NEET UG 2023 H5 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 :
Statement I: The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height.
Statement II: Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to evaluate two statements related to the phenomenon of transpiration in plants.

Step 2: Detailed Explanation:
Statement I: Transpiration creates a negative pressure potential, or tension, in the xylem. This is known as the transpiration pull. Due to the cohesive properties of water (molecules sticking together) and adhesive properties (water sticking to xylem walls), this pull can draw a continuous column of water from the roots to the top of the plant. This mechanism, called the cohesion-tension theory, is powerful enough to lift water to heights well over 130 meters, as seen in the tallest trees like Sequoia. Hence, Statement I is correct.

Statement II: Transpiration is the process of water evaporating from the leaf surfaces. Evaporation is a cooling process because the water molecules absorb energy (heat) from the leaf to change from a liquid to a gas phase. This process of evaporative cooling can significantly lower the temperature of the leaf surface, often by 10 to 15 degrees Celsius, protecting it from overheating in direct sunlight. Hence, Statement II is also correct.

Step 3: Final Answer:
Since both Statement I and Statement II are correct descriptions of the effects of transpiration, the correct option is (C).

Quick Tip

Remember the key aspects of the cohesion-tension theory for water transport in plants. Transpiration is not just about water loss; it plays crucial roles in nutrient transport and thermal regulation for the plant.

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

(A) To disperse pollen grains
(B) To protect seeds

(C) To attract insects
(D) To trap pollen grains

Correct Answer: (D) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the function of the tassel in relation to the corn cob. It's important to understand the reproductive structures of a corn plant. The tassel is the male inflorescence located at the top of the plant, while the cob (or ear) is the female inflorescence which develops silks.

Step 2: Detailed Explanation:
The function of the tassel itself is to produce and disperse pollen grains (which is option A). The function of the silks on the corn cob is to trap these airborne pollen grains to facilitate fertilization.
However, the question is phrased as "function of tassels **in the corn cob**", which can be interpreted as the role the tassel plays in the context of the cob's development. The biological purpose of the tassel is to provide pollen for the cob. This purpose is only fulfilled when the pollen is trapped by the cob's silks. Therefore, within the functional relationship between the tassel and the cob, the trapping of pollen is the crucial event that completes the tassel's role. While the tassel disperses pollen, and the silk traps it, the question's wording points towards the interaction at the cob. The provided answer key indicates (D), suggesting this interpretation is intended. From a functional perspective of the entire reproductive process centered on the cob, the tassel's role culminates in its pollen being trapped.

Step 3: Final Answer:
Based on the specific (though potentially confusing) wording of the question and the provided answer key, the function is linked to the outcome at the cob, which is trapping pollen grains. Thus, option (D) is considered correct in this context.

Quick Tip

In biology, be precise about the functions of different structures. Tassels (male) produce/disperse pollen. Silks (female, on the cob) trap pollen. Pay close attention to the phrasing of the question, as it might test your understanding of the interaction between parts, not just the function of an isolated part.

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

(A) Passive Transport
(B) Active Transport

(C) Osmosis
(D) Facilitated Diffusion

Correct Answer: (B) Active Transport

Solution:

Step 1: Understanding the Question:
The question asks to identify the transport mechanism responsible for moving ions across a membrane from a region of lower concentration to a region of higher concentration (i.e., against the concentration gradient).

Step 2: Detailed Explanation:
Passive Transport: This is the movement of substances across a membrane down the concentration gradient (from high to low concentration) without the expenditure of cellular energy. Osmosis and facilitated diffusion are types of passive transport.
Osmosis: Specifically refers to the movement of water across a semipermeable membrane down its water potential gradient.
Facilitated Diffusion: This is the passive movement of molecules across the cell membrane via the aid of a membrane protein, but still down the concentration gradient.
Active Transport: This process moves substances (like ions) across a cell membrane against their concentration or electrochemical gradient. This "uphill" movement requires the cell to expend energy, typically in the form of ATP.

Step 3: Final Answer:
The movement of ions against their concentration gradient is the defining characteristic of active transport. Therefore, option (B) is the correct answer.

Quick Tip

Remember the key difference: passive transport goes "downhill" (high to low concentration) and requires no energy, while active transport goes "uphill" (low to high concentration) and requires energy (ATP).

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104. 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 center of Photosystem II (PS II) shows maximum absorption.

Step 2: Detailed Explanation:
In photosynthesis, there are two photosystems, PS I and PS II. Each photosystem has a light-harvesting complex and a reaction center. The reaction center is a specific chlorophyll 'a' molecule that gets excited and donates an electron.
- The reaction center of **Photosystem II (PS II)** is called **P680** because it absorbs light most effectively at a wavelength of 680 nm.
- The reaction center of **Photosystem I (PS I)** is called **P700** because it absorbs light most effectively at a wavelength of 700 nm.

Step 3: Final Answer:
Since the question asks about PS II, its reaction center has an absorption maximum at 680 nm. Thus, option (C) is correct.

Quick Tip

A simple way to remember is that the photosystems are numbered in the order of their discovery, not the order they function in the Z-scheme. PS II comes first in the electron flow pathway, and its number (680) is lower than PS I's number (700).

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105. Axile placentation is observed in

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

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

Solution:

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

Step 2: Detailed Explanation:
Axile Placentation: This type occurs in a syncarpous (fused carpels), multicarpellary ovary. The ovary is partitioned into two or more chambers (locules) by septa, and the ovules are attached to the central axis where the septa meet.

Let's analyze the options:
(A) Tomato (axile), Dianthus (free-central), Pea (marginal). This option is incorrect.
(B) **China rose**, **Petunia**, and **Lemon** all show axile placentation. This option is correct.
(C) Mustard (parietal), Cucumber (parietal), Primrose (free-central). This option is incorrect.
(D) China rose (axile), Beans (marginal), Lupin (marginal). This option is incorrect.

Step 3: Final Answer:
The group of plants where all members show axile placentation is China rose, Petunia, and Lemon. Therefore, option (B) is the correct answer.

Quick Tip

Memorize key examples for each type of placentation: **Marginal:** Pea, Bean. **Axile:** Tomato, Lemon, China rose. **Parietal:** Mustard, Argemone. **Free-central:** Dianthus, Primrose. **Basal:** Sunflower, Marigold.

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

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) about ATP consumption during glycolysis and asks to evaluate their correctness and relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A: Glycolysis is a 10-step process that breaks down glucose. The initial phase is the "investment phase" where energy is consumed. Indeed, two molecules of ATP are used in this phase. So, Assertion A is true.

Analysis of Reason R: Let's examine the specific steps where ATP is used:
1. **Step 1:** Glucose is phosphorylated to glucose-6-phosphate by the enzyme hexokinase. This

step consumes one molecule of ATP.
2. **Step 3:** Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate by the enzyme phosphofructokinase. This step consumes a second molecule of ATP.
The Reason R correctly identifies these two specific steps of ATP consumption. So, Reason R is also true.

Relationship between A and R: Reason R provides the exact details of the two steps where ATP is utilized, thereby correctly and completely explaining why Assertion A is true.

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

Quick Tip

For Assertion-Reason questions, follow a systematic approach: 1. Check if Assertion is true. 2. Check if Reason is true. 3. If both are true, check if the Reason correctly explains the Assertion by asking "Why?" or "How?" after reading the Assertion.

