids) but DNA does not. - They found that only the radioactive DNA (^{32}P) entered the host bacterial cells, while the radioactive protein coat (^{35}S) remained outside. Since the injected DNA was sufficient to cause the production of new phages, this provided conclusive proof that DNA is the genetic material.
- **Wilkins and Franklin:** Used X-ray diffraction to study the structure of DNA, which was crucial for Watson and Crick's model, but did not prove its function as genetic material.

The Hershey-Chase experiment is considered the "unequivocal proof".

Step 3: Final Answer:
The unequivocal proof that DNA is the genetic material was provided by Alfred Hershey and Martha Chase.

Quick Tip

Remember the key contributions: - Griffith: Discovered transformation. - Avery et al.: Identified the transforming substance as DNA. - Hershey Chase: Provided unequivocal proof using radioactive tracers. The word "unequivocal" in the question points directly to the Hershey-Chase experiment.

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

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

Correct Answer: (D) Respiratory loss

Solution:

Step 1: Understanding the Question:
The question provides the fundamental equation for net primary productivity and asks to identify what the term 'R' represents.

Step 2: Key Formula or Approach:
The relationship between Gross Primary Productivity (GPP), Net Primary Productivity (NPP), and Respiration (R) is given by:

$$\text{NPP} = \text{GPP} - \text{R}$$

Step 3: Detailed Explanation:
Let's define the terms:
- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (like plants) and converted into chemical energy in the form of organic compounds through photosynthesis. It's the total amount of photosynthesis.
- **Respiratory Loss (R):** Producers use a significant portion of the energy they capture (GPP) for their own metabolic activities, such as growth, maintenance, and reproduction. This energy is consumed through cellular respiration. 'R' represents this amount of energy lost as heat during respiration.
- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass

after accounting for their respiratory losses. It is the energy that is stored as biomass and is available to the next trophic level (consumers).

Therefore, R in the equation GPP – R = NPP represents the energy lost through respiration by the producers.

Step 4: Final Answer:
In the equation, R represents Respiratory loss.

Quick Tip

Think of it like a salary: - **GPP** is your gross salary (total income). - **R (Respiration)** are your expenses and taxes. - **NPP** is your net salary (take-home pay), which is what you have left to use or save.

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133. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the definition of Expressed Sequence Tags (ESTs), a concept related to genomics and the Human Genome Project.

Step 2: Detailed Explanation:
The process of identifying ESTs involves:
1. Isolating messenger RNA (mRNA) from a specific cell or tissue type. The presence of mRNA indicates that a gene is being "expressed" or transcribed. 2. Using the enzyme reverse transcriptase to create a complementary DNA (cDNA) copy of the mRNA. 3. Sequencing short fragments (tags) from the ends of these cDNAs. These short sequenced fragments are called Expressed Sequence Tags (ESTs).
Because ESTs are derived from mRNA, they represent fragments of genes that are actively being transcribed into RNA in that particular tissue at that particular time. This methodology was used as a rapid way to discover and catalog genes. Therefore, ESTs represent "all genes that are expressed as RNA".

Let's look at the options:
- (A) "Certain important expressed genes" is too vague. The method identifies all expressed

genes, not just "important" ones.
- (C) "All genes that are expressed as proteins" is incorrect. The process starts from mRNA. Not all transcribed RNAs are translated into proteins (e.g., non-coding RNAs).
- (D) "All genes whether expressed or unexpressed" is incorrect. ESTs specifically target expressed genes by using mRNA as the starting material.

Step 3: Final Answer:
Expressed Sequence Tags (ESTs) refer to all genes that are expressed as RNA.

Quick Tip

Break down the term: - Expressed: The gene is turned on (transcribed into mRNA). - Sequence Tag: A short piece of DNA sequence that acts as a unique identifier or "tag" for that gene. This helps remember that ESTs are about identifying expressed genes.

