NEET UG 2023 H1 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. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :
Assertion A: Late wood has fewer xylary elements with narrow vessels.
Reason R: Cambium is less active in winters.
In the light of the above statements, choose the correct answer from the options

given below :

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

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

Solution:

Step 1: Understanding the Statements
The question presents an Assertion (A) about the characteristics of late wood and a Reason (R) explaining the activity of cambium in winter. We need to evaluate if both statements are true and if the reason correctly explains the assertion.

Step 2: Detailed Explanation
Assertion A: Late wood, also known as autumn wood, is formed during the later part of the growing season (autumn/winter). During this period, the environmental conditions are less favourable for growth. This results in the formation of fewer xylary elements, and the vessels (or tracheids) that are formed are narrower in diameter. So, Assertion A is true.

Reason R: The cambium is a layer of actively dividing cells responsible for secondary growth (increase in girth). Its activity is influenced by physiological and environmental factors, such as temperature and water availability. In winters, the conditions are harsh, and the cambium becomes less active. This reduced activity leads to the formation of late wood. So, Reason R is also true.

Connecting A and R: Because the cambium is less active in winters (Reason R), it produces fewer xylem elements with narrow vessels, which is the characteristic feature of late wood (Assertion A). Therefore, Reason R is the correct explanation for Assertion A.

Step 3: Final Answer
Both Assertion A and Reason R are true, and Reason R correctly explains Assertion A. Thus, option (C) is the correct answer.

Quick Tip

For Assertion-Reason questions, first check the validity of each statement independently. Then, check if the Reason provides a direct explanation for the Assertion by asking "Why?" about the Assertion. If the Reason answers "Why?", it is the correct explanation.

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

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

Correct Answer: (D) 1992

Solution:

Step 1: Understanding the Question
The question asks for the year in which the Earth Summit, where the Convention on Biological Diversity (CBD) was established, was held in Rio de Janeiro.

Step 2: Detailed Explanation
The United Nations Conference on Environment and Development (UNCED), popularly known as the Earth Summit, was a major international conference held in Rio de Janeiro, Brazil.
This summit took place from June 3 to June 14, 1992.
One of the key outcomes of this summit was the opening for signature of the Convention on Biological Diversity (CBD).
Therefore, the historic event occurred in 1992.

Step 3: Final Answer
Based on historical facts, the Earth Summit in Rio de Janeiro was held in 1992. Hence, option (D) is the correct answer.

Quick Tip

Memorize the years and locations of major environmental summits and protocols, such as the Earth Summit (1992, Rio), the World Summit on Sustainable Development (2002, Johannesburg), the Kyoto Protocol (1997), and the Montreal Protocol (1987).

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

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

Correct Answer: (A) Respiratory loss

Solution:

Step 1: Understanding the Question
The question asks to identify the term 'R' in the ecological equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).

Step 2: Key Formula or Approach
The relationship between GPP, NPP, and R is given by the equation:

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

Step 3: Detailed Explanation
Gross Primary Productivity (GPP): This is the rate at which solar energy is captured in sugar molecules during photosynthesis by producers (like plants). It represents the total amount of energy produced.
Net Primary Productivity (NPP): This is the energy that remains as biomass after the producers have met their own energetic needs. It is the energy available to the consumers in the ecosystem.
Producers use a significant portion of the energy they produce (GPP) for their own metabolic activities, primarily cellular respiration. The energy consumed during respiration is lost as heat.
This loss of energy through respiration is represented by 'R'.
So, the equation states that Net Primary Productivity is what's left of the Gross Primary Productivity after the Respiratory losses are accounted for.
Therefore, R stands for Respiratory loss.

Step 4: Final Answer
In the given equation, R represents the energy lost by the producers through respiration. Thus, option (A) is correct.

Quick Tip

Think of GPP as the 'gross income' of an ecosystem and NPP as the 'net income' or 'take-home pay'. The difference, 'R', is the 'expenditure' needed to run the system (i.e., respiration).

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

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

Correct Answer: (D) To trap pollen grains

Solution:

Step 1: Understanding the Question
The question asks for the function of "tassels in the corn cob". It's important to note the specific botanical structures of a corn plant (maize).

Step 2: Detailed Explanation
There appears to be a biological inaccuracy in the question's phrasing. In a corn plant:
Tassel: This is the male inflorescence located at the top of the plant. Its primary function is to produce and disperse a large amount of pollen grains. This corresponds to option (A).
Corn Cob/Ear: This is the female inflorescence located lower on the stalk. It develops into the fruit (the corn we eat). From the tip of the cob emerge long, silky threads called **silks**.
Silks: Each silk is a stigma and style. The function of the silks is to trap the airborne pollen grains dispersed from the tassels. This corresponds to option (D).

The question incorrectly links "tassels" with the "corn cob". However, given the options, the question is likely asking about the function of the structures associated with the cob that are involved in pollination, which are the silks. The function of the silks is to trap pollen grains. The provided answer key indicates (D) is correct, reinforcing the interpretation that the question, despite its flawed terminology, refers to the function of the silks on the cob.

Step 3: Final Answer
Assuming the question mistakenly refers to the silks on the corn cob instead of the tassels, their function is to trap pollen grains. Therefore, option (D) is the intended correct answer.

Quick Tip

In competitive exams, be aware of potentially poorly phrased questions. Analyze all options and choose the one that is most biologically plausible in the context, even if the terminology is slightly incorrect. In maize, remember: Tassel (male, top) disperses pollen; Silk (female, on cob) traps pollen.

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

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

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

Solution:

Step 1: Understanding the Question
The question asks to identify the specific types of RNA molecules that are transcribed by the enzyme RNA polymerase III in eukaryotic cells.

Step 2: Detailed Explanation
In eukaryotes, there are three main types of RNA polymerases, each with distinct roles in transcription:
RNA Polymerase I: Located in the nucleolus, it is responsible for transcribing most of the ribosomal RNA (rRNA) genes, specifically the 28S, 18S, and 5.8S rRNA molecules. This eliminates option (C).
RNA Polymerase II: Located in the nucleoplasm, its primary role is to transcribe the genes that code for proteins. This means it synthesizes the precursors of messenger RNA (pre-mRNA or hnRNA) and also most small nuclear RNAs (snRNAs). This eliminates option (A).
RNA Polymerase III: Also located in the nucleoplasm, it transcribes genes for smaller RNA molecules. Its main products are transfer RNA (tRNA), 5S ribosomal RNA (5S rRNA), and some small nuclear RNAs (snRNAs, such as U6 snRNA).

Comparing these roles with the given options:
(A) Precursor of mRNA is transcribed by RNA Pol II.
(B) "Only snRNAs" is incorrect; RNA Pol II also transcribes snRNAs, and RNA Pol III transcribes more than just snRNAs.
(C) 28S, 18S, and 5.8S rRNAs are transcribed by RNA Pol I.
(D) tRNA, 5S rRNA, and snRNA are the correct products of RNA Polymerase III.

Step 3: Final Answer
The role of RNA polymerase III is the transcription of tRNA, 5S rRNA, and some snRNAs. Therefore, option (D) is the correct answer.

Quick Tip

Use the mnemonic "1-2-3, R-M-T" to remember the main products of the eukaryotic RNA polymerases: Pol **I** -¿ **r**RNA, Pol **II** -¿ **m**RNA, Pol **III** -¿ **t**RNA. This helps to quickly recall their primary functions.

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

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

Correct Answer: (B) Bright orange colour

Solution:

Step 1: Understanding the Question
The question asks for the color of fluorescence observed when DNA stained with ethidium bromide (EtBr) is exposed to ultraviolet (UV) light. This is a standard technique in molecular biology.

Step 2: Detailed Explanation
Agarose Gel Electrophoresis: This technique is used to separate DNA fragments based on their size.
Staining with Ethidium Bromide (EtBr): After electrophoresis, the DNA in the gel is invisible. To visualize it, the gel is soaked in a solution containing ethidium bromide. EtBr is a fluorescent dye that intercalates, or inserts itself, between the base pairs of the DNA double helix.
Visualization under UV Light: The EtBr-DNA complex absorbs UV radiation at a wavelength of around 300-360 nm. Upon absorption of this energy, it fluoresces, emitting light in the visible spectrum. The emitted light has a longer wavelength, which appears as a characteristic bright orange colour. This allows the separated DNA bands to be seen and photographed.

Step 3: Final Answer
DNA stained with ethidium bromide fluoresces bright orange when exposed to UV radiation. Thus, option (B) is the correct answer.

Quick Tip

Associate specific stains with their resulting colors in molecular biology techniques. For example, Ethidium Bromide + DNA + UV light = Bright Orange. This is a very common and frequently asked question from biotechnology.

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

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

Correct Answer: (C) Dobson units

Solution:

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

Step 2: Detailed Explanation
Let's analyze the given units:
(A) Decameter: A unit of length, equal to 10 meters. It is not used for measuring atmospheric gases.
(B) Kilobase (kb): A unit used in molecular biology to measure the length of DNA or RNA molecules, equal to 1000 base pairs. It is irrelevant to atmospheric science.
(C) Dobson Units (DU): This is the standard unit used to measure the total amount of ozone in a vertical column of the atmosphere (the ozone column). One Dobson Unit is defined as the thickness (in units of 10 µm) of the layer of pure ozone that would be formed if all the ozone in the column were compressed to standard temperature (0°C) and pressure (1 atm). For example, 300 DU corresponds to a 3 mm thick layer of pure ozone.
(D) Decibels (dB): A logarithmic unit used to measure the intensity of sound or the power level of an electrical signal. It is unrelated to ozone measurement.