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

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

Correct Answer: (D) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks to identify the plant hormone (phytohormone) that can be used to speed up the maturation process in young conifer trees to promote earlier seed production.

Step 2: Detailed Explanation:
Let's review the functions of the given hormones:
- **Zeatin:** A type of cytokinin, primarily involved in cell division, chloroplast development, and delaying senescence.
- **Abscisic Acid (ABA):** A stress hormone, involved in dormancy, stomatal closure, and inhibiting growth.
- **Indole-3-butyric Acid (IBA):** An auxin, primarily used to promote root formation in cuttings.
- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including promoting stem

elongation (bolting), breaking dormancy, and inducing flowering. A key commercial application is spraying juvenile conifers with GAs to hasten maturity, leading to early seed production for breeding programs.

Step 3: Final Answer:
Gibberellic acid is the phytohormone used to accelerate the maturity period in juvenile conifers. Therefore, option (D) is the correct answer.

Quick Tip

Associate key commercial applications with each phytohormone. For Gibberellins, remember its role in increasing grape size, promoting malting in brewing, and hastening maturity in conifers.

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

(A) Ethylene
(B) 2, 4-D
(C) GA3
(D) Kinetin

Correct Answer: (A) Ethylene

Solution:

Step 1: Understanding the Question:
The question asks to identify the hormone responsible for the rapid elongation of internodes or petioles in rice plants that are submerged in deep water.

Step 2: Detailed Explanation:
Deep water rice plants have a unique adaptation to survive flooding. When submerged, the plants rapidly elongate their stems (internodes) and leaf stalks (petioles) to keep the leaves and flowering parts above the water surface for photosynthesis and gas exchange.
This rapid elongation response is primarily triggered by the gaseous hormone **Ethylene**. Ethylene accumulates in the submerged parts of the plant and promotes this growth.
- **2, 4-D** is a synthetic auxin, often used as a herbicide.
- **GA3 (Gibberellic Acid)** also promotes stem elongation but ethylene is the key regulator in this specific context of deep water rice.
- **Kinetin** is a cytokinin, which promotes cell division.

Step 3: Final Answer:
Ethylene is the hormone that promotes internode/petiole elongation in deep water rice. Therefore, option (A) is the correct answer.

Quick Tip

Remember that ethylene is a gaseous hormone with unique functions, including fruit ripening, senescence, and specific stress responses like the elongation in submerged plants.

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109. How many ATP and NADPH2 are required for the synthesis of one molecule of Glucose during Calvin cycle?

(A) 12 ATP and 16 NADPH2
(B) 18 ATP and 16 NADPH2
(C) 12 ATP and 12 NADPH2
(D) 18 ATP and 12 NADPH2

Correct Answer: (D) 18 ATP and 12 NADPH2

Solution:

Step 1: Understanding the Question:
The question asks for the total number of ATP and NADPH 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 CO_2. We need to determine the energy cost per CO_2 molecule fixed in the Calvin cycle and then multiply by 6.
The Calvin cycle has three stages: Carboxylation, Reduction, and Regeneration.
- **Reduction:** For each CO_2 molecule fixed, 2 ATP and 2 NADPH are used to reduce 3-PGA to G3P.
- **Regeneration:** For each CO_2 molecule fixed, 1 ATP is used to regenerate RuBP.
Total cost per CO_2 fixed = (2 ATP + 1 ATP) + 2 NADPH = 3 ATP + 2 NADPH.

Step 3: Detailed Explanation:
To synthesize one molecule of glucose (C_6), the cycle must run 6 times, fixing 6 molecules of CO_2.
Total ATP required = 6 turns $\times$ 3 ATP/turn = **18 ATP**.
Total NADPH required = 6 turns $\times$ 2 NADPH/turn = **12 NADPH**.
(Note: NADPH2 is an older notation for NADPH + H^+, commonly written as NADPH in modern texts).

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

Quick Tip

Remember the per-CO cost for the Calvin cycle: 3 ATP and 2 NADPH. To find the cost for glucose (C), simply multiply these numbers by 6.

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110. 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, 5 srRNA and snRNA

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

Solution:

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

Step 2: Detailed Explanation:
Eukaryotic cells have at least three distinct types of RNA polymerases in their nucleus, each responsible for transcribing different classes of RNA.
- **RNA Polymerase I:** Transcribes ribosomal RNAs (rRNAs), specifically the 28S, 18S, and 5.8S rRNA genes.
- **RNA Polymerase II:** Transcribes the precursor of messenger RNA (mRNA), which is called heterogeneous nuclear RNA (hnRNA), as well as most small nuclear RNAs (snRNAs).
- **RNA Polymerase III:** Transcribes transfer RNA (tRNA), the 5S ribosomal RNA (5S rRNA), and some small nuclear RNAs (snRNAs) like U6 snRNA, and small nucleolar RNAs (snoRNAs).

Let's evaluate the options based on this information:
(A) Transcription of precursor of mRNA is done by RNA Pol II.
(B) Transcription of only snRNAs is incorrect as RNA Pol II also transcribes some snRNAs, and RNA Pol III transcribes more than just snRNAs.
(C) Transcription of rRNAs (28S, 18S and 5.8S) is done by RNA Pol I.
(D) Transcription of tRNA, 5S rRNA, and snRNA correctly describes the main roles of RNA Pol III.

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

Quick Tip

Use the mnemonic "1, 2, 3 - R, M, T" to remember the primary products of the polymerases: RNA Pol **I** for **r**RNA, RNA Pol **II** for **m**RNA, and RNA Pol **III** for **t**RNA. This helps remember the main function, although Pol III also transcribes 5S rRNA and some snRNAs.

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111. 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 appear.

Step 2: Detailed Explanation:
Prophase I of meiosis is a long and complex phase, divided into five substages:
1. **Leptotene:** Chromosomes start to condense.
2. **Zygotene:** Homologous chromosomes pair up (synapsis) to form bivalents. The synaptonemal complex begins to form.
3. **Pachytene:** This is the longest stage. Bivalents are clearly visible as tetrads. **Crossing over**, the exchange of genetic material between non-sister chromatids of homologous chromosomes, occurs during this stage. The sites where crossing over happens are marked by the appearance of proteinaceous structures called **recombination nodules**.
4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate, but they remain attached at the sites of crossing over, which are now visible as X-shaped structures called chiasmata.
5. **Diakinesis:** Chromosomes become fully condensed, and chiasmata terminalize. The nuclear envelope breaks down.

Step 3: Final Answer:
Recombination nodules, which are the sites of crossing over, appear during the Pachytene stage. Therefore, option (D) is the correct answer.

Quick Tip

Remember the key events of Prophase I substages: **L**eptotene - Compaction. **Z**ygotene - Synapsis (Zipping up). **P**achytene - Crossing over (Pairing is perfect). **D**iplotene - Chiasmata visible (De-synapsis). **D**iakinesis - Terminalization.