---

134. Among eukaryotes, replication of DNA takes place in -

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

Correct Answer: (C) 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 divided into two main stages: Interphase and the M phase (Mitotic phase). Interphase is further subdivided into three phases:
- **G_1 phase (Gap 1):** This is the period of cell growth before DNA synthesis begins. The cell is metabolically active and synthesizes proteins and RNAs.
- **S phase (Synthesis):** This is the phase where the cell's DNA is replicated. At the end of the S phase, each chromosome consists of two sister chromatids. The amount of DNA in the cell doubles during this phase.
- **G_2 phase (Gap 2):** This is the period after DNA synthesis has occurred but before the start of mitosis. The cell continues to grow and produces proteins necessary for cell division.
- **M phase (Mitosis/Meiosis):** This is the phase of actual cell division, including nuclear division (mitosis) and cytoplasmic division (cytokinesis).

Therefore, DNA replication is confined to the S phase of the cell cycle.

Step 3: Final Answer:
Replication of DNA in eukaryotes takes place in the S phase.

Quick Tip

Remember the cell cycle order: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$. The 'S' stands for 'Synthesis', specifically the synthesis of new DNA.

---

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

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

Correct Answer: (D) Tungsten or gold

Solution:

Step 1: Understanding the Question:
The question asks to identify the type of metal used for the microparticles in the gene gun (biolistics) method of genetic transformation.

Step 2: Detailed Explanation:
The gene gun method, also known as biolistics or microparticle bombardment, is a physical method for delivering foreign DNA (transgenes) into cells. The procedure involves:
1. Coating microscopic particles of a heavy metal with the DNA of interest. 2. Loading these DNA-coated microparticles onto a carrier sheet. 3. Propelling the particles at high velocity towards the target cells or tissues using a burst of pressurized gas (like helium). 4. The high-velocity particles penetrate the cell walls and membranes, carrying the foreign DNA into the cell's interior.
The microparticles need to be dense enough to have sufficient momentum to penetrate the cells and chemically inert so they do not react with the DNA or the cell's components. The most commonly used metals for these microparticles are **gold (Au)** and **tungsten (W)**.

Step 3: Final Answer:
In the gene gun method, microparticles of tungsten or gold are used.

Quick Tip

Associate the "gene gun" with shooting "golden bullets." The use of heavy, inert metals like gold or tungsten is crucial for the success of this biolistic technique.

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) about pollination and fertilization in gymnosperms. We need to evaluate their correctness.

Step 2: Detailed Explanation:
- **Analysis of Assertion (A):** "In gymnosperms the pollen grains are released from the microsporangium and carried by air currents."
Gymnosperms (like pines, cycads) lack flowers and their ovules are exposed. Pollination is predominantly anemophilous, meaning it is mediated by wind (air currents). Pollen grains are produced in microsporangia (pollen sacs) and released into the air. This statement is **true**.

- **Analysis of 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 has several inaccuracies. 1. Air currents carry the pollen grains to the ovule, specifically to the micropyle of the ovule, not directly to the archegonia which are inside the ovule. 2. After landing on the ovule, the pollen grain germinates and **forms a pollen tube**. This pollen tube grows through the nucellus towards the archegonium. 3. The pollen tube carries the male gametes and discharges them near the archegonium for fertilization. The formation of a pollen tube (siphonogamy) is a key feature of seed plants, including gymnosperms (with a few exceptions in primitive groups where the process is slightly different, but a tube is still formed). Therefore, the statement that a "pollen tube is not formed" is incorrect. The

Reason R is **false**.

Step 3: Final Answer:
Assertion A is true, but Reason R is false.

Quick Tip

Remember that both gymnosperms and angiosperms are siphonogamous, meaning they form a pollen tube to deliver male gametes. The key error in the Reason statement is the claim that a pollen tube is not formed.

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137. Match List I with List II :
List I (Interaction)
A. Mutualism
B. Commensalism
C. Amensalism
D. Parasitism
List II (Species A and B)
I. +(A), 0(B)
II. -(A), 0(B)
III. +(A), -(B)
IV. +(A), +(B)
Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching different types of population interactions (List I) with their symbolic representation (List II), where '+' denotes benefit, '-' denotes harm, and '0' denotes no effect.