Step 3: Final Answer
The correct unit for measuring the thickness of the ozone layer is the Dobson unit. Therefore, option (C) is the correct answer.

Quick Tip

For environmental science topics, create a list of important quantities and their specific units of measurement. For instance: Ozone layer - Dobson Units; Sound intensity - Decibels; Radioactivity - Becquerel/Curie.

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108. The phenomenon of pleiotropism refers to

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

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

Solution:

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

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

(A) a single gene affecting multiple phenotypic expression: This is the definition of **pleiotropy**. A single gene can influence several different, often unrelated, traits. A classic example is the gene for phenylketonuria (PKU), which causes mental retardation, reduced hair pigmentation, and skin pigmentation.
(B) more than two genes affecting a single character: This describes **polygenic inheritance**. Traits like height, skin color, and weight are controlled by the cumulative effect of many genes.
(C) presence of several alleles of a single gene controlling a single crossover: This option is confusing and does not describe a standard genetic phenomenon. The presence of several alleles of a single gene is called **multiple allelism**. Crossover is a separate process.
(D) presence of two alleles, each of the two genes controlling a single trait: This is also an incorrectly phrased option. It seems to mix ideas of alleles and multiple genes.

Based on standard genetic definitions, pleiotropy is when one gene influences multiple traits.

Step 3: Final Answer
The correct definition of pleiotropism is a single gene affecting multiple phenotypic expressions. Therefore, option (A) is the correct answer.

Quick Tip

To avoid confusion, clearly distinguish between pleiotropy and polygenic inheritance.
Pleiotropy: One gene → Many traits.
Polygenic Inheritance: Many genes → One trait.

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

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

Correct Answer: (D) Gibberellic Acid

Solution:

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

Step 2: Detailed Explanation
Let's examine the functions of the listed phytohormones:
(A) Zeatin: A type of cytokinin, primarily involved in promoting cell division (cytokinesis),

chloroplast development, and delaying senescence. It does not primarily hasten maturity.
(B) Abscisic Acid (ABA): Generally considered a plant growth inhibitor. It promotes dormancy, stomatal closure under stress, and senescence. It would be counterproductive for hastening maturity for seed production.
(C) Indole-3-butyric Acid (IBA): A type of auxin, mainly used to promote root formation in plant cuttings. It is involved in cell elongation and apical dominance but not in hastening the reproductive phase.
(D) Gibberellic Acid (GA): Gibberellins have several roles, including stem elongation (bolting), breaking dormancy, and promoting flowering and fruit development. A key application in horticulture and forestry is spraying juvenile conifers with GAs to overcome the juvenile phase and induce early flowering and seed production. This is commercially important for breeding programs.

Step 3: Final Answer
Gibberellic acid is the phytohormone used to hasten the maturity period in juvenile conifers, leading to early seed production. Hence, option (D) is correct.

Quick Tip

For exams, create a table summarizing the major functions and commercial applications of the five main classes of plant hormones: Auxins, Gibberellins, Cytokinins, Abscisic Acid, and Ethylene. This will help you quickly recall their specific roles.

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

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

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

Solution:

Step 1: Understanding the Statements
The question presents an Assertion (A) about the protonema being the first stage of the moss gametophyte and a Reason (R) explaining its origin from a spore. We need to assess the truth-

fulness of both and their relationship.

Step 2: Detailed Explanation
Moss Life Cycle: The life cycle of a moss (a bryophyte) involves an alternation of generations between a haploid gametophyte and a diploid sporophyte.
1. The diploid sporophyte, which remains attached to the gametophyte, has a structure called a capsule. Meiosis occurs within the capsule to produce haploid spores.
2. When a haploid spore lands on a suitable substrate, it germinates.
3. The spore develops into a filamentous, green, creeping structure called the **protonema**. This is the juvenile gametophyte stage. So, Reason R, which states that the protonema develops directly from spores produced in the capsule, is correct.
4. The protonema is indeed the very first stage of the gametophyte generation. Later, leafy buds arise from this protonema, which develop into the mature, upright, leafy gametophyte (the main moss plant). Therefore, Assertion A is also correct.

Connecting A and R: The reason the protonema is the first stage of the gametophyte (Assertion A) is precisely because it is the structure that directly emerges from the germinating spore (Reason R). The spore is the beginning of the gametophytic generation. Thus, Reason R provides the correct explanation for Assertion A.

Step 3: Final Answer
Both Assertion A and Reason R are correct statements, and Reason R is the correct explanation for Assertion A. Therefore, option (C) is the correct answer.

Quick Tip

To master plant life cycles, draw them out. For mosses, remember the sequence: Spore (n) → Protonema (n) → Leafy Gametophyte (n) → Gametes (n) → Zygote (2n) → Sporophyte (2n) → Spore (n). This visual map helps in answering any related question.

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

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

Correct Answer: (D) DNA

Solution:

Step 1: Understanding the Question
The question asks which biological macromolecule is precipitated out from a solution by adding

chilled ethanol during the purification step in recombinant DNA technology. This is a standard step in DNA isolation protocols.

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, RNA, proteins, and lipids.
2. **Removal of other macromolecules:** Enzymes like proteases (to digest proteins like histones) and RNase (to digest RNA) are often added.
3. **Precipitation of DNA:** After other major contaminants are removed, the DNA is in an aqueous solution. DNA is insoluble in alcohols like ethanol or isopropanol. When chilled ethanol is added to the aqueous solution, the DNA precipitates out as a fine, white, thread-like mass. The low temperature reduces the solubility further, enhancing precipitation. Other soluble components like salts and sugars remain in the solution.

Therefore, the addition of chilled ethanol is the specific step used to precipitate and collect the purified DNA.

Step 3: Final Answer
Based on the principles of DNA isolation, chilled ethanol is used to precipitate DNA from the solution. Hence, option (D) is the correct answer.

Quick Tip

Remember that DNA is insoluble in alcohol. This is a fundamental principle used in almost all DNA extraction kits and protocols. The precipitated DNA can often be visualized as a cloudy or thread-like substance and can be spooled onto a glass rod.

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

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

Correct Answer: (C) 680 nm

Solution:

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

Step 2: Detailed Explanation
In photosynthesis, there are two photosystems, PS I and PS II, each with a reaction centre composed of a special pair of chlorophyll 'a' molecules. These reaction centres are named after their characteristic absorption peaks in the red region of the light spectrum.
Photosystem II (PS II): Its reaction centre is called **P680** because it absorbs light most effectively at a wavelength of **680 nm**.
Photosystem I (PS I): Its reaction centre is called **P700** because it absorbs light most effectively at a wavelength of **700 nm**.

Therefore, the absorption maximum for the reaction centre in PS II is 680 nm.

Step 3: Final Answer
The reaction centre in PS II is known as P680, indicating its absorption maxima is at 680 nm. Thus, option (C) is correct.

Quick Tip

A simple way to remember is that in the non-cyclic electron flow (Z-scheme), PS II comes before PS I. Similarly, the number 680 comes before 700. So, PS II corresponds to P680 and PS I corresponds to P700.

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

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

Correct Answer: (C) Diadelphous and Dithecous anthers

Solution:

Step 1: Understanding the Question
The question asks to identify the specific characteristics of the androecium (stamens) that are unique to the family Fabaceae when compared to Solanaceae and Liliaceae.

Step 2: Detailed Explanation
Let's analyze the stamen characteristics of each family:
Family Fabaceae (Subfamily Papilionoideae): The androecium typically consists of ten stamens. A key feature is that they are **diadelphous**, meaning they are united 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).

Family Solanaceae: The androecium has five stamens which are **epipetalous** (attached to the petals). They are not fused into bundles.
Family Liliaceae: The androecium has six stamens, arranged in two whorls of three (3+3). They are often **epiphyllous** or **epitepalous** (attached to the tepals).

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

Step 3: Final Answer
The diadelphous condition of stamens is a specific characteristic of family Fabaceae that distinguishes it from Solanaceae and Liliaceae. Thus, option (C) is the correct answer.

Quick Tip

When studying plant families, focus on unique floral characteristics. For Fabaceae, remember the vexillary aestivation of the corolla and the diadelphous (9)+1 arrangement of stamens. These are frequently tested features.

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

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

Correct Answer: (C) manganese

Solution:

Step 1: Understanding the Question
The question asks to identify the micronutrient that plays a crucial role in the photolysis (splitting) of water during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation
The splitting of water molecules occurs in Photosystem II (PS II) and is catalyzed by a protein complex called the Oxygen-Evolving Complex (OEC). The reaction is:

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

This process requires the presence of specific inorganic ions as cofactors. The core of the OEC contains a cluster of four **manganese (Mn)** ions and one calcium (Ca^{2+}) ion. Chloride ions (Cl^-) are also essential for this process.
Let's look at the roles of the other options:
(A) Magnesium (Mg): It is the central atom in the chlorophyll molecule, essential for capturing light energy, but not for splitting water.
(B) Copper (Cu): It is a component of plastocyanin, an electron carrier protein that transfers electrons from cytochrome b6f complex to PS I.
(D) Molybdenum (Mo): It is a component of enzymes like nitrate reductase and nitrogenase, involved in nitrogen metabolism.