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112. 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 structures within a fertilized embryo sac:
- **Haploid (n) structures:** Before fertilization, the egg cell, synergids, and antipodals are all haploid. After fertilization, any remaining (non-degenerated) synergids or antipodals are still haploid.
- **Diploid (2n) structure:** The **zygote** is formed by the fusion of a haploid male gamete (n) and the haploid egg cell (n). Thus, the zygote is diploid (2n).
- **Triploid (3n) structure:** The **Primary Endosperm Nucleus (PEN)** is formed by the fusion of the second haploid male gamete (n) with the diploid central cell (which contains two polar nuclei, n + n). Thus, PEN is triploid (3n).

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 required ploidy levels.
(B) Synergids (n), antipodals (n), Polar nuclei (n+n, forming the diploid central cell nucleus before fertilization). This is incorrect.
(C) Synergids (n), Primary endosperm nucleus (3n), zygote (2n). The order is incorrect.
(D) Antipodals (n), synergids (n), primary endosperm nucleus (3n). The first two are haploid, not matching the sequence.

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

Quick Tip

Double fertilization is a key feature of angiosperms. Remember the two fusion events: 1. Male gamete (n) + Egg (n) $\rightarrow$ Zygote (2n). 2. Male gamete (n) + Central Cell (n+n) $\rightarrow$ Primary Endosperm Nucleus (3n).

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113. 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 stage in meiosis where the centromere, the structure holding two sister chromatids together, divides.

Step 2: Detailed Explanation:
Meiosis consists of two successive divisions: Meiosis I and Meiosis II.
- **Meiosis I:** This is a reductional division. In **Anaphase I**, homologous chromosomes separate and move to opposite poles. The sister chromatids remain attached at their centromeres; the centromeres do **not** divide.
- **Meiosis II:** This is an equational division, very similar to mitosis. In **Metaphase II**, chromosomes (each composed of two sister chromatids) align at the metaphase plate. In **Anaphase II**, the centromeres finally divide (split), allowing the sister chromatids to separate and move to opposite poles. These separated chromatids are now considered individual chromosomes.

Step 3: Final Answer:
The division of the centromere occurs during Anaphase II of meiosis. Therefore, option (A) is the correct answer.

Quick Tip

A key distinction: - **Anaphase I:** Separation of homologous chromosomes. Centromeres do NOT split. - **Anaphase II:** Separation of sister chromatids. Centromeres DO split. This is identical to what happens in mitotic anaphase.

114. 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 for the definition of the term 'R' in the ecological equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).

Step 2: Detailed Explanation:
- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (like plants) during photosynthesis to create organic matter. It represents the total amount of food produced.
- Producers must use some of this energy for their own life processes, such as growth, maintenance, and metabolism. The primary metabolic process that consumes this energy is cellular **respiration**.
- **Respiratory Loss (R):** This is the portion of GPP that is consumed by the producers for their own respiration.
- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass that is actually available to the next trophic level (herbivores). It is what is left over after the producers have met their own energy needs.
The relationship is therefore: NPP = GPP - R, or GPP - R = NPP.

Step 3: Final Answer:
In the given equation, 'R' stands for the energy lost by producers through respiration. Therefore, option (A) is the correct answer.

Quick Tip

Think of GPP as the 'gross salary' of an ecosystem. 'R' is the 'taxes' or 'living expenses' (respiration) of the producers. NPP is the 'net income' or 'take-home pay' that is available to be passed on to consumers.

115. 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 (a blue-black color) in the iodine test, unlike starch.

Step 2: Detailed Explanation:
The iodine test is used to detect the presence of starch. Starch is a polymer of α-glucose and has two components: amylose and amylopectin.
- **Amylose**, the component responsible for the blue-black color, is a linear polymer that coils into a **helical structure**. The interior of this helix is just the right size to trap iodine molecules (I_3^- and I_5^- ions), forming a starch-iodine complex that absorbs light and appears deep blue-black.
- **Cellulose**, on the other hand, is a polymer of β-glucose. The β-1,4 glycosidic linkages cause cellulose to form straight, linear chains. These chains lie parallel to each other and are held together by hydrogen bonds, forming strong microfibrils. Cellulose does **not** form complex helices.
Because cellulose lacks the helical structure needed to trap iodine molecules, no complex is formed, and no blue color is observed.

Step 3: Final Answer:
Cellulose does not turn blue with iodine because its linear structure does not contain the complex helices required to hold iodine molecules. Therefore, option (A) is the correct answer.

Quick Tip

The key difference in structure between starch and cellulose is the type of glycosidic bond: α-1,4 in starch leads to helices, while β-1,4 in cellulose leads to straight chains. This structural difference dictates their chemical properties and biological roles.

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116. 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 unit of measurement used for the thickness or concentration of the ozone layer in the atmosphere.

Step 2: Detailed Explanation:
Let's examine the units given in the options:
- **Decameter:** A unit of length, equal to 10 meters.
- **Kilobase (kb):** A unit used in molecular biology to measure the length of DNA or RNA molecules, equal to 1000 base pairs.
- **Dobson units (DU):** This is the standard unit for measuring the total amount of ozone in a vertical column of air. One Dobson Unit is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at a temperature of 0 degrees Celsius and a pressure of 1 atmosphere.
- **Decibels (dB):** A logarithmic unit used to measure sound intensity or the power level of an electrical signal.

Step 3: Final Answer:
The thickness of the ozone layer is measured in Dobson units. Therefore, option (C) is the correct answer.

Quick Tip

Associate specific units with their corresponding measurements. Dobson units are specifically for ozone column density, just as decibels are for sound and light-years are for astronomical distance.

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

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

Correct Answer: (B) Bright orange colour

Solution:

Step 1: Understanding the Question:
The question asks about the appearance of DNA that has been stained with ethidium bromide when it is viewed under ultraviolet (UV) light. This is a standard technique in molecular biology.

Step 2: Detailed Explanation:
Agarose Gel Electrophoresis is a common method used to separate DNA fragments by size. After separation, the DNA in the gel is invisible to the naked eye. To visualize it, a fluorescent dye is used.
Ethidium bromide (EtBr) is a fluorescent dye that acts as an intercalating agent. This means it inserts itself between the stacked base pairs of the DNA double helix.
When the gel containing EtBr-stained DNA is placed under a UV transilluminator (a source of UV radiation), the ethidium bromide absorbs the UV light and re-emits it as visible light. This phenomenon is called fluorescence. The DNA-ethidium bromide complex fluoresces with a characteristic **bright orange** color.

Step 3: Final Answer:
DNA stained with ethidium bromide appears as bright orange bands under UV radiation. Therefore, option (B) is the correct answer.

Quick Tip

Ethidium bromide is a potent mutagen, so proper safety precautions (gloves, lab coat, UV protection) must always be used when working with it. The bright orange fluorescence under UV light is a classic and easily recognizable result in molecular biology labs.

---

118. 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 asks to identify a pair of pteridophytes that are heterosporous.

Step 2: Detailed Explanation:
Pteridophytes are vascular plants that reproduce via spores. They can be classified based on the type of spores they produce:
- **Homosporous:** These plants produce only one type of spore, which develops into a bisexual gametophyte (having both antheridia and archegonia). Most pteridophytes are homosporous. Examples include *Psilotum*, *Lycopodium*, and *Equisetum*.
- **Heterosporous:** These plants produce two distinct types of spores: smaller microspores (which develop into male gametophytes) and larger megaspores (which develop into female gametophytes). This condition is a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples of heterosporous pteridophytes are *Selaginella* and aquatic ferns like *Salvinia*, *Azolla*, and *Marsilea*.