Step 2: Detailed Explanation:
Let's define each interaction and find its corresponding representation:
- **A. Mutualism:** An interaction where both species A and B benefit. The representation is (+, +). This matches **IV**.
- **B. Commensalism:** An interaction where one species (A) benefits, and the other species (B) is neither harmed nor benefited (unaffected). The representation is (+, 0). This matches

I.
- **C. Amensalism:** An interaction where one species (A) is harmed, and the other species (B) is unaffected. The representation is (-, 0). This matches **II**.
- **D. Parasitism:** An interaction where one species (the parasite, A) benefits at the expense of the other species (the host, B), which is harmed. The representation is (+, -). This matches **III**.

So the correct pairings are: - A $\rightarrow$ IV - B $\rightarrow$ I - C $\rightarrow$ II - D $\rightarrow$ III
Now let's check the options. The option that corresponds to this matching is (C).

Step 3: Final Answer:
The correct matching is A-IV, B-I, C-II, D-III.

Quick Tip

Create a simple table in your mind or on paper for population interactions. This makes matching questions very easy. - Mutualism: (+,+) - Competition: (-,-) - Predation/Parasitism: (+,-) - Commensalism: (+,0) - Amensalism: (-,0) - Neutralism: (0,0)

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138. Match List I with List II:
List I
A. Cohesion
B. Adhesion
C. Surface tension
D. Guttation
List II
I. More attraction in liquid phase
II. Mutual attraction among water molecules
III. Water loss in liquid phase
IV. Attraction towards polar surfaces
Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question asks to match properties and processes related to water in plants (List I) with their correct descriptions (List II).

Step 2: Detailed Explanation:
Let's define each term in List I and match it with the correct description in List II.
- **A. Cohesion:** This is the property of water molecules being attracted to each other due to hydrogen bonds. This is best described as "Mutual attraction among water molecules". This matches **II**.
- **B. Adhesion:** This is the attraction of water molecules to a different type of surface, such as the polar surfaces of the xylem walls (tracheids and vessels). This is best described as "Attraction towards polar surfaces". This matches **IV**.
- **C. Surface tension:** This is a consequence of cohesion. Water molecules at the surface are more strongly attracted to each other (in the liquid) than to the molecules in the air (gas phase). This property allows water to resist an external force and is described as "More attraction in liquid phase". This matches **I**.
- **D. Guttation:** This is the exudation of water droplets (xylem sap) from the tips or margins of leaves, typically occurring at night or in highly humid conditions when transpiration is low. It is "Water loss in liquid phase". This matches **III**.

So, the correct pairings are: - A $\rightarrow$ II - B $\rightarrow$ IV - C $\rightarrow$ I - D $\rightarrow$ III
Checking the options, option (B) matches our pairings.

Step 3: Final Answer:
The correct matching is A-II, B-IV, C-I, D-III.

Quick Tip

Clearly distinguish these terms: - Cohesion: Water-to-Water attraction. - Adhesion: Water-to-Surface (e.g., xylem wall) attraction. - Surface Tension: A result of cohesion at the liquid-air interface. - Guttation vs. Transpiration: Guttation is water loss as a liquid (hydathodes), while transpiration is water loss as a vapor (stomata).

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

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

Correct Answer: (2) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks to identify the enzyme whose activity is inhibited by malonate, thereby stop-

ping the growth of pathogenic bacteria. This relates to the concept of enzyme inhibition.

Step 2: Detailed Explanation:
Malonate is a classic example of a competitive inhibitor. Its structure is very similar to that of succinate, the natural substrate for the enzyme succinic dehydrogenase.