Step 3: Final Answer
Manganese (Mn) is the essential micronutrient required for the enzymatic splitting of water in photosynthesis. Therefore, option (C) is correct.

Quick Tip

Create a list matching essential micronutrients to their key functions in plants. For example: Mn → Photolysis of water; Zn → Auxin synthesis; Mo → Nitrogen fixation; B → Pollen germination. This is a high-yield topic for exams.

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

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

Correct Answer: (C) Habitat loss and fragmentation

Solution:

Step 1: Understanding the Question
The question asks to identify the most significant driver of species extinction among the four major causes collectively known as 'The Evil Quartet'.

Step 2: Detailed Explanation
'The Evil Quartet' is a term used to describe the four main human-caused drivers of biodiversity loss:

1. **Habitat loss and fragmentation:** This involves the destruction or division of natural habitats (e.g., deforestation, urbanization, conversion to agriculture). It is widely regarded by ecologists as the single greatest threat to biodiversity globally. When an organism's home is destroyed or broken into small, isolated patches, its populations decline, and it becomes vulnerable to extinction.
2. **Over-exploitation:** This refers to harvesting species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting). It is a major threat to many large animals and commercially valuable species.
3. **Alien species invasions:** The introduction of non-native species into an ecosystem can disrupt food webs, outcompete native species for resources, and introduce diseases, leading to the decline and extinction of native species.
4. **Co-extinctions:** This occurs when the extinction of one species causes the extinction of another species that depended on it (e.g., a specialist parasite losing its only host).

While all four are serious threats, habitat loss and fragmentation affects the largest number of species across all taxa and is the primary cause of the current extinction crisis.

Step 3: Final Answer
Among the four major causes of biodiversity loss, habitat loss and fragmentation is considered the most important driver of species extinction. Thus, option (C) is correct.

Quick Tip

When thinking about threats to biodiversity, always consider habitat loss as the number one factor. The other threats often exacerbate the problem created by a shrinking and fragmented habitat.

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

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

Correct Answer: (B) Active Transport

Solution:

Step 1: Understanding the Question
The key phrase in the question is "against their concentration gradient". This means moving substances from an area of lower concentration to an area of higher concentration. We need to identify the transport mechanism that allows this.

Step 2: Detailed Explanation
Let's define the different types of membrane transport:
(A) Passive Transport: The movement of substances across a membrane **down** the concentration gradient (from high to low concentration). It does not require metabolic energy.
(C) Osmosis: A specific type of passive transport involving the movement of water across a semipermeable membrane down its water potential gradient.
(D) Facilitated Diffusion: A type of passive transport where substances move down the concentration gradient with the help of membrane proteins (channels or carriers). It does not require energy.
(B) Active Transport: The movement of substances across a membrane **against** their concentration gradient (from low to high concentration). This process is like moving something "uphill" and requires carrier proteins and the expenditure of metabolic energy, typically in the form of ATP.

The accumulation of ions against a gradient is a hallmark of active transport.

Step 3: Final Answer
The movement of ions against a concentration gradient requires energy and is defined as Active Transport. Therefore, option (B) is the correct answer.

Quick Tip

Remember the key distinction: **Passive** = Downhill, no energy. **Active** = Uphill, requires energy (ATP). The phrase "against the concentration gradient" is a direct indicator of active transport.

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

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

Correct Answer: (D) Dedifferentiation

Solution:

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

Step 2: Detailed Explanation
Let's define the relevant terms:
Differentiation: The process by which cells become specialized in structure and function (e.g., a meristematic cell becomes a mesophyll cell).
Dedifferentiation: The process by which mature, differentiated cells lose their specialization and revert to a meristematic state, regaining the capacity for cell division. This is exactly what happens when a mesophyll cell (a differentiated cell) is placed on a suitable nutrient medium and forms a callus (an undifferentiated mass of cells).
Redifferentiation: The process where dedifferentiated cells (like those in a callus) divide and differentiate again to form new specialized cells, tissues, and organs, eventually forming a new plantlet.
Senescence: The process of aging in cells or organisms.

The phenomenon described in the question is the reversal of differentiation.

Step 3: Final Answer
The conversion of differentiated mesophyll cells into an undifferentiated callus is known as dedifferentiation. Therefore, option (D) is the correct answer.

Quick Tip

Memorize the sequence of events in micropropagation via callus formation: 1. **Explant** (differentiated tissue) 2. **Dedifferentiation** $\rightarrow$ **Callus** (undifferentiated) 3. **Redifferentiation** $\rightarrow$ **Plantlet** (differentiated organs)

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

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

Correct Answer: (D) Pachytene

Solution:

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

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 structures called bivalents.
3. **Pachytene:** This is a relatively long stage where the paired homologous chromosomes (bivalents) are clearly visible as tetrads. During this stage, **crossing over** occurs. This is the exchange of genetic material between non-sister chromatids of homologous chromosomes. The sites where crossing over occurs are marked by the appearance of protein complexes called **recombination nodules**.
4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate, except at the sites of crossing over. These X-shaped structures are called chiasmata.
5. **Diakinesis:** Chromosomes become fully condensed, and the chiasmata terminalize. The nuclear envelope breaks down.

The appearance of recombination nodules is directly associated with the process of crossing over, which is the characteristic event of the pachytene stage.

Step 3: Final Answer
Recombination nodules, the sites of crossing over, appear during the Pachytene substage of Prophase I. Therefore, option (D) is correct.

Quick Tip

Use the mnemonic "Lazy Zebra Pushes Down Donkey" to remember the order of Prophase I substages: Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis. Associate **P**achytene with **P**airing and crossing over.

---

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

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

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

Solution:

Step 1: Analyzing the Statements
We need to evaluate the scientific accuracy of both Statement I and Statement II regarding the effects of transpiration.

Step 2: Evaluation of Statement I
This statement refers to the transpiration pull model, also known as the cohesion-tension theory. This theory explains the ascent of sap in tall trees. The key forces involved are:
- **Cohesion:** Strong mutual attraction between water molecules.
- **Adhesion:** Attraction of water molecules to the polar surfaces of xylem vessels.
- **Tension (Transpiration Pull):** A negative pressure potential created in the xylem as water evaporates from the leaves.
These properties give water high tensile strength, allowing it to form an unbroken column that can be pulled up from the roots to the top of the tallest trees. The tallest trees, like the Coast Redwood (Sequoia sempervirens), can exceed 115 meters. The transpiration pull is strong enough to lift water to these heights and even higher (theoretically up to several hundred meters), so lifting it over 130 meters is physically possible. **Therefore, Statement I is correct.**

Step 3: Evaluation of Statement II
This statement describes the cooling effect of transpiration. When water changes from a liquid to a gas (evaporation) on the leaf surface, it absorbs a significant amount of energy from the leaf. This is called the latent heat of vaporization. This loss of heat energy cools the leaf surface, preventing it from getting damaged by high temperatures, especially under intense sunlight. A cooling effect of 10 to 15 degrees Celsius is a well-documented and accepted phenomenon. **Therefore, Statement II is also correct.**

Step 4: Final Answer
Since both Statement I and Statement II are factually correct, the correct option is (C).

Quick Tip

Remember the dual importance of transpiration: it's the 'engine' that pulls water and minerals up the plant (ascent of sap), and it's the plant's 'air conditioner' that prevents leaves from overheating.

---

120. Axile placentation is observed in

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

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

Solution:

Step 1: Understanding the Question
The question asks to identify the group of plants from the given options that all exhibit axile placentation. Placentation refers to the arrangement of ovules within the ovary.

Step 2: Defining Axile Placentation
In axile placentation, the ovary is partitioned by septa into two or more chambers (locules). The placenta is located on the central axis where the septa meet, and the ovules are attached to this central axis within each locule.

Step 3: Analyzing the Options
Let's determine the type of placentation for each plant in the options:
(A) Tomato, Dianthus and Pea:
- Tomato: Axile placentation.
- Dianthus: Free-central placentation.
- Pea: Marginal placentation.
This option is incorrect as it contains three different types.

(B) China rose, Petunia and Lemon:
- China rose (Hibiscus): Axile placentation.
- Petunia (from Solanaceae family): Axile placentation.
- Lemon (Citrus): Axile placentation.
This option is correct as all three plants show axile placentation.

(C) Mustard, Cucumber and Primrose:
- Mustard: Parietal placentation.
- Cucumber: Parietal placentation.
- Primrose: Free-central placentation.
This option is incorrect.

(D) China rose, Beans and Lupin:
- China rose: Axile placentation.
- Beans (like Pea): Marginal placentation.
- Lupin: Marginal placentation.
This option is incorrect.

Step 4: Final Answer
The only group where all plants listed exhibit axile placentation is China rose, Petunia, and Lemon. Therefore, option (B) is the correct answer.