Let's evaluate the options:
(A) *Psilotum* (homosporous) and *Salvinia* (heterosporous). Incorrect.
(B) *Equisetum* (homosporous) and *Salvinia* (heterosporous). Incorrect.
(C) *Lycopodium* (homosporous) and *Selaginella* (heterosporous). Incorrect.
(D) ***Selaginella*** (heterosporous) and ***Salvinia*** (heterosporous). Both are heterosporous. Correct.

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

Quick Tip

Memorize the key examples for homospory and heterospory in pteridophytes. *Selaginella* and *Salvinia* are the most commonly cited examples of heterosporous pteridophytes in textbooks. Remember that heterospory is a significant evolutionary step towards seed development.

---

119. 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 scientist(s) who provided the definitive or "unequivocal" proof

that DNA is the genetic material.

Step 2: Detailed Explanation:
Let's review the contributions of the scientists listed:
- **Frederick Griffith (1928):** His experiment on *Streptococcus pneumoniae* demonstrated the "transforming principle," showing that genetic material could be transferred from dead pathogenic bacteria to live non-pathogenic bacteria, making them pathogenic. He did not identify the nature of this material.
- **Avery, Macleod, and McCarty (1944):** They expanded on Griffith's work and showed through biochemical analysis (using enzymes like proteases, RNases, and DNases) that the transforming principle was DNA. Their work provided strong evidence, but some scientists remained skeptical, believing that protein contamination might be responsible.
- **Wilkins and Franklin:** Their X-ray diffraction studies of DNA were crucial for Watson and Crick to determine the double helix structure of DNA, but their work was about structure, not proving its function as the genetic material.
- **Alfred Hershey and Martha Chase (1952):** Their "blender experiment" used bacteriophages (viruses that infect bacteria). They labeled the viral protein coat with radioactive sulfur (^{35}S) and the viral DNA with radioactive phosphorus (^{32}P). They found that only the radioactive phosphorus (DNA) entered the bacterial cells during infection, while the radioactive sulfur (protein) remained outside. Since the bacteria then produced new viruses, this demonstrated conclusively that DNA, not protein, was the genetic material that carried the instructions for replication. This experiment is widely regarded as the unequivocal proof.

Step 3: Final Answer:
The Hershey-Chase experiment provided the definitive proof that DNA is the genetic material. Therefore, option (D) is the correct answer.

Quick Tip

Remember the timeline and contribution: 1. **Griffith:** Discovered transformation. 2. **Avery, Macleod, McCarty:** Identified DNA as the transforming substance. 3. **Hershey & Chase:** Provided conclusive proof using radioactive tracers.

---

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

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

Correct Answer: (A) Tungsten or gold

Solution:

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

Step 2: Detailed Explanation:
The gene gun method, also known as biolistics or microprojectile bombardment, is a physical method for delivering foreign DNA (transgenes) into cells, particularly plant cells which have a rigid cell wall that is difficult to penetrate.
The process involves:
1. Coating microscopic particles of a heavy metal with the desired DNA.
2. These coated microparticles are then accelerated to a very high velocity using a "gene gun".
3. The high-velocity particles penetrate the cell wall and cell membrane of the target cells, carrying the DNA into the cell's interior.
The metals used must be dense (to have enough momentum to penetrate the cells) and chemically inert (so they don't react with the DNA or the cell's components). **Gold** and **Tungsten** are the two metals most commonly used for this purpose.

Step 3: Final Answer:
The microparticles used in the gene gun method are typically made of tungsten or gold. Therefore, option (A) is the correct answer.

Quick Tip

Associate the gene gun (biolistics) method with direct physical delivery of DNA and its use of heavy, inert metal particles like gold or tungsten. This method is especially useful for transforming plant cells.

---

121. 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 (differentiated) cells, like leaf mesophyll cells, are induced to divide and form an undifferentiated mass of cells

called a callus. It asks for the correct term for this phenomenon.

Step 2: Detailed Explanation:
Let's define the terms:
- **Differentiation:** The process by which a less specialized cell becomes a more specialized cell type. For example, a meristematic cell differentiating into a mesophyll cell.
- **Dedifferentiation:** The process by which differentiated cells, which have lost the ability to divide, regain the capacity for cell division under certain conditions (like in a culture medium). The formation of a callus from mature, differentiated explant cells (like mesophyll cells) is the classic example of dedifferentiation.
- **Redifferentiation:** The process by which dedifferentiated cells (like callus cells) divide and then differentiate again to form new, specialized cells, tissues, and organs.
- **Development:** The overall sum of growth and differentiation processes.
- **Senescence:** The process of aging in plants.

In the scenario described, the already specialized leaf mesophyll cells are reverting to a state of active cell division to form an unspecialized callus. This reversal is called dedifferentiation.

Step 3: Final Answer:
The phenomenon of differentiated cells forming a callus is called dedifferentiation. Therefore, option (D) is the correct answer.

Quick Tip

Remember the sequence in plant tissue culture: 1. **Explant** (Differentiated cells) 2. $\rightarrow$ **Dedifferentiation** $\rightarrow$ 3. **Callus** (Undifferentiated cells) 4. $\rightarrow$ **Redifferentiation** $\rightarrow$ 5. **Plantlet** (Differentiated organs)

---

122. 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 the genetic term "pleiotropism".

Step 2: Detailed Explanation:
Let's analyze the given options in the context of genetics:

- **(A) a single gene affecting multiple phenotypic expression:** This is the correct definition of **pleiotropy**. A single gene influences two or more seemingly unrelated phenotypic traits. A classic example is the gene responsible for phenylketonuria (PKU), which, when mutated, causes mental retardation, reduced skin pigmentation, and other symptoms.
- **(B) more than two genes affecting a single character:** This describes **polygenic inheritance**, where a single trait (like height or skin color) is controlled by the cumulative effect of many genes.
- **(C) presence of several alleles of a single gene controlling a single crossover:** This is an incorrect and confusing statement. The presence of several alleles of a single gene is known as **multiple allelism** (e.g., ABO blood group alleles). It doesn't control a "single crossover".
- **(D) presence of two alleles, each of the two genes controlling a single trait:** This statement is also poorly worded but seems to refer to standard Mendelian inheritance involving two different genes, not pleiotropy.

Step 3: Final Answer:
Pleiotropism is the phenomenon where one gene influences multiple traits. Therefore, option (A) is the correct answer.

Quick Tip

Contrast Pleiotropy with Polygenic Inheritance: - **Pleiotropy:** One gene → Many traits. - **Polygenic Inheritance:** Many genes → One trait. They are essentially opposite concepts.

---

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Statement I Analysis: The terms 'endarch' and 'exarch' are used to describe the position of the **primary xylem**, not the secondary xylem. These terms refer to the pattern of development of the first-formed xylem (protoxylem) in relation to the later-formed xylem (metaxylem).
- **Endarch**: Protoxylem is towards the center (pith), and metaxylem is towards the periphery. This is characteristic of stems.
- **Exarch**: Protoxylem is towards the periphery, and metaxylem is towards the center. This is characteristic of roots.
Since the statement mentions secondary xylem, Statement I is incorrect.