Succinate	**Malonate**
$^{-}OOC - CH2 - CH2 - COO^{-}$	$^{-}OOC - CH2 - COO^{-}$

Due to this structural similarity, malonate binds to the active site of succinic dehydrogenase but does not undergo a reaction. This blocks the substrate (succinate) from binding, thus inhibiting the enzyme's activity.
Succinic dehydrogenase is a key enzyme in the Krebs cycle (or tricarboxylic acid cycle), which is essential for cellular respiration and energy production in both bacteria and eukaryotes. By inhibiting this enzyme, malonate disrupts the Krebs cycle, leading to a lack of energy (ATP) production, which inhibits the growth of the pathogenic bacteria.

Step 3: Evaluating other options:

- **Dinitrogenase:** An enzyme used by nitrogen-fixing bacteria to convert atmospheric nitrogen (N_2) to ammonia (NH_3). It is not inhibited by malonate.
- **Amylase:** An enzyme that breaks down starch into sugars.
- **Lipase:** An enzyme that breaks down fats (lipids).

These enzymes do not have active sites that malonate can bind to as a competitive inhibitor.

Step 4: Final Answer:
Therefore, malonate inhibits the activity of succinic dehydrogenase.

Quick Tip

Remember that competitive inhibitors often have a structure very similar to the enzyme's natural substrate. Malonate and succinate are a frequently cited example in competitive inhibition.

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140. Match List I with List II:

List I		**List II**	
A.	Oxidative decarboxylation	I.	Citrate synthase
B.	Glycolysis	II.	Pyruvate dehydrogenase
C.	Oxidative phosphorylation	III.	Electron transport system
D.	Tricarboxylic acid cycle	IV.	EMP pathway

Choose the correct answer from the options given below :

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

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching metabolic processes from List I with their associated enzymes or pathways from List II.

Step 2: Detailed Explanation:
Let's analyze each item in List I and find its correct match in List II.

- **A. Oxidative decarboxylation:** This process involves the removal of a carboxyl group as CO_2 along with oxidation. A key example is the conversion of pyruvate to acetyl-CoA, which is catalyzed by the **Pyruvate dehydrogenase** complex. So, **A matches with II**.

- **B. Glycolysis:** This is the metabolic pathway that converts glucose into pyruvate. It is also known as the Embden-Meyerhof-Parnas pathway, or **EMP pathway**. So, **B matches with IV**.

- **C. Oxidative phosphorylation:** This is the process where ATP is formed as a result of the transfer of electrons from NADH or $FADH_2$ to O_2 by a series of electron carriers. This entire process happens in the **Electron transport system (ETS)**. So, **C matches with III**.

- **D. Tricarboxylic acid cycle (TCA cycle):** Also known as the Krebs cycle. The first step of this cycle involves the condensation of acetyl-CoA with oxaloacetate to form citrate, a reaction catalyzed by the enzyme **Citrate synthase**. So, **D matches with I**.

Step 3: Final Matching:
The correct matching is:
A $\rightarrow$ II
B $\rightarrow$ IV
C $\rightarrow$ III
D $\rightarrow$ I

This corresponds to the option (1).

Quick Tip

For matching questions, start with the pairs you are most certain about. For instance, knowing that Glycolysis is the EMP pathway (B-IV) might help eliminate some incorrect options quickly.

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

Correct Answer: (3) 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 evaluate each statement:

- **Statement A: Lenticels are the lens-shaped openings permitting the exchange of gases.** This is **correct**. Lenticels are porous tissues consisting of cells with large intercellular spaces in the periderm of secondarily thickened organs, such as stems and roots of woody plants. They function as pores for direct gas exchange between internal tissues and the atmosphere.

- **Statement B: Bark formed early in the season is called hard bark.** This is **incorrect**. Bark formed early in the season (spring) is called 'soft bark', while bark formed late in the season (autumn) is called 'hard bark'. This is analogous to spring wood and autumn wood.

- **Statement C: Bark is a technical term that refers to all tissues exterior to vascular cambium.** This statement is a broad definition and generally considered correct

in botany. However, statement D provides a more precise component-based definition. In the context of multiple-choice questions where only the 'most' correct options are chosen, this might be considered less precise than D. According to the provided answer key, this statement is considered incorrect.