Quick Tip

To master placentation, associate each type with a common fruit or vegetable you can visualize: - **Axile:** Sliced tomato or lemon. - **Marginal:** Pea pod. - **Parietal:** Sliced cucumber or papaya. - **Free-central:** Primrose flower. - **Basal:** Sunflower seed in the head.

---

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

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

Correct Answer: (A) Anaphase II

Solution:

Step 1: Understanding the Question
The question asks to identify the specific stage in the meiotic process where the centromeres split.

Step 2: Differentiating Meiosis I and Meiosis II
Meiosis consists of two successive divisions, Meiosis I and Meiosis II.
Meiosis I (Reductional Division): The primary event in Anaphase I is the separation of **homologous chromosomes**. The sister chromatids of each chromosome remain attached at their centromeres. Thus, the centromeres do **not** divide in Meiosis I.
Meiosis II (Equational Division): This division is very similar to mitosis. In Metaphase II, individual chromosomes (each consisting of two sister chromatids) align at the equatorial plate. In **Anaphase II**, the centromere of each chromosome finally divides, allowing the **sister chromatids** to separate and move to opposite poles. These separated chromatids are now considered individual chromosomes.

Step 3: Analyzing the Stages
- **Metaphase I:** Homologous pairs align; centromeres do not divide.
- **Metaphase II:** Individual chromosomes align; centromeres do not divide yet.
- **Anaphase II:** Centromeres divide, and sister chromatids separate.
- **Telophase:** Division is nearly complete; this phase follows the separation of chromatids.

Step 4: Final Answer
The division of the centromere, which leads to the separation of sister chromatids, occurs during Anaphase II. Therefore, option (A) is correct.

Quick Tip

A key difference to remember: - **Anaphase I** separates **homologous chromosomes**. - **Anaphase II** separates **sister chromatids** (due to centromere division). This distinction is fundamental to understanding meiosis.

---

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

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

Correct Answer: (A) Alfred Sturtevant

Solution:

Step 1: Understanding the Question
The question asks to identify the scientist who first proposed and used the frequency of genetic recombination to determine the relative distances between genes on a chromosome, a technique known as gene mapping.

Step 2: Reviewing the Contributions of the Scientists
(D) Sutton and Boveri: They independently proposed the **Chromosomal Theory of Inheritance** around 1902, stating that genes are located on chromosomes.
(B) Henking: In 1891, while studying spermatogenesis, he observed a specific nuclear structure which he named the X body. This was later identified as the X chromosome.
(C) Thomas Hunt Morgan: Working with fruit flies (Drosophila melanogaster), he provided experimental proof for the Chromosomal Theory of Inheritance. He discovered concepts like linkage (genes on the same chromosome tend to be inherited together) and recombination (crossing over can break linkages). His work laid the foundation for gene mapping.
(A) Alfred Sturtevant: He was a student in T.H. Morgan's lab. In 1913, he had the crucial insight that the **frequency** of recombination between linked genes was a function of their physical distance from each other on the chromosome. He used recombination data to construct the very first **genetic linkage map**.

Step 3: Final Answer
While Morgan's work was foundational, it was his student, Alfred Sturtevant, who first used recombination frequencies as a measure of distance to create a gene map. Therefore, option (A) is the correct answer.

Quick Tip

Associate the scientists with their key "firsts": - **Sutton & Boveri:** First to propose the Chromosomal Theory. - **Morgan:** First to experimentally prove linkage and recombination in Drosophila. - **Sturtevant:** First to create a genetic map using recombination frequency.

---

123. Cellulose does not form blue colour with Iodine because

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

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

Solution:

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

Step 2: Detailed Explanation
The iodine test is specific for the presence of starch. The principle behind this test lies in the structure of the polysaccharide.
Starch: Starch consists of two components, amylose and amylopectin. Amylose is an unbranched polymer of α-glucose units linked by α-1,4 glycosidic bonds. This structure causes the amylose chain to form a complex helical (coiled) shape. Iodine molecules (specifically, the I_3^- and I_5^- ions in the iodine solution) can fit inside this helix, forming a starch-iodine complex. This complex absorbs light, resulting in the characteristic blue-black colour.
Cellulose: Cellulose is a polymer of β-glucose units linked by β-1,4 glycosidic bonds. This type of linkage results in a straight, linear chain rather than a helix. The chains are arranged parallel to each other and are held by extensive hydrogen bonds, forming strong microfibrils. Because cellulose does not have the complex helical structure of amylose, it cannot trap or hold iodine molecules to form the colored complex.

Analyzing the options:
(A) This correctly states that cellulose lacks complex helices and thus cannot hold iodine.
(B) Cellulose is a very stable polymer and does not break down upon reaction with iodine.
(C) Cellulose is a polysaccharide, not a disaccharide.
(D) Cellulose is a linear, uncoiled molecule, not helical.

Step 3: Final Answer
The absence of a helical structure in cellulose prevents the formation of an iodine complex, so

it does not turn blue. Thus, option (A) is correct.

Quick Tip

Remember the key structural difference: Starch (α-glucose) = Helical = Traps Iodine = Blue colour. Cellulose (β-glucose) = Linear = No trapping = No blue colour. This structural difference also explains why humans can digest starch but not cellulose.

---

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

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

Correct Answer: (A) Tungsten or gold

Solution:

Step 1: Understanding the Question
The question asks to identify the metals used as microparticles in the gene gun method for genetic transformation.

Step 2: Detailed Explanation
The gene gun method, also known as biolistics or microprojectile bombardment, is a direct method of gene transfer, primarily used for transforming plant cells.
Principle: The method involves coating microscopic particles of a heavy metal with the desired DNA (the "alien" DNA or transgene). These DNA-coated microparticles are then accelerated to a high velocity and fired into the target host cells or tissues. The particles penetrate the cell walls and membranes, carrying the DNA into the cell's interior, where it can be incorporated into the host genome.
Choice of Metal: The microparticles must be dense enough to achieve the necessary momentum to penetrate the cell wall, but also small enough not to cause excessive damage. Most importantly, they must be biologically inert so they don't cause a toxic reaction within the cell. **Gold (Au)** and **Tungsten (W)** fit these criteria perfectly. They are very dense and chemically non-reactive. Silver, copper, and zinc are generally too reactive or toxic to be used for this purpose.

Step 3: Final Answer
Gold and tungsten are the standard metals used for coating with DNA in the gene gun method. Therefore, option (A) is the correct answer.

Quick Tip

Associate "gene gun" with "golden bullets". This mnemonic helps to remember that gold is one of the primary metals used, along with tungsten, for the microprojectiles in biolistics.

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

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

Correct Answer: (D) Selaginella and Salvinia

Solution:

Step 1: Understanding the Question
The question requires identifying a pair of pteridophytes that are both heterosporous.

Step 2: Detailed Explanation
Pteridophytes are classified based on the types of spores they produce:
Homosporous Pteridophytes: These plants produce only one type of spore, which grows into a bisexual (monoecious) gametophyte that bears both antheridia and archegonia. The majority of pteridophytes are homosporous. Examples include Psilotum, Lycopodium, and Equisetum.
Heterosporous Pteridophytes: These plants produce two distinct types of spores: smaller microspores and larger megaspores. Microspores germinate to form male gametophytes, and megaspores germinate to form female gametophytes. This condition is a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples of heterosporous pteridophytes are Selaginella, Salvinia, Azolla, and Marsilea.

Analyzing the options:
(A) Psilotum is homosporous, Salvinia is heterosporous.
(B) Equisetum is homosporous, Salvinia is heterosporous.
(C) Lycopodium is homosporous, Selaginella is heterosporous.
(D) Selaginella is heterosporous, and Salvinia is also heterosporous.

Step 3: Final Answer
Both Selaginella and Salvinia are examples of heterosporous pteridophytes. Therefore, option (D) is the correct pair.

Quick Tip

For exams, remember the main examples for each category. A good mnemonic for heterosporous pteridophytes is "Selaginella, Salvinia, Azolla, Marsilea". Most other common pteridophytes like Pteris, Dryopteris, Equisetum, and Lycopodium are homosporous.

---

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

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

Correct Answer: (D) Alfred Hershey and Martha Chase

Solution:

Step 1: Understanding the Question
The question asks to identify the scientists who provided the definitive or "unequivocal" proof that DNA is the substance of heredity.

Step 2: Detailed Explanation
The discovery of DNA as the genetic material was a gradual process with contributions from several scientists:
(C) Frederick Griffith (1928): His "transforming principle" experiment with *Streptococcus pneumoniae* showed that a substance from dead pathogenic bacteria could transform living non-pathogenic bacteria, but he did not identify the substance.
(A) Avery, Macleod, and McCarthy (1944): They expanded on Griffith's work and showed through systematic experiments using enzymes (proteases, RNases, DNases) that the transforming principle was DNA. This was strong evidence, but not universally accepted, as some scientists still believed that protein contaminants might be responsible.
(D) Alfred Hershey and Martha Chase (1952): They conducted the famous "blender experiment" using bacteriophages (viruses that infect bacteria). They used radioactive isotopes to label the two main components of the virus:
- **Protein coat** was labeled with radioactive sulfur (^{35}S), as sulfur is present in proteins but not DNA.
- **DNA core** was labeled with radioactive phosphorus (^{32}P), as phosphorus is present in DNA but not proteins.
They found that only the radioactive phosphorus (^{32}P) entered the bacterial cells, while the radioactive sulfur (^{35}S) remained outside. Since the bacteria produced new viruses, it was the DNA that must have carried the genetic information. This experiment provided the clear, unambiguous, and unequivocal proof that DNA is the genetic material.
(B) Wilkins and Franklin: They were instrumental in determining the structure of DNA using X-ray diffraction, which was crucial for Watson and Crick's model, but they did not

conduct experiments to prove it was the genetic material.