Statement II Analysis: The exarch condition, as explained above, is the arrangement where protoxylem is located towards the outer side of the vascular bundle. This arrangement is the defining characteristic of the root system in vascular plants. Therefore, Statement II is true.

Step 3: Final Answer:
Based on the analysis, Statement I is incorrect, and Statement II is true. This corresponds to option (B).

Quick Tip

Remember that terms like 'endarch' and 'exarch' are related to the developmental direction of primary tissues. Secondary growth originates from the vascular cambium and grows radially, so these terms do not apply to it. Associate **Exarch** with **Roots** and **Endarch** with **Stems**.

---

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

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

Correct Answer: (C) Diadelphous and Dithecous anthers

Solution:

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

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

- **Fabaceae (e.g., Pea):** The stamens are typically ten. A key feature is that their filaments are fused into two bundles, a condition known as **diadelphous** (commonly in a (9)+1 arrangement). The anthers are **dithecous** (having two lobes).
- **Solanaceae (e.g., Potato):** The stamens are typically five and are **epipetalous** (attached to the petals). The anthers are dithecous.
- **Liliaceae (e.g., Lily):** The stamens are typically six and are often **epiphyllous** or **epitepalous** (attached to the tepals). The anthers are dithecous.

Now let's evaluate the options:
(A) Monoadelphous (filaments in one bundle) is found in Malvaceae. Monothecous anthers are also found in Malvaceae. Not Fabaceae.
(B) Epiphyllous condition is a feature of Liliaceae. Not specific to Fabaceae.
(C) **Diadelphous** condition is a hallmark of the family Fabaceae (specifically, its subfamily Papilionoideae). The anthers are dithecous, which is common, but the diadelphous arrangement is the specific feature.
(D) Polyadelphous (filaments in more than two bundles) is seen in Citrus. Epipetalous stamens are a feature of Solanaceae.

Step 3: Final Answer:
The combination of diadelphous stamens and dithecous anthers is characteristic of Fabaceae and not found in Solanaceae or Liliaceae. Therefore, option (C) is correct.

Quick Tip

When comparing plant families, focus on the unique floral characteristics, especially related to the androecium (stamens) and gynoecium (carpel). For Fabaceae, the key feature to remember is the diadelphous stamens ((9)+1) and the marginal placentation.

---

125. 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 what macromolecule is precipitated when chilled ethanol is added during the DNA purification process in recombinant DNA technology.

Step 2: Detailed Explanation:
The process of isolating DNA involves several steps:
1. Breaking open the cells (cell lysis) to release the cellular contents, including DNA and other macromolecules like RNA, proteins, polysaccharides, and lipids.
2. Treating the lysate with enzymes to remove unwanted molecules. For example, proteases are used to digest proteins (like histones), and RNase is used to digest RNA.
3. After removing most of the contaminants, the purified DNA is in an aqueous solution. DNA is a polar molecule and is soluble in water, but it is insoluble in ethanol.
4. When chilled ethanol is added to this aqueous solution, the DNA precipitates out of the solution, as it can no longer stay dissolved. It appears as a collection of fine white threads. This process is called ethanol precipitation.

Step 3: Final Answer:
The addition of chilled ethanol causes the DNA to precipitate. Therefore, option (D) is the correct answer.

Quick Tip

Remember the basic principle of DNA precipitation: "DNA is soluble in water, insoluble in alcohol." Chilled ethanol is used to maximize the yield of precipitated DNA. This is a crucial final step in DNA isolation protocols.

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126. 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 and

the detritus food chain.

Step 2: Detailed Explanation:
Let's analyze each statement:
A. Detrivores perform fragmentation. This is correct. Detrivores, such as earthworms, break down large pieces of dead organic matter (detritus) into smaller particles. This process is called fragmentation.
B. The humus is further degraded by some microbes during mineralization. This is correct. Humus is a dark, amorphous substance that is highly resistant to microbial action and decomposes very slowly. The slow process of microbial degradation of humus, which releases inorganic nutrients, is called mineralization.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching. This is correct. Leaching is the process by which water-soluble substances, including inorganic nutrients released during decomposition, are washed down through the soil profile and can get precipitated as unavailable salts.
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. The physical breakdown of detritus by earthworms is fragmentation. Catabolism refers to the enzymatic breakdown of detritus into simpler inorganic substances by bacteria and fungi.

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

Quick Tip

Remember the three main steps of decomposition in order: 1. **Fragmentation:** Physical breakdown by detritivores. 2. **Leaching:** Soluble nutrients are washed away. 3. **Catabolism:** Chemical/enzymatic breakdown by microbes. Humification and Mineralization occur subsequently.

---

127. 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 used recombination frequency to map the positions of genes on a chromosome.

Step 2: Detailed Explanation:
- **Thomas Hunt Morgan (C):** Working with *Drosophila melanogaster*, he discovered linkage (genes on the same chromosome tend to be inherited together) and recombination (crossing over can break linkages). He proposed that the strength of linkage was related to the distance between genes.
- **Alfred Sturtevant (A):** He was an undergraduate student in T.H. Morgan's lab. In 1913, he took Morgan's idea a step further. He hypothesized that the frequency of recombination between two genes could be used as a direct measure of the physical distance between them on the chromosome. He used recombination data to construct the first-ever genetic map.
- **Henking (B):** Discovered the X-body (later identified as the X chromosome).
- **Sutton and Boveri (D):** Independently proposed the Chromosomal Theory of Inheritance, which states that genes are located on chromosomes.

Step 3: Final Answer:
While Morgan laid the groundwork, Alfred Sturtevant was the first person to actually use recombination frequencies to construct a genetic map. Therefore, option (A) is the correct answer.

Quick Tip

Remember the key contributions: Morgan discovered linkage and recombination. Sturtevant, his student, used recombination frequency to create the first gene map. The unit of genetic distance, the centiMorgan (cM), is named in honor of T.H. Morgan.

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128. 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 cause of species extinction from the four

major causes, collectively known as 'The Evil Quartet'.

Step 2: Detailed Explanation:
'The Evil Quartet' refers to the four primary threats to biodiversity:
1. **Habitat Loss and Fragmentation:** This involves the destruction or division of natural habitats due to activities like deforestation, urbanization, and agriculture. It directly removes the space, food, and resources species need to survive.
2. **Over-exploitation:** This is the harvesting of species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting).
3. **Alien Species Invasions:** The introduction of non-native species into an ecosystem can disrupt the local food web, outcompete native species for resources, or introduce diseases.
4. **Co-extinctions:** The extinction of one species can lead to the extinction of another species that depends on it, such as a host-specific parasite or a plant and its obligate pollinator.

Among these four, **habitat loss and fragmentation** is globally recognized as the single most important and primary driver of extinction. When an organism's home is destroyed or broken into small, isolated patches, its population cannot be sustained.

Step 3: Final Answer:
The most important cause driving the extinction of species is habitat loss and fragmentation. Therefore, option (C) is the correct answer.

Quick Tip

While all four causes in 'The Evil Quartet' are significant, always remember that habitat loss is the leading cause. It's the foundation of the problem—if a species has nowhere to live, it cannot survive, regardless of other threats.