- **Statement D: Bark refers to periderm and secondary phloem.** This is a **correct** and precise definition. Bark is composed of two main parts: the inner bark (secondary phloem) and the outer bark (periderm and all tissues outside it, also known as rhytidome). Thus, 'periderm and secondary phloem' are the essential components of bark.

- **Statement E: Phellogen is single-layered in thickness.** This is generally true, as phellogen (cork cambium) is a meristematic tissue. However, it can sometimes be two or more cell layers thick. Therefore, stating it is strictly 'single-layered' might be considered an oversimplification and thus incorrect in a strict sense.

Step 3: Final Answer:
Based on the analysis, statements A and D are the most accurate and universally accepted facts. The provided answer key confirms that A and D are the correct statements.

Quick Tip

In plant anatomy, definitions can be nuanced. 'Bark' has both a broad definition (all tissues outside vascular cambium) and a more specific one (periderm + secondary phloem). Often, questions test the more precise, component-based definition.

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

Correct Answer: (4) 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 of features.

Step 2: Detailed Explanation:
Klinefelter's Syndrome is a genetic condition caused by the presence of an extra X chromosome in males, resulting in the karyotype 47, XXY. Let's analyze each statement:

- **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.

- **Statement B: Such an individual has overall masculine development. However, the feminine development is also expressed.** This is **correct**. Individuals are phenotypically male, but the extra X chromosome leads to the development of some feminine characteristics, such as gynecomastia (enlargement of breast tissue).

- **Statement C: The affected individual is short statured.** This is **incorrect**. Individuals with Klinefelter's Syndrome are often taller than average, with long limbs. Short stature is characteristic of Turner's Syndrome (45, XO).

- **Statement D: Physical, psychomotor and mental development is retarded.** This is **incorrect**. While some individuals may have learning disabilities or delayed speech development, severe mental retardation is not a typical feature. Intelligence is usually within the normal range.

- **Statement E: Such individuals are sterile.** This is **correct**. The presence of the extra X chromosome leads to underdeveloped testes (testicular atrophy) and, consequently, infertility or sterility due to low or no sperm production (azoospermia).

Step 3: Final Answer:
The correct statements are B and E. Therefore, the correct option is (4).

Quick Tip

For chromosomal disorders, create a table comparing key features of Klinefelter's Syndrome (XXY), Turner's Syndrome (XO), and Down's Syndrome (Trisomy 21). Focus on karyotype, physical characteristics, fertility, and mental development.

---

143. 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) B, D, A, C
(B) B, C, D, A
(C) C, A, B, D
(D) C, B, D, A

Correct Answer: (4) C, B, D, A

Solution:

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

Step 2: Detailed Explanation:
The process of creating recombinant DNA involves several sequential steps. Let's analyze the logical flow:

1. **Isolation of the Genetic Material:** The very first step is to obtain the DNA from the source organism. This could be isolating the entire genomic DNA. Phrased as **C. Isolation of desired DNA fragment**, this represents the initial step of getting the source material.
2. **Cutting the DNA:** Once the DNA is isolated, restriction enzymes are used to cut it at specific recognition sites to generate fragments. One of these fragments will be the gene of interest. This corresponds to **B. Cutting of DNA at specific location by restriction enzyme**. After cutting, the specific fragment is often isolated using gel electrophoresis. So, C $\rightarrow$ B is a logical start.
3. **Amplification of the Gene:** To get a sufficient quantity of the gene of interest for subsequent steps, it is amplified using the Polymerase Chain Reaction (PCR). This is **D. Amplification of gene of interest using PCR**.
4. **Ligation and Insertion:** The amplified gene of interest is then ligated (joined) with a vector DNA (like a plasmid) that has been cut with the same restriction enzyme. The resulting molecule is the recombinant DNA. This recombinant DNA is then introduced into a suitable host cell (like a bacterium). This final step is **A. Insertion of recombinant DNA into the host cell**.