Step 3: Final Answer
The Hershey-Chase experiment is considered the conclusive evidence that established DNA as the genetic material. Therefore, option (D) is correct.

Quick Tip

Remember the progression of discovery: Griffith showed *something* transformed bacteria. Avery et al. showed it was *probably* DNA. Hershey and Chase showed it was *definitively* DNA by tracking radio-labeled components.

---

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

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

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

Solution:

Step 1: Understanding the Question
The question asks for the total number of ATP and $NADPH_2$ molecules required to produce 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). We need to calculate the energy requirement for 6 turns of the Calvin cycle.

Step 3: Detailed Explanation
The Calvin cycle has three main stages:
1. Carboxylation: 1 CO_2 combines with 1 RuBP. No energy is used here.
2. Reduction: In this stage, the product of carboxylation (2 molecules of 3-PGA) is reduced to 2 molecules of triose phosphate (G3P). This process requires energy for each molecule of CO_2 fixed:
- 2 ATP are used for phosphorylation.
- 2 $NADPH_2$ are used for reduction.
3. Regeneration: To regenerate the initial CO_2 acceptor (RuBP) from the triose phosphates, more energy is required. For each molecule of CO_2 fixed:
- 1 ATP is used.

Calculation for 1 turn (1 CO_2):
- Total ATP used = 2 (from Reduction) + 1 (from Regeneration) = **3 ATP**
- Total $NADPH_2$ used = **2 $NADPH_2$** (from Reduction)

Calculation for 6 turns (to produce 1 Glucose):
To synthesize one molecule of glucose (C_6), the cycle must fix 6 molecules of CO_2. Therefore, we multiply the requirements for one turn by 6:
- Total ATP = 6 turns × 3 ATP/turn = **18 ATP**
- Total $NADPH_2$ = 6 turns × 2 $NADPH_2$/turn = **12 $NADPH_2$**

Step 4: Final Answer
The synthesis of one molecule of glucose requires 18 ATP and 12 $NADPH_2$. Therefore, option (D) is the correct answer.

Quick Tip

For a quick check, remember the ratio for one CO_2 fixed is 3 ATP : 2 $NADPH_2$. To make a 6-carbon glucose, multiply by 6, which gives 18 ATP : 12 $NADPH_2$.

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

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

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

Solution:

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

Step 2: Detailed Explanation
Let's analyze each statement:

A. Detrivores perform fragmentation. This is **correct**. Fragmentation is the physical breakdown of large pieces of dead organic matter (detritus) into smaller particles. This is done by detritivores like earthworms and termites, which increases the surface area for microbial action.
B. The humus is further degraded by some microbes during mineralization. This is **correct**. Humus is a dark, amorphous, colloid-like substance that is highly resistant to microbial action and decomposes very slowly. The slow process by which microbes eventually degrade humus to release inorganic nutrients is called mineralization.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching. This statement is largely **correct**. Leaching is the process where water-soluble nutrients percolate down through the soil profile and can become unavailable to plants. The term "precipitated" might be slightly imprecise in some contexts, but the core idea of nutrients moving down into the soil is correct.
D. The detritus food chain begins with living organisms. This is **incorrect**. The detritus food chain (DFC) begins with dead organic matter (detritus). The grazing food chain (GFC) begins with living organisms (producers).
E. Earthworms break down detritus into smaller particles by a process called catabolism. This is **incorrect**. Earthworms break down detritus by **fragmentation**. Catabolism is the enzymatic breakdown of complex organic matter into simpler inorganic substances by decomposer organisms like bacteria and fungi.

Step 3: Final Answer
Statements A, B, and C are correct, while D and E are incorrect. Therefore, the correct option is (C) A, B, C only.

Quick Tip

Remember the key steps in decomposition: 1. **Fragmentation** (physical breakdown by detritivores). 2. **Leaching** (water-soluble nutrients move down). 3. **Catabolism** (enzymatic breakdown by microbes). 4. **Humification** (formation of humus). 5. **Mineralization** (release of inorganic nutrients from humus).

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

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

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

Solution:

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

Step 2: Detailed Explanation
Let's determine the ploidy level of the key structures in an angiosperm embryo sac after fertilization:
Haploid (n) structures: Before fertilization, the egg cell, synergids, and antipodal cells are all haploid. After fertilization, the synergids and antipodals typically degenerate, but they are still considered haploid structures of the embryo sac.
Diploid (2n) structures: The **zygote** is the primary diploid structure, formed by the fusion of one male gamete (n) with the egg cell (n). It develops into the embryo.
Triploid (3n) structures: The **Primary Endosperm Nucleus (PEN)** is the primary triploid structure. It is formed by the fusion of the second male gamete (n) with the diploid central cell (which contains two polar nuclei, n + n). The PEN develops into the endosperm, which provides nourishment to the developing embryo.

Now let's evaluate the options based on the required sequence (haploid, diploid, triploid):
(A) **Synergids (n), Zygote (2n), Primary endosperm nucleus (3n).** This sequence matches the n, 2n, 3n pattern correctly.
(B) Synergids (n), antipodals (n), Polar nuclei (n+n, so diploid before fusion). This is not the correct sequence.
(C) Synergids (n), Primary endosperm nucleus (3n), zygote (2n). The order is incorrect.
(D) Antipodals (n), synergids (n), primary endosperm nucleus (3n). This does not follow the n, 2n, 3n pattern.

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

Quick Tip

Remember the "double fertilization" process: - 1st fertilization: Male gamete (n) + Egg (n) $\rightarrow$ Zygote (2n) - 2nd fertilization: Male gamete (n) + Central Cell (2n) $\rightarrow$ PEN (3n) This is the source of the diploid and triploid structures. Any remaining cells of the original embryo sac (synergids, antipodals) are haploid.

---

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

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

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

Solution:

Step 1: Understanding the Statements
The question presents an Assertion (A) stating that ATP is consumed at two points in glycolysis, and a Reason (R) that specifies these two points. We must evaluate their accuracy and relationship.

Step 2: Detailed Explanation
Assertion A: ATP is used at two steps in glycolysis.
This statement is **true**. Glycolysis is divided into a preparatory (investment) phase and a payoff phase. During the preparatory phase, the cell invests two molecules of ATP to activate the glucose molecule.

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 analyze the two parts of this reason: 1. The first ATP is indeed used to phosphorylate glucose to glucose-6-phosphate, a reaction catalyzed by hexokinase. This part is correct. 2. The second ATP is used to phosphorylate fructose-6-phosphate to fructose-1,6-bisphosphate, catalyzed by phosphofructokinase.
Connecting A and R:
Since Assertion A is true but Reason R is also true due the correct choice is that A is true but R is the correct explanation of A.

Quick Tip

Pay close attention to biochemical terminology. The difference between "bisphosphate" (two separate phosphate groups) and "diphosphate" (two linked phosphate groups, like in ADP) can be the key to a correct answer in questions on metabolic pathways.

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131. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

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

Step 2: Detailed Explanation
Expressed Sequence Tags (ESTs) are short, single-pass sequence reads derived from Complementary DNA (cDNA) libraries.
1. To generate a cDNA library, messenger RNA (mRNA) is first isolated from a cell. mRNA represents the genes that are actively being transcribed, or "expressed."
2. The enzyme reverse transcriptase is used to synthesize a single-stranded DNA molecule complementary to the mRNA template. This is cDNA.
3. Short fragments of these cDNAs are sequenced to generate ESTs.
Therefore, ESTs are tags or identifiers for genes that are expressed as RNA (specifically, mRNA) in a given tissue at a given time.

Analyzing the options:
(A) This is incorrect. ESTs only represent expressed genes, not unexpressed ones.
(B) This is incorrect. ESTs are generated from the entire mRNA population, not just "certain important" genes.
(C) This is the most accurate description. ESTs represent all genes that are transcribed into RNA.
(D) This is incorrect. While many RNAs are translated into proteins, not all are (e.g., non-coding RNAs). ESTs represent the RNA transcript itself, not the final protein product.

Step 3: Final Answer
ESTs are sequences derived from mRNA, so they represent all genes that are expressed as RNA. Thus, option (C) is correct.

Quick Tip

Remember that ESTs come from cDNA, and cDNA is made from mRNA. The 'E' in EST stands for "Expressed," which means the gene is transcribed into RNA. This directly links ESTs to genes expressed as RNA.