---

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

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) about the life cycle of mosses and asks to evaluate their correctness and relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A: The life cycle of a moss involves an alternation of generations. The haploid gametophyte is the dominant stage. When a haploid spore germinates, it first develops into a filamentous, creeping, green, and branched structure called the **protonema**. This is the juvenile or first stage of the gametophyte. Later, the leafy gametophyte (the familiar moss plant) develops from a bud on the protonema. Thus, Assertion A is true.

Analysis of Reason R: The spores in mosses are produced by meiosis within the **capsule** of the diploid sporophyte. When these haploid spores are released and land on a suitable substrate, they germinate and develop directly into the protonema. Thus, Reason R is also true.

Relationship between A and R: Reason R correctly states how the protonema is formed (from a spore produced in the capsule). This directly explains the origin of the protonema, which is described in Assertion A as the first stage of the gametophyte. Therefore, R is the correct explanation of A.

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

Quick Tip

Remember the two distinct stages of the moss gametophyte: 1. **Protonema stage:** Juvenile, filamentous, develops from the spore. 2. **Leafy stage:** Adult stage, develops from the protonema, bears the sex organs. This is a key feature of the Bryophytes (mosses).

---

130. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

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

Step 2: Detailed Explanation:
Gene expression begins with transcription, where a gene's DNA sequence is copied into an RNA molecule (mRNA). This mRNA is then (usually) translated into a protein.
To study which genes are active or "expressed" in a cell, scientists isolate the mRNA. They then use the enzyme reverse transcriptase to make a complementary DNA (cDNA) copy of the mRNA.
Expressed Sequence Tags (ESTs) are short (typically 200-500 nucleotides) subsequences of these cDNA molecules. Since cDNA is derived from mRNA, ESTs represent fragments of genes that are being transcribed into RNA.
The goal of EST projects, a key part of the Human Genome Project, was to identify and catalog all the genes that are expressed as RNA.
- Option (A) is incorrect because ESTs only represent expressed genes. - Option (B) is incorrect because the goal is to identify all expressed genes, not just "certain important" ones. - Option (D) is incorrect because ESTs represent genes expressed as RNA. Not all RNAs are translated into proteins (e.g., non-coding RNAs). ESTs identify genes at the transcription level, not the translation level.

Step 3: Final Answer:
ESTs are used to identify all genes that are expressed as RNA. Therefore, option (C) is the correct answer.

Quick Tip

Break down the term: "Expressed" means transcribed into RNA. "Sequence Tag" means it's a short piece of sequence used to identify a longer gene. So, EST = a short tag that identifies an expressed gene. This links directly to genes expressed as RNA.

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

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

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

Solution:

Step 1: Understanding the Question:
The question provides an Assertion (A) and a Reason (R) related to the formation of wood in temperate climates and asks for an evaluation of their correctness and relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A: In temperate regions, the vascular cambium shows seasonal activity. The wood formed during the autumn or winter season is called **late wood** or autumn wood. This wood is characterized by having fewer xylem elements (xylary elements), and the vessels are narrower and have thicker walls. This makes the late wood denser. Thus, Assertion A is true.

Analysis of Reason R: The activity of the vascular cambium is influenced by physiological and environmental factors, such as temperature. During the unfavorable conditions of winter, the **cambium becomes less active**. In the spring, when conditions are favorable, the cambium is very active. Thus, Reason R is also true.

Relationship between A and R: The reduced activity of the cambium during the winter (Reason R) is the direct cause for the production of fewer xylary elements with narrow vessels, which constitutes the late wood (Assertion A). Therefore, R is the correct explanation of A.

Step 3: Final Answer:
Both Assertion A and Reason R are true, and R is the correct explanation for A. Thus, option (C) is the correct choice.

Quick Tip

Contrast late wood with early wood: - **Early (Spring) Wood:** Cambium is active $\rightarrow$ Many, wide vessels $\rightarrow$ Lighter color, lower density. - **Late (Autumn) Wood:** Cambium is less active $\rightarrow$ Fewer, narrow vessels $\rightarrow$ Darker color, higher density. The alternation of these two types creates the annual growth rings.

---

132. 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," formally known as the United Nations Conference on Environment and Development (UNCED), was held in Rio de Janeiro.

Step 2: Detailed Explanation:
The Earth Summit was a landmark international conference held in Rio de Janeiro, Brazil, from June 3 to 14, **1992**. A major outcome of this summit was the agreement on the Convention on Biological Diversity (CBD). This convention had three main goals:
1. The conservation of biological diversity.
2. The sustainable use of its components.
3. The fair and equitable sharing of benefits arising out of the utilization of genetic resources.

Step 3: Final Answer:
The Earth Summit in Rio de Janeiro was held in 1992. Therefore, option (D) is the correct answer.

Quick Tip

Associate key environmental summits with their locations and years. The Rio Earth Summit of 1992 is one of the most famous, leading to the CBD and the Framework Convention on Climate Change (UNFCCC). Another related event is the World Summit on Sustainable Development held in Johannesburg in 2002.

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

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

Correct Answer: (C) insect pollinated plants

Solution:

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

Step 2: Detailed Explanation:
These characteristics are all adaptations to attract pollinators. Let's analyze the options:
- **(A) Bat pollinated plants (Chiropterophily):** Flowers are typically large but often dull-colored (white or greenish), open at night, and emit a strong, fermenting or musty odor. They

produce copious nectar.
- **(B) Wind pollinated plants (Anemophily):** Flowers do not need to attract pollinators. They are typically small, inconspicuous, not colourful, and lack fragrance and nectar. They produce large amounts of light, non-sticky pollen.
- **(C) Insect pollinated plants (Entomophily):** Flowers have evolved features to attract insects. They are often **large**, **colourful** (to be visually conspicuous), **fragrant** (to attract from a distance), and provide a reward in the form of **nectar** or pollen.
- **(D) Bird pollinated plants (Ornithophily):** Flowers are usually large and brightly colored (often red or orange), produce abundant nectar, but are typically odorless, as birds have a poor sense of smell.

Step 3: Final Answer:
The combination of large size, bright colours, fragrance, and nectar is a classic suite of adaptations for insect pollination. Therefore, option (C) is correct.

Quick Tip

Create a mental checklist for different pollination syndromes. For insects, think "all rewards": visual (color, size), olfactory (scent), and food (nectar). For wind, think "no rewards": small, dull, no scent, no nectar. For birds, think "visual and food, no scent".

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134. 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 the M (Mitotic) phase. Interphase is further subdivided into three phases:
- **G_1 phase (Gap 1):** This is the period of cell growth before the DNA is duplicated. The cell is metabolically active and synthesizes proteins and RNA.
- **S phase (Synthesis):** This is the phase where the cell synthesizes a complete copy of the DNA in its nucleus. The amount of DNA per cell doubles during this phase (from 2C to 4C). Centrosome duplication also occurs.

- **G_2 phase (Gap 2):** This is the period of further growth after DNA replication has been completed. The cell prepares for mitosis by synthesizing proteins required for cell division.
- **M phase (Mitosis):** This is the phase of actual cell division, including nuclear division (mitosis) and cytoplasmic division (cytokinesis).

Step 3: Final Answer:
DNA replication specifically occurs during the S phase of the cell cycle. Therefore, option (D) is the correct answer.