So, the correct sequence of the given steps is C $\rightarrow$ B $\rightarrow$ D $\rightarrow$ A.

Step 3: Final Answer:
Arranging the steps in the correct order gives C, B, D, A. This matches option (4).

Quick Tip

Remember the general workflow of rDNA technology: Isolate the DNA, Cut it with restriction enzymes, Amplify the desired gene (PCR), Ligate it into a vector, and finally, Insert the recombinant vector into a host.

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

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

Correct Answer: (2) membrane, proton pump, proton gradient, ATP synthase

Solution:

Step 1: Understanding the Question:
The question asks for the essential components required for the process of chemiosmosis, which is the mechanism for ATP synthesis in both photosynthesis and cellular respiration.

Step 2: Detailed Explanation:
According to Peter Mitchell's chemiosmotic theory, ATP synthesis is coupled to the movement of protons across a semipermeable membrane. The key requirements are:

- **A membrane:** An intact inner mitochondrial membrane or a thylakoid membrane is necessary to maintain a proton gradient. It must be impermeable to protons except through specific channels.
- **A proton pump:** This is typically the electron transport chain (ETC). As electrons move through the ETC, energy is used to pump protons (H^+) from the matrix (in mitochondria) or stroma (in chloroplasts) to the intermembrane space or thylakoid lumen, respectively.
- **A proton gradient:** The pumping of protons creates a difference in proton concentration and electrical charge across the membrane, which is a form of potential energy called the proton-motive force.
- **ATP synthase:** This is a transmembrane enzyme complex (also known as F_0-F_1 particle) that has a channel for protons to flow back down their concentration gradient. The energy released from this proton flow is used by the enzyme to synthesize ATP from ADP and inorganic phosphate (Pi).

Step 3: Evaluating the options:

- (1) and (3) are incorrect because NADP synthase (more accurately, $NADP^+$ reductase) is involved in reducing $NADP^+$ to NADPH in photosynthesis, but it is not a core component of the ATP synthesis mechanism via chemiosmosis itself.

- (4) is incorrect because it omits the crucial requirement of an intact membrane to establish and maintain the gradient. It also mentions 'electron gradient' which is less precise than 'proton gradient'. The gradient that drives ATP synthesis is of protons (H^+).
- (2) correctly lists all four essential components: the membrane, the pump to create the gradient, the gradient itself, and the ATP synthase enzyme that utilizes the gradient.

Step 4: Final Answer:
The correct combination required for chemiosmosis is membrane, proton pump, proton gradient, and ATP synthase.

Quick Tip

Think of chemiosmosis like a hydroelectric dam. The **membrane** is the dam wall. The **proton pump** is the system that fills the reservoir. The **proton gradient** is the stored water at a high level. The **ATP synthase** is the turbine through which water flows to generate electricity (ATP).

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

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

Correct Answer: (2) 80

Solution:

Step 1: Understanding the Question:
The question asks for the total number of different proteins found in a ribosome. Ribosomes are complex structures composed of ribosomal RNA (rRNA) and proteins.

Step 2: Detailed Explanation:
The composition of ribosomes differs between prokaryotes and eukaryotes.

- **Prokaryotic ribosomes (70S):** They consist of a 50S large subunit and a 30S small subunit. The 50S subunit contains about 34 proteins, and the 30S subunit contains about 21 proteins, for a total of approximately 55 proteins.
- **Eukaryotic ribosomes (80S):** They consist of a 60S large subunit and a 40S small subunit. The 60S subunit contains about 49 proteins, and the 40S subunit contains about 33 proteins. The total number of proteins is approximately 82.

Since the question does not specify the type of ribosome (prokaryotic or eukaryotic), we must choose the best fit from the given options. The number 80 is a very close approximation for the number of proteins in a eukaryotic ribosome. The other options (20, 40, 60) are not accurate for either type. In the context of general biology questions, "ribosome" often implicitly refers to the more complex eukaryotic ribosome unless stated otherwise.