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

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

Correct Answer: (D) S phase

Solution:

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

Step 2: Detailed Explanation
The eukaryotic cell cycle is divided into two main stages: Interphase and M phase (Mitotic phase). Interphase is further subdivided into three phases:
G_1 phase (Gap 1): This is the phase of cell growth where the cell synthesizes proteins and organelles. The cell is metabolically active, but DNA does not replicate.
S phase (Synthesis phase): This is the specific phase where DNA replication takes place. The amount of DNA in the cell doubles, but the chromosome number remains the same (each chromosome now consists of two sister chromatids).
G_2 phase (Gap 2): The cell continues to grow and synthesizes proteins and organelles in preparation for mitosis.
M phase (Mitotic phase): This is the phase where the cell divides its nucleus (mitosis) and cytoplasm (cytokinesis) to form two daughter cells.

Step 3: Final Answer
DNA replication is the defining event of the S phase. Therefore, option (D) is the correct answer.

Quick Tip

Remember the cell cycle phases in order: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$. Associate 'S' with 'Synthesis' of DNA. This is a fundamental concept in cell biology.

---

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

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

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

Solution:

Step 1: Analyzing the Statements
We need to evaluate the correctness of two statements regarding xylem development patterns.

Step 2: Evaluation of Statement I
The terms 'endarch' and 'exarch' describe the pattern of development of **primary xylem**, not secondary xylem.
- **Endarch:** The protoxylem (first-formed primary xylem) is located towards the center (pith), and the metaxylem (later-formed primary xylem) is towards the periphery. This is characteristic of stems.
- **Exarch:** The protoxylem is located towards the periphery, and the metaxylem is towards the center. This is characteristic of roots.
Secondary xylem is formed by the vascular cambium and does not follow these developmental patterns. Therefore, **Statement I is incorrect**.

Step 3: Evaluation of Statement II
This statement claims that the exarch condition is the most common feature of the root system. As explained above, the arrangement of primary xylem in roots where the protoxylem is on the outer side and metaxylem is on the inner side is called the exarch condition. This is a defining characteristic of roots in dicots and monocots. Therefore, **Statement II is true**.

Step 4: Final Answer
Statement I is incorrect, and Statement II is true. This corresponds to option (B).

Quick Tip

Remember the association: **Ex**arch is in roots (think **ex**it, outside), and **En**darch is in stems (think **en**ter, inside). These terms apply only to primary xylem.

---

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

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

Correct Answer: (C) insect pollinated plants

Solution:

Step 1: Understanding the Question
The question describes a set of floral characteristics (large size, colourful, fragrant, nectar-producing) and asks to identify the corresponding pollination agent. This relates to the concept of pollination syndromes.

Step 2: Detailed Explanation
Different pollination agents are attracted by different floral features:
(A) Bat pollinated plants (Chiropterophily): Flowers are typically large but pale or dull-coloured, open at night, and emit a strong, musty or fermented fruit-like odour. They produce copious nectar.
(B) Wind pollinated plants (Anemophily): Flowers are small, inconspicuous, lack colour, fragrance, and nectar. They are adapted to produce and release large quantities of lightweight pollen.
(C) Insect pollinated plants (Entomophily): Flowers have evolved to attract insects. The combination of being **large** (to be visible), **colourful** (to attract visually), **fragrant** (to attract by smell), and producing **nectar** (as a food reward) is the classic suite of adaptations for insect pollination.
(D) Bird pollinated plants (Ornithophily): Flowers are often large and brightly coloured (especially red and orange), but they typically lack a strong scent as birds have a poor sense of smell. They produce abundant, dilute nectar.

The combination of all four traits listed in the question is most characteristic of insect-pollinated plants.

Step 3: Final Answer
The set of features described perfectly matches the adaptations for attracting insects. Therefore, option (C) is the correct answer.

Quick Tip

Create a table to remember pollination syndromes. Key columns should be: Pollinator (Wind, Insect, Bird, Bat), Flower Size, Colour, Scent, and Nectar. This helps in quickly answering such questions.

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

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

Correct Answer: (A) Ethylene

Solution:

Step 1: Understanding the Question
The question asks to identify the plant hormone responsible for promoting the rapid elongation of internodes or petioles in deep-water rice varieties when they are submerged.

Step 2: Detailed Explanation
Deep-water rice has a remarkable adaptation to survive flooding. When the plant is submerged, the gaseous hormone **ethylene** accumulates in the submerged plant parts because its diffusion out of the plant is blocked by water.
This increased concentration of ethylene triggers a physiological response. It enhances the sensitivity of the cells to gibberellic acid (GA) or promotes GA synthesis, which in turn causes rapid cell division and elongation in the internodes and petioles. This allows the leaves to quickly reach the water surface to continue photosynthesis and gas exchange.
While GA_3 (a gibberellin) is the hormone that directly causes the elongation, ethylene is the primary signal or promoter of this response specifically in the context of submergence in deep-water rice. Given the options, ethylene is the most accurate answer for the hormone that "promotes" this specific adaptive phenomenon.

Step 3: Final Answer
Ethylene is the key hormone that accumulates during submergence and promotes the elongation response in deep-water rice. Thus, option (A) is correct.

Quick Tip

Remember ethylene as the "stress" hormone in some contexts. In deep-water rice, the stress of submergence leads to ethylene accumulation, which triggers the escape mechanism (rapid elongation).

---

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

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

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

Solution:

Step 1: Understanding the Statements
The question presents an Assertion (A) defining a flower and a Reason (R) explaining the

structural modification. We need to evaluate both statements and their relationship.

Step 2: Detailed Explanation
Assertion A: "A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem." This is the correct and standard botanical definition of a flower. The transition from a vegetative phase to a reproductive phase involves the transformation of the shoot apical meristem into a floral meristem, which has determinate growth. So, **Assertion A is true**.
Reason R: "Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves." This statement accurately describes the modification process. The floral axis, or thalamus, is essentially a shoot with highly condensed internodes. The floral whorls (sepals, petals, stamens, and carpels) are homologous to leaves and are arranged at these closely packed nodes. So, **Reason R is also true**.

Connecting A and R:
The Reason (condensation of internodes and production of floral appendages instead of leaves) explains exactly why a flower is considered a modified shoot (the Assertion). It details the structural changes that occur when a shoot apex becomes a floral apex. Therefore, **Reason R is the correct explanation of Assertion A**.

Step 3: Final Answer
Both A and R are true, and R correctly explains A. Therefore, option (C) is the correct answer.

Quick Tip

Evidence for the "flower as a modified shoot" theory includes that floral parts sometimes revert to leaf-like structures (phyllody) and that the thalamus is essentially a stem with nodes and condensed internodes.

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137. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

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

Step 2: Detailed Matching
A. M Phase: This is the mitotic phase where the cell divides. Mitosis is known as **equational division** because the daughter cells have the same number of chromosomes as the parent cell. Thus, **A matches with IV**.
B. G_2 Phase: This is the second gap phase, occurring after DNA synthesis (S phase) and before mitosis (M phase). During this phase, the cell continues to grow, and crucial **proteins are synthesized**, such as tubulin for the mitotic spindle. Thus, **B matches with I**.
C. Quiescent stage (G_0): This is a state where cells exit the cell cycle and stop dividing. They are metabolically active but are in an **inactive phase** with respect to proliferation. Thus, **C matches with II**.
D. G_1 Phase: This is the first gap phase, which is the **interval between** the end of **mitosis** (M phase) and the **initiation of DNA replication** (S phase). Thus, **D matches with III**.

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

Quick Tip

Draw the cell cycle diagram (a circle with G_1, S, G_2, M phases) and label the key event of each phase. This visual aid makes matching questions much easier to solve. G_0 is an exit from the G_1 phase.

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

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

Correct Answer: (C) 80

Solution:

Step 1: Understanding the Question
The question asks for the approximate number of different proteins found in a ribosome. As it does not specify prokaryotic or eukaryotic, we consider the most common context in general biology, which is the eukaryotic ribosome.

Step 2: Detailed Explanation
Ribosomes are complex molecular machines made of ribosomal RNA (rRNA) and ribosomal proteins.
Eukaryotic Ribosome (80S): It is composed of two subunits:
- **Large Subunit (60S):** Contains 3 types of rRNA molecules and approximately 49 different proteins.
- **Small Subunit (40S):** Contains 1 type of rRNA molecule and approximately 33 different proteins.
The total number of different proteins in an 80S eukaryotic ribosome is therefore approximately 49 + 33 = 82 proteins.

Prokaryotic Ribosome (70S): For comparison, it consists of:
- Large Subunit (50S): 34 proteins.
- Small Subunit (30S): 21 proteins.
Total proteins are approximately 55.

Looking at the options, the value '80' is a very close approximation for the number of proteins in a eukaryotic ribosome.

Step 3: Final Answer
A eukaryotic ribosome is composed of approximately 80 different proteins. Thus, option (C) is the correct answer.

Quick Tip

For questions on ribosomes, remember the Svedberg units and composition. Eukaryotes: 80S = 60S + 40S, with 80 proteins. Prokaryotes: 70S = 50S + 30S, with 55 proteins. The numbers don't add up arithmetically because Svedberg units are a measure of sedimentation rate, not mass.

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

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

Correct Answer: (4) 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 effects on aquatic ecosystems.