Quick Tip

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

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

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

Correct Answer: (C) manganese

Solution:

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

Step 2: Detailed Explanation:
The splitting of water molecules ($2H_2O \rightarrow 4H^+ + O_2 + 4e^-$) occurs in Photosystem II (PS II) and is catalyzed by the Oxygen Evolving Complex (OEC). This process is crucial as it provides the electrons to replace those lost by P680, releases protons into the thylakoid lumen to create a proton gradient for ATP synthesis, and produces oxygen as a byproduct.
The OEC contains a cluster of four **manganese** (Mn) atoms, along with calcium and chloride ions, which are essential for its catalytic activity.
- **Magnesium (Mg):** Is a central component of the chlorophyll molecule, essential for absorbing light energy, but not directly involved in splitting water.
- **Copper (Cu):** Is a component of plastocyanin, an electron carrier in the photosynthetic electron transport chain.
- **Molybdenum (Mo):** Is a cofactor for enzymes like nitrate reductase, not directly involved

in photosynthesis.

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

Quick Tip

Remember the key roles of specific micronutrients in photosynthesis: **Manganese (Mn)** for water splitting, **Magnesium (Mg)** in chlorophyll, and **Copper (Cu)** in plastocyanin. Don't confuse the roles of Mn and Mg.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's analyze each statement:
(A) This is a correct statement. Water hyacinth (*Eichhornia crassipes*) is an invasive aquatic plant that thrives in nutrient-rich (eutrophic) water bodies. Its rapid growth can cover the entire water surface, blocking sunlight and oxygen, leading to ecological imbalance.
(B) This is a correct statement describing the phenomenon of **biomagnification** or biological magnification, where the concentration of non-biodegradable toxic substances (like DDT or mercury) increases at each successive trophic level in a food chain.
(C) This is a correct statement. When sewage with high organic matter enters a water body, decomposer microorganisms multiply rapidly. Their respiration consumes large amounts of dissolved oxygen, increasing the Biochemical Oxygen Demand (BOD). The resulting depletion of oxygen (hypoxia or anoxia) can lead to mass death of fish and other aquatic organisms.

(D) This is an **incorrect** statement. Algal blooms are massive growths of algae, often caused by nutrient enrichment (eutrophication) from sources like fertilizer runoff, not primarily excess organic matter. These blooms severely **deteriorate** water quality. They block sunlight, and when the algae die, their decomposition by bacteria consumes vast amounts of dissolved oxygen, leading to fish kills and severely harming fisheries.

Step 3: Final Answer:
The statement that algal blooms improve water quality and promote fisheries is incorrect; they have the opposite effect. Therefore, option (D) is the answer.

Quick Tip

Remember that "eutrophication" and "algal blooms" are negative terms in ecology. They lead to high BOD, oxygen depletion, and a decline in water quality and biodiversity. They are detrimental, not beneficial, to aquatic ecosystems and fisheries.

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

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

Correct Answer: (A) B and E only

Solution:

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

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.
A. This disorder was first described by Dr. Harry Klinefelter in 1942. Langdon Down described Down's Syndrome. So, statement A is incorrect.
B. Individuals are phenotypically male but have underdeveloped testes. They have overall

masculine development but also show some feminine characteristics (gynaecomastia, or development of breasts). So, statement B is correct.
C. Affected individuals are typically tall, with longer limbs, not short statured. Short stature is a characteristic of Turner's Syndrome (45, XO). So, statement C is incorrect.
D. This statement describes features more characteristic of Down's Syndrome (Trisomy 21). While some individuals with Klinefelter's may have learning difficulties, severe retardation is not a typical feature. So, statement D is incorrect.
E. Due to underdeveloped testes (testicular atrophy), individuals with Klinefelter's Syndrome are infertile or **sterile**. So, statement E is correct.

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

Quick Tip

For chromosomal disorders, memorize the key features: - **Klinefelter's (XXY):** Tall, sterile male with some female characteristics (gynaecomastia). - **Turner's (XO):** Short, sterile female with rudimentary ovaries. - **Down's (Trisomy 21):** Short stature, characteristic facial features, mental and physical developmental delays.

---

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

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

Correct Answer: (D) A and D only

Solution:

Step 1: Understanding the Question:
The question asks to identify the correct statements about bark and related structures.

Step 2: Detailed Explanation:
Let's analyze each statement:
A. Lenticels are the lens-shaped openings permitting the exchange of gases. This is correct. Lenticels are porous tissues on the bark of woody stems that allow for gas exchange

between the internal tissues and the atmosphere.
B. Bark formed early in the season is called hard bark. This is incorrect. Bark formed early in the season (spring) is called 'soft bark', while that formed late in the season (autumn) is 'hard bark'. This is analogous to early wood and late wood.
C. Bark is a technical term that refers to all tissues exterior to vascular cambium. This statement is generally correct as a broad, non-technical definition. However, in a strict botanical context, there can be nuances, which might be why it is not included in the correct answer combination. It includes primary and secondary phloem, cortex, and periderm.
D. Bark refers to periderm and secondary phloem. This is a more precise and commonly accepted technical definition of bark. The periderm (phellogen, phellem, phelloderm) and the secondary phloem together constitute the bark. This is correct.
E. Phellogen is single-layered in thickness. This statement is correct. Phellogen, or cork cambium, is a meristematic tissue that is typically a single layer of cells. However, based on the provided answer key, it is considered incorrect in the context of the given options, possibly due to ambiguity or a specific interpretation by the exam setters.

Given the options, the most definitively correct and standard textbook statements are A and D.

Step 3: Final Answer:
Based on the most accurate and unambiguous statements, A and D are correct. Therefore, option (D) is the most appropriate answer.

Quick Tip

Remember the components of bark. In a broad sense, it's everything outside the vascular cambium. More specifically, it includes Periderm + Secondary Phloem. The periderm itself consists of Phellem (cork), Phellogen (cork cambium), and Phelloderm (secondary cortex).

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

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

Correct Answer: (C) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks to identify the enzyme that is inhibited by malonate, thereby hindering bac-

terial growth.

Step 2: Detailed Explanation:
This question relates to the concept of enzyme inhibition, specifically competitive inhibition.
- **Competitive Inhibition:** Occurs when a molecule (the inhibitor) that is structurally similar to the enzyme's normal substrate binds to the active site of the enzyme, preventing the actual substrate from binding.
- **Succinic Dehydrogenase:** This is an enzyme in the Krebs cycle (citric acid cycle) that catalyzes the oxidation of succinate to fumarate.
- **Malonate:** The structure of malonate is very similar to that of succinate. Because of this structural similarity, malonate can bind to the active site of the succinic dehydrogenase enzyme. However, the enzyme cannot act on malonate. This binding blocks the active site and prevents succinate from being converted to fumarate.
By inhibiting this key enzyme in the Krebs cycle, malonate disrupts cellular respiration and ATP production, which in turn inhibits the growth of the bacteria.

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

Quick Tip

Malonate inhibiting succinic dehydrogenase is the textbook example of competitive enzyme inhibition. Associate the two: Substrate = Succinate, Inhibitor = Malonate, Enzyme = Succinic Dehydrogenase. The structural similarity is the key.