Step 3: Final Answer:
The number of different proteins in a eukaryotic ribosome is approximately 80. This matches option (2).

Quick Tip

Memorize the key differences between prokaryotic (70S) and eukaryotic (80S) ribosomes, including their subunit Svedberg units (50S+30S vs 60S+40S) and the approximate number of proteins. Note that Svedberg units are not additive.

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

Correct Answer: (2) 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 if Assertion (A) and Reason (R) are true statements individually, and then determine if R is the correct explanation for A.

Step 2: Evaluating Assertion A:
Assertion A: A flower is defined as a modified shoot wherein the shoot apical meristem changes to floral meristem.
This statement is **true**. Botanically, a flower is considered a highly modified and condensed reproductive shoot. The transition from vegetative growth to reproductive growth involves the transformation of the shoot apical meristem into a floral meristem, which then gives rise to the

flower.

Step 3: Evaluating Reason R:
Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.
This statement is also **true**. The modification of the shoot involves a dramatic condensation of the axis, bringing the nodes very close together. The appendages produced at these nodes are modified leaves, which become the floral parts (sepals, petals, stamens, and carpels) arranged in whorls.

Step 4: Linking Assertion and Reason:
Reason R explains *how* the shoot is modified to become a flower. It details the process of internode condensation and the production of floral appendages instead of vegetative leaves. This directly explains why a flower is called a modified shoot. Therefore, R is the correct explanation for A.

Step 5: Final Answer:
Since both A and R are true, and R correctly explains A, the correct option is (2).

Quick Tip

When tackling Assertion-Reason questions, use a two-step process: 1. Check the validity of each statement independently. 2. If both are true, check if the Reason logically explains the Assertion by asking "Why?" or "How?" after reading the Assertion. If the Reason answers that question, it's the correct explanation.

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

Correct Answer: (4) 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 correct descriptions or events (List II).

Step 2: Detailed Explanation:
Let's analyze each phase in List I and find its corresponding description in List II.

- **A. M Phase:** This is the mitotic phase, where the cell divides. Mitosis is known as **equational division** because the number of chromosomes in the parent and daughter cells remains the same. So, **A matches with IV**.

- **B. G_2 Phase:** This is the gap 2 phase, which occurs after DNA synthesis (S phase) and before mitosis (M phase). During this phase, the cell continues to grow, and **proteins are synthesized** in preparation for mitosis, such as tubulin for spindle formation. So, **B matches with I**.

- **C. Quiescent stage (G_0):** This is a period in the cell cycle where cells exist in a non-dividing state. They are metabolically active but have exited the cell cycle. This is considered an **inactive phase** with respect to proliferation. So, **C matches with II**.

- **D. G_1 Phase:** This is the gap 1 phase, the first phase of interphase. It is the **interval between mitosis (the previous M phase) and the initiation of DNA replication (the next S phase)**. The cell grows and carries out its normal metabolic functions during this phase. So, **D matches with III**.

Step 3: Final Matching:
The correct matching is:
A $\rightarrow$ IV
B $\rightarrow$ I
C $\rightarrow$ II
D $\rightarrow$ III

This corresponds to the option (4).

Quick Tip

Draw a diagram of the cell cycle ($G_1 \rightarrow S \rightarrow G_2 \rightarrow M$) and write down the key event for each phase. Also, remember that the G_0 phase is an exit from the G_1 phase for non-dividing cells.

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148. Given below are two statements :
Statement I: Gause's 'Competitive Exclusion Principle' states that two closely re-

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

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

Solution:

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

Step 2: Evaluating Statement I:
Statement I provides a definition of Gause's 'Competitive Exclusion Principle'. It states that two species competing for the exact same limited resources cannot coexist in the same place at the same time; one species will have an advantage that will eventually lead to the elimination of the other. This is the precise and correct definition of the principle. Thus, **Statement I is correct**.