Step 2: Detailed Explanation
Let's analyze each statement:
(1) **Water hyacinth in eutrophic water bodies:** This statement is correct. Eutrophic water bodies are rich in nutrients, which promotes the excessive growth of aquatic plants like water hyacinth. This leads to an imbalance in the ecosystem.
(2) **Biomagnification:** This statement describes biomagnification (or bioaccumulation), where the concentration of toxic substances (like heavy metals or pesticides) increases at successive trophic levels in a food chain. This is a correct phenomenon.
(3) **Biodegradation and Oxygen Depletion:** This statement is correct. When sewage with a high amount of organic matter is discharged into a water body, decomposer microorganisms break it down. This process consumes a large amount of dissolved oxygen, leading to a sharp drop in oxygen levels (measured as high Biological Oxygen Demand or BOD). The lack of oxygen can cause the death of fish and other aquatic organisms.
(4) **Algal Blooms:** This statement is incorrect. Algal blooms are caused by an excess of nutrients (like nitrates and phosphates), not primarily organic matter, in the water. These blooms drastically deteriorate water quality. When the algae die, they are decomposed by bacteria, which consumes a large amount of dissolved oxygen, leading to hypoxia or anoxia and the death of fish. Therefore, algal blooms harm fisheries, not promote them, and degrade water quality.

Step 3: Final Answer
The statement that algal blooms improve water quality and promote fisheries is factually incorrect. Hence, option (4) is the correct answer.

Quick Tip

Remember the key consequences of eutrophication: excessive plant/algal growth, increased BOD, oxygen depletion, and death of aquatic animals. Algal blooms are a clear indicator of poor water quality.

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

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

Correct Answer: (3) membrane, proton pump, proton gradient, ATP synthase

Solution:

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

Step 2: Key Concepts
Chemiosmosis is the mechanism by which ATP is produced during cellular respiration and photosynthesis. It involves the movement of ions (specifically protons or H^+) across a selectively permeable membrane, down their electrochemical gradient. This process is described by Peter Mitchell's chemiosmotic theory.

Step 3: Detailed Explanation
The key components for chemiosmosis are:
1. **A membrane:** A semipermeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is essential to establish and maintain a concentration gradient of protons.
2. **A proton pump:** This is a mechanism to actively transport protons across the membrane, from a region of low concentration to a region of high concentration. This is typically achieved by the electron transport chain (ETC), which uses the energy from electrons to pump H^+.
3. **A proton gradient:** The pumping of protons creates a high concentration of H^+ on one side of the membrane, resulting in a proton motive force (an electrochemical gradient).
4. **ATP synthase:** This is an enzyme complex embedded in the membrane that provides a channel for protons to flow back down their concentration gradient. The energy released from this flow is used by ATP synthase to synthesize ATP from ADP and inorganic phosphate (Pi).

Analyzing the options:
(1) and (2) are incomplete as they miss the essential membrane component required to maintain the gradient.
(3) includes all four necessary components: the membrane, the pump, the resulting gradient, and the enzyme (ATP synthase) that utilizes the gradient.
(4) is incorrect because NADP synthase is not directly involved in chemiosmosis for ATP synthesis; instead, $NADP^+$ reductase is involved in the final step of the light-dependent reactions of photosynthesis to produce NADPH.

Step 4: Final Answer
The correct combination of components required for chemiosmosis is membrane, proton pump, proton gradient, and ATP synthase. Thus, option (3) is the correct answer.

Quick Tip

Think of chemiosmosis like a dam. The membrane is the dam wall, the proton pump is the machinery that fills the reservoir (creating the proton gradient), and the ATP synthase is the turbine through which water flows to generate electricity (ATP).

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141. Match List I with List II:

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

Choose the correct answer from the options given below :

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

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

Solution:

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

Step 2: Detailed Explanation
Let's match each term in List I with its correct definition in List II.

- **A. Cohesion:** This is the property of like molecules sticking to each other due to mutual attraction. For water, it's the attraction among water molecules. This matches with **II. Mutual attraction among water molecules**.

- **B. Adhesion:** This is the property of different molecules or surfaces clinging to one another. In plants, it refers to the attraction of water molecules to the polar surfaces of xylem elements. This matches with **IV. Attraction towards polar surfaces**.

- **C. Surface tension:** This property is a direct result of cohesion. Water molecules at the surface are more strongly attracted to other water molecules in the liquid phase than to the molecules in the air above. This matches with **I. More attraction in liquid phase**.

- **D. Guttation:** This is the process of exudation of water droplets (xylem sap) from the tips or margins of leaves, typically occurring at night when transpiration is low and root pressure is high. It is a form of water loss in the liquid phase. This matches with **III. Water loss in liquid phase**.

Step 3: Final Answer
Based on the matching:
A matches with II.
B matches with IV.

C matches with I.
D matches with III.
This combination corresponds to **A-II, B-IV, C-I, D-III**, which is option (3).

Quick Tip

Remember the 'Co-' in Cohesion means 'together' (like molecules together), and 'Ad-' in Adhesion means 'to' (sticking 'to' a different surface). Guttation is often confused with dew, but guttation is water coming from *inside* the plant, whereas dew is condensation from the atmosphere.

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142. Match List I with List II :

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

Choose the correct answer from the options given below :

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

Correct Answer: (1) 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 match each micronutrient with its correct function.

- **A. Iron (Fe):** Iron is a crucial component of proteins involved in redox reactions, such as cytochromes in the electron transport chain. It is also essential for the formation of chlorophyll and is a key part of the enzyme catalase, being necessary for its activation and function. This matches with **III. Activator of catalase**.

- **B. Zinc (Zn):** Zinc is required for the activity of various enzymes, especially carboxylases. It is also critically needed for the synthesis of auxin, a major plant growth hormone. This matches with **I. Synthesis of auxin**.

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

- **D. Molybdenum (Mo):** Molybdenum is a component of several enzymes, including nitrogenase and nitrate reductase, both of which are critical for nitrogen metabolism in plants. This matches with **II. Component of nitrate reductase**.

Step 3: Final Answer
Based on the matching:
A matches with III.
B matches with I.
C matches with IV.
D matches with II.
This combination corresponds to **A-III, B-I, C-IV, D-II**, which is option (1).

Quick Tip

Create flashcards for essential micronutrients and their key functions. Mnemonics can be helpful, for example: "ZinC for AuXin" and "Molybdenum for Nitrogen metabolism (Nitrate Reductase, Nitrogenase)".

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

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

Correct Answer: (1) Statement I is correct but Statement II is false.

Solution:

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

their correctness.

Step 2: Detailed Explanation
Analysis of Statement I:
Statement I provides a definition of Gause's 'Competitive Exclusion Principle'. This principle posits that when two species compete for the exact same limited resources within a stable environment, one will be more efficient and will eventually outcompete and eliminate the other. This definition is accurate. A classic example is the experiment with two species of *Paramecium*, *P. aurelia* and *P. caudatum*. When grown together, *P. aurelia* outcompeted *P. caudatum*. Thus, **Statement I is correct**.

Analysis of Statement II:
Statement II claims that carnivores are generally more adversely affected by competition than herbivores. This is a generalization that is not universally accepted and is often considered incorrect in ecological theory. Competition can be intense at all trophic levels. Herbivores often face strong competition for limited plant resources, which can be just as, if not more, intense than competition among carnivores for prey. For instance, competition for grazing land among different herbivore species can be very high. Therefore, making a blanket statement that one group is "more adversely affected" is not accurate. Thus, **Statement II is false**.

Step 3: Final Answer
Since Statement I is a correct definition of Gause's principle and Statement II is an incorrect generalization, the correct option is (1).

Quick Tip

Remember Gause's principle as "one niche, one species". However, also be aware of mechanisms that allow coexistence, such as resource partitioning (e.g., MacArthur's warblers feeding in different parts of the same tree), which is an exception to competitive exclusion.

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

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

Correct Answer: (3) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question
The question asks for the enzyme that is inhibited by malonate, leading to the inhibition of bacterial growth. This points towards a specific type of enzyme inhibition.

Step 2: Key Concepts
This question relates to the concept of **competitive enzyme inhibition**. A competitive inhibitor is a molecule that structurally resembles the enzyme's substrate. It competes with the substrate for binding to the active site of the enzyme. By binding to the active site, the inhibitor prevents the substrate from binding, thereby reducing the enzyme's activity.

Step 3: Detailed Explanation

- **Enzyme and Substrate:** The enzyme in question is **succinic dehydrogenase**. It is a key enzyme in the Krebs cycle (citric acid cycle), which is a central metabolic pathway for energy production in aerobic organisms, including many pathogenic bacteria.

- **Substrate:** The natural substrate for succinic dehydrogenase is **succinate**. The enzyme catalyzes the oxidation of succinate to fumarate.

$$\text{Succinate} \xrightarrow{\text{Succinic dehydrogenase}} \text{Fumarate}$$

- **Inhibitor: Malonate** (or malonic acid) has a chemical structure very similar to succinate.

Due to this structural similarity, malonate acts as a competitive inhibitor of succinic dehydrogenase. It binds to the active site of the enzyme but cannot be acted upon. This blocks the active site and prevents succinate from binding. By inhibiting this crucial step in the Krebs cycle, malonate disrupts cellular respiration and ATP production, which in turn inhibits the growth and proliferation of the bacteria.

Step 4: Final Answer
Malonate is a classic competitive inhibitor of the enzyme succinic dehydrogenase. Therefore, option (3) is the correct answer.

Quick Tip

Remember the classic example of competitive inhibition: succinic dehydrogenase is inhibited by its structural analogue, malonate. This is a frequently tested concept in exams.

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145. Identify the correct statements :
A. Lenticels are the lens-shaped openings permitting the exchange of gases.
B. Bark formed early in the season is called hard bark.
C. Bark is a technical term that refers to all tissues exterior to vascular cambium.
D. Bark refers to periderm and secondary phloem.

E. Phellogen is single-layered in thickness.
Choose the correct answer from the options given below :

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

Correct Answer: (4) A and D only

Solution:

Step 1: Understanding the Question
The question asks to identify which of the five given statements about plant anatomy (specifically bark and related structures) are correct.

Step 2: Detailed Explanation
Let's evaluate each statement:

- **Statement A:** Lenticels are indeed lens-shaped pores on the bark of woody plants that allow for the exchange of gases between the internal tissues and the atmosphere. **This statement is correct.**

- **Statement B:** Bark formed early in the season (spring wood) is known as 'soft bark', while bark formed later in the season (autumn wood) is called 'hard bark'. Therefore, this statement is incorrect.

- **Statement C:** While 'bark' is a non-technical term that broadly refers to all tissues outside the vascular cambium, this definition can be considered less precise than statement D. In the context of multiple-choice questions where a more specific correct option exists, the general one might be excluded.

- **Statement D:** Anatomically, bark is composed of the periderm (cork, cork cambium, and secondary cortex) and the secondary phloem. This is a precise and correct definition of bark. **This statement is correct.**

- **Statement E:** Phellogen (cork cambium) is a meristematic tissue. It is generally described as being a single layer of cells, but it can be a few layers thick in some species. Given the definite correctness of A and D, and the ambiguity or potential inaccuracy of B, C, and E in a strict sense, we must choose the best option.

Step 3: Final Answer
Statements A and D are unequivocally correct descriptions used in botany. Statement B is

incorrect. Statements C and E are debatable or less precise. Comparing the options, the combination of the most accurate statements is A and D.
Therefore, option (4) is the correct choice.

Quick Tip

In plant anatomy questions, pay close attention to precise definitions. 'Bark' has both a general and a specific anatomical definition. The specific one (Periderm + Secondary Phloem) is often preferred in exams.

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

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

Correct Answer: (1) A is true but R is false.

Solution:

Step 1: Understanding the Question
The question asks to evaluate an Assertion (A) and a Reason (R) related to pollination and fertilization in gymnosperms.

Step 2: Detailed Explanation
Analysis of Assertion A:
Assertion A states that gymnosperm pollen grains are released from the microsporangium and carried by air currents. This describes anemophily, or wind pollination, which is the characteristic mode of pollination in most gymnosperms (like conifers). So, **Assertion A is true**.

Analysis of Reason R:
Reason R describes the events after pollination. It states that air currents carry the pollen grains to the mouth of the archegonia, and then the male gametes are discharged without the formation of a pollen tube. This is incorrect. In gymnosperms, the pollen grain lands on the micropyle of the ovule (not directly on the archegonium). It then germinates to form a **pollen**

tube, which grows through the nucellus and delivers the non-motile male gametes to the vicinity of the egg cell within the archegonium. The statement "pollen tube is not formed" is a critical error. So, **Reason R is false**.

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

Quick Tip

A key feature of seed plants (gymnosperms and angiosperms) is siphonogamy - the formation of a pollen tube to deliver male gametes. This adaptation eliminated the need for water for fertilization, which was required in bryophytes and pteridophytes.

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

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

Correct Answer: (1) B and E only

Solution:

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

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

- **Statement A:** This is incorrect. Langdon Down described Down's Syndrome (Trisomy 21). Klinefelter's Syndrome was described by Harry Klinefelter in 1942.

- **Statement B:** This is correct. Individuals with Klinefelter's Syndrome are phenotypically male and have overall masculine development. However, the extra X chromosome leads to the expression of some feminine characteristics, such as the development of breasts (gynaecomastia).

- **Statement C:** This is incorrect. Individuals with Klinefelter's Syndrome are often taller than average, not short statured. Short stature is a characteristic of Turner's Syndrome (45, XO).

- **Statement D:** This is incorrect. This description is more characteristic of Down's Syndrome. While some learning disabilities may be present in individuals with Klinefelter's Syndrome, severe retardation of physical, psychomotor, and mental development is not a typical feature.

- **Statement E:** This is correct. The presence of the extra X chromosome leads to underdeveloped testes (testicular atrophy), resulting in low testosterone production and sterility.

Step 3: Final Answer
Based on the analysis, only statements B and E are correct. Therefore, option (1) is the correct answer.

Quick Tip

To avoid confusion between chromosomal disorders, create a summary table. For each syndrome (e.g., Down's, Turner's, Klinefelter's), list the karyotype, key physical features, and effects on development and fertility.

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

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

Correct Answer: (1) C, B, D, A

Solution:

Step 1: Understanding the Question
The question asks to arrange the given steps of creating recombinant DNA in the correct chronological order.

Step 2: Detailed Explanation
Let's break down the logical flow of recombinant DNA technology:
1. **Isolation of Genetic Material (DNA):** The very first step is to isolate the desired DNA (the gene of interest) from the source organism. This corresponds to step **C. Isolation of desired DNA fragment.**
2. **Cutting the DNA:** Once the DNA is isolated, both the gene of interest and the vector DNA (e.g., a plasmid) must be cut with the same restriction enzyme to create complementary "sticky ends". This corresponds to step **B. Cutting of DNA at specific location by restriction enzyme.**
3. **Amplification of Gene of Interest:** To obtain a sufficient quantity of the desired gene for ligation, it is amplified using the Polymerase Chain Reaction (PCR). This step ensures there are many copies of the gene to be inserted into the vectors. This corresponds to step **D. Amplification of gene of interest using PCR.**
4. **Ligation:** The amplified gene of interest is then joined (ligated) with the cut vector DNA using the enzyme DNA ligase. This forms the recombinant DNA molecule. (This step is implicit between D and A).
5. **Transformation/Insertion:** The final step in this sequence is to introduce the recombinant DNA into a suitable host cell (like E. coli) where it can replicate. This process is called transformation. This corresponds to step **A. Insertion of recombinant DNA into the host cell.**

Step 3: Final Answer
The correct sequence of the given steps is C → B → D → A. This matches option (1).

Quick Tip

Remember the acronym "I-C-A-L-I": **I**solation, **C**utting, **A**mplification, **L**igation, **I**nsertion. This covers the main workflow for creating a recombinant organism. (Ligation is not an option here but happens between D and A).

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149. 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-III, B-I, C-II, D-IV

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

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

Solution:

Step 1: Understanding the Question
The question requires matching metabolic processes or reactions from List I with the associated enzyme, pathway, or system from List II.

Step 2: Detailed Explanation
Let's match each item from List I with its correct counterpart in List II.

- **A. Oxidative decarboxylation:** This is a key reaction that links glycolysis to the Krebs cycle. It involves the conversion of pyruvate to acetyl-CoA, a process catalyzed by the **Pyruvate dehydrogenase** complex. This matches with **II**.

- **B. Glycolysis:** This is the initial pathway of glucose breakdown. It is also known as the **EMP pathway**, named after its discoverers Embden, Meyerhof, and Parnas. This 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 process takes place in the **Electron transport system** (ETS). This matches with **III**.

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

Step 3: Final Answer
Based on the matching:
A matches with II.
B matches with IV.
C matches with III.
D matches with I.
This combination corresponds to **A-II, B-IV, C-III, D-I**, which is option (2).

Quick Tip

Associate key enzymes or alternative names with major metabolic pathways. For example, Glycolysis = EMP pathway; Krebs Cycle starts with Citrate Synthase; the Link Reaction is catalyzed by Pyruvate Dehydrogenase; and ATP synthesis via ETS is Oxidative Phosphorylation.

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150. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

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

Step 2: Detailed Explanation
Let's define each interaction and match it to its symbol.

- **A. Mutualism:** An interaction where both species (A and B) benefit from the relationship. This is represented as (+, +). This matches with **IV. +(A), +(B)**.

- **B. Commensalism:** An interaction where one species (A) benefits, and the other species (B) is neither harmed nor benefited (unaffected). This is represented as (+, O). This matches with **I. +(A), O(B)**.

- **C. Amensalism:** An interaction where one species (A) is harmed, and the other species (B) is unaffected. This is represented as (-, O). This matches with **II. -(A), O(B)**.

- **D. Parasitism:** An interaction where one species (the parasite, A) benefits at the expense of the other species (the host, B), which is harmed. This is represented as (+, -). This

matches with **III. +(A), -(B)**. (Note: The question paper OCR might have a typo for option III, but based on standard definitions, this is the correct match).

Step 3: Final Answer
Based on the matching:
A matches with IV.
B matches with I.
C matches with II.
D matches with III.
This combination corresponds to **A-IV, B-I, C-II, D-III**, which is option (4).

Quick Tip

Create a table for all population interactions (Mutualism, Commensalism, Amensalism, Parasitism, Predation, Competition) and their (+, -, O) notation. This makes it easy to memorize and quickly answer matching questions.