Step 3: Evaluating Statement II:
Statement II claims that carnivores are more adversely affected by competition than herbivores. This is generally **false**. Competition is typically more intense at lower trophic levels. Herbivores often compete for specific, stationary plant resources, which can lead to intense competition. Carnivores, on the other hand, often have larger territories, are more mobile, and may have a broader range of prey, which can reduce the intensity of direct competition. Furthermore, population sizes are smaller at higher trophic levels, which can also influence the dynamics of competition. Thus, **Statement II is false**.

Step 4: Final Answer:
Since Statement I is correct and Statement II is false, the correct option is (4).

Quick Tip

Remember Gause's principle with the example of Paramecium aurelia and Paramecium caudatum. When grown together, P. aurelia outcompetes P. caudatum for the limited food resources. Also, recall that competition intensity is generally greater at lower trophic levels.

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

(A) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels.
(B) 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.
(C) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.
(D) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body.

Correct Answer: (3) 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:

- **Statement (1):** This describes the process of biomagnification, where the concentration of non-biodegradable toxic substances (like DDT or mercury) increases at each successive trophic level in a food chain. This statement is **correct**.

- **Statement (2):** This describes the effect of sewage pollution. When sewage (rich in organic matter) enters a water body, decomposer microorganisms multiply rapidly. Their respiratory activity consumes a large amount of dissolved oxygen, increasing the Biological Oxygen Demand (BOD). The depletion of oxygen can lead to the death of fish and other aquatic organisms. This statement is **correct**.

- **Statement (3):** Algal blooms are caused by an excess of nutrients (eutrophication), particularly nitrates and phosphates, not primarily organic matter itself (though decomposition of organic matter releases these nutrients). These blooms severely **degrade water quality**. They block sunlight from reaching submerged plants, and when the algae die, their decomposition by bacteria consumes vast amounts of dissolved oxygen, leading to hypoxic or anoxic conditions that kill fish. Therefore, they are detrimental to fisheries, not promotional. This statement is **incorrect**.

- **Statement (4):** Water hyacinth (Eichhornia crassipes) is a notorious invasive aquatic weed that thrives in nutrient-rich (eutrophic) water bodies. Its rapid growth covers the

water surface, blocking light, reducing oxygen levels, and disrupting the entire aquatic ecosystem. This statement is **correct**.

Step 3: Final Answer:
The statement that is not correct is (3).

Quick Tip

Associate algal blooms with eutrophication and negative consequences: high BOD upon decay, oxygen depletion, and fish kills. They are a sign of poor water quality, not improvement.

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's determine the function of each micronutrient:

- **A. Iron (Fe):** Iron is an essential component of proteins involved in electron transport, such as cytochromes and ferredoxin. It is also required for the formation of chlorophyll and acts as an **activator for the catalase** enzyme. So, **A matches with III**.

- **B. Zinc (Zn):** Zinc is required for the activity of various enzymes, especially carboxylases. It is also essential for the **synthesis of auxin**, a key plant growth hormone. So, **B**

matches with I.

- **C. Boron (B):** Boron is required for the uptake and utilization of Ca^{2+}, membrane functioning, pollen germination, **cell elongation, and cell differentiation**. So, **C matches with IV**.

- **D. Molybdenum (Mo):** Molybdenum is a **component of several enzymes**, including nitrogenase (involved in nitrogen fixation) and **nitrate reductase**, which is critical for converting nitrate to nitrite during nitrogen assimilation. So, **D matches with II**.

Step 3: Final Matching:
The correct matching is:
A $\rightarrow$ III
B $\rightarrow$ I
C $\rightarrow$ IV
D $\rightarrow$ II

This corresponds to the option (4).

Quick Tip

Create flashcards for essential plant nutrients. For each nutrient, list its key function(s) and a major deficiency symptom. For example: Zn $\rightarrow$ Auxin synthesis $\rightarrow$ Deficiency causes 'little leaf' disease. Mo $\rightarrow$ Nitrate reductase $\rightarrow$ Deficiency affects nitrogen metabolism.