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140. 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.
(A) C, B, D, A
(B) B, D, A, C
(C) B, C, D, A
(D) C, A, B, D

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

Solution:

Step 1: Understanding the Question:
The question asks to arrange the given steps for creating a recombinant organism in the correct

chronological order.

Step 2: Detailed Explanation:
Let's analyze the logical flow of the process of creating and using recombinant DNA:
1. **Isolation of desired DNA fragment (C):** The first step is to obtain the gene of interest from the source organism. This involves isolating the total DNA and then separating the desired gene.
2. **Cutting of DNA at specific location by restriction enzyme (B):** Once the gene of interest and the vector DNA (e.g., a plasmid) are isolated, both must be cut with the same restriction enzyme to create compatible "sticky ends".
3. **Amplification of gene of interest using PCR (D):** To get many copies of the gene of interest for ligation into the vector, Polymerase Chain Reaction (PCR) is used. This step can be performed after isolation (C) and before ligation. Ligation involves joining the gene into the cut vector using DNA ligase (this step is implied between D and A).
4. **Insertion of recombinant DNA into the host cell (A):** After the gene is ligated into the vector, creating the recombinant DNA molecule, this molecule is introduced into a suitable host cell (like a bacterium) for replication and expression. This process is called transformation.

The correct sequence is C $\rightarrow$ B $\rightarrow$ D $\rightarrow$ A.

Step 3: Final Answer:
The correct sequence of steps is Isolation (C), Cutting (B), Amplification (D), and Insertion (A). This corresponds to option (A).

Quick Tip

Think of the process like building with LEGOs: 1. **Isolate (C):** Find the specific LEGO brick you want (gene). 2. **Cut (B):** Use a tool (restriction enzyme) to make a space in your LEGO base (vector) and to prepare your brick. 3. **Amplify (D):** Make many copies of your special brick (gene using PCR). 4. **Insert (A):** Put the new brick into the base and then put the whole creation into a "factory" (host cell) to make more.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's match each element with its function:
- **A. Iron (Fe):** It is an important constituent of proteins involved in electron transfer like ferredoxin and cytochromes. It is also required for the activation of the enzyme **catalase** and is essential for the formation of chlorophyll. So, **A matches with III**.
- **B. Zinc (Zn):** It activates various enzymes, especially carboxylases. It is also needed for the **synthesis of auxin**, a key plant growth hormone. So, **B matches with I**.
- **C. Boron (B):** It is required for uptake and utilization of Ca^{2+}, membrane functioning, pollen germination, **cell elongation**, and **cell differentiation**. So, **C matches with IV**.
- **D. Molybdenum (Mo):** It is a component of several enzymes, including **nitrate reductase** and nitrogenase, both of which are crucial for nitrogen metabolism. So, **D matches with II**.

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

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

Quick Tip

Create flashcards or a table to memorize the specific functions of essential micronutrients. Key associations to remember are: Zn → Auxin synthesis, Mo → Nitrate reductase, B → Pollen germination, Fe → Catalase/chlorophyll synthesis.

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142. Match List I with List II :
List I
A. Cohesion
B. Adhesion
C. Surface tension
D. Guttation
List II
I. More attraction in liquid phase

II. Mutual attraction among water molecules
III. Water loss in liquid phase
IV. Attraction towards polar surfaces

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching the terms related to water properties and transport in plants (List I) with their correct definitions (List II).

Step 2: Detailed Explanation:
Let's match each term with its definition:
- **A. Cohesion:** Refers to the force of attraction between molecules of the same substance. In this context, it is the **mutual attraction among water molecules**, which is due to hydrogen bonding. So, **A matches with II**.
- **B. Adhesion:** Refers to the force of attraction between molecules of different substances. In plants, it's the **attraction of water molecules towards polar surfaces**, such as the walls of the xylem vessels. So, **B matches with IV**.
- **C. Surface tension:** A property of liquids arising from cohesion. Water molecules at the surface are more attracted to each other in the liquid phase than to molecules in the gas phase above, creating a 'skin' on the surface. This is described as **more attraction in the liquid phase**. So, **C matches with I**.
- **D. Guttation:** The exudation of drops of xylem sap from the tips or margins of leaves of some vascular plants. It is essentially **water loss in the liquid phase**, not as vapor (which is transpiration). So, **D matches with III**.

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

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

Quick Tip

Remember the 'C' and 'A' in Cohesion and Adhesion: - **Co**hesion: Attraction between **co**-workers (same type of molecule - water). - **Ad**hesion: Attraction to an **ad**ditional surface (different type - water and xylem). Guttation is often confused with dew; remember guttation is water coming *from inside* the plant.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to match the metabolic processes in List I with the associated enzyme, pathway, or system in List II.

Step 2: Detailed Explanation:
Let's match each process with its corresponding term:
- **A. Oxidative decarboxylation:** This is a key step linking glycolysis and the Krebs cycle. Pyruvate is converted to acetyl-CoA, releasing CO_2 and producing NADH. This reaction is catalyzed by the **pyruvate dehydrogenase** complex. So, **A matches with II**.
- **B. Glycolysis:** The metabolic pathway that converts glucose into pyruvate. It is also known as the **EMP (Embden-Meyerhof-Parnas) pathway**, named after its discoverers. So, **B matches with IV**.
- **C. Oxidative phosphorylation:** The final stage of cellular respiration where the energy from NADH and $FADH_2$ is used to produce a large amount of ATP. This process occurs via the **electron transport system (ETS)** located on the inner mitochondrial membrane. So, **C matches with III**.
- **D. Tricarboxylic acid (TCA) cycle:** Also known as the Krebs cycle or citric acid cycle. The first step of this cycle involves the enzyme **citrate synthase**, which catalyzes the reaction between acetyl-CoA and oxaloacetate to form citrate. So, **D matches with I**.

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

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

Quick Tip

Associate alternative names and key enzymes with metabolic pathways: - Glycolysis = EMP pathway. - TCA Cycle = Krebs Cycle / Citric Acid Cycle (starts with Citrate Synthase). - Link reaction = Oxidative decarboxylation (catalyzed by Pyruvate Dehydrogenase). - ATP synthesis via ETS = Oxidative Phosphorylation.

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

(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 asks to match the phases of the cell cycle in List I with their descriptions in List II.

Step 2: Detailed Explanation:
Let's match each phase with its description:
- **A. M Phase (Mitosis):** This is the phase of actual cell division where the chromosome number is maintained. It is therefore known as **equational division**. So, **A matches with IV**.
- **B. G_2 Phase (Gap 2):** This phase occurs after DNA replication (S phase) and before the M phase. During G_2, the cell continues to grow and synthesizes proteins (like tubulin for microtubules) required for mitosis. Thus, it's a phase where **proteins are synthesized**. So, **B matches with I**.
- **C. Quiescent stage (G_0):** This is a non-dividing state that cells can enter from G_1. The cell is metabolically active but does not proliferate further. It is considered an **inactive phase** with respect to the cell cycle. So, **C matches with II**.

- **D. G_1 Phase (Gap 1):** This is the first growth phase and represents the **interval between the end of mitosis (M phase) and the initiation of DNA replication (S phase)**. So, **D matches with III**.

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

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

Quick Tip

Visualize the cell cycle as a clock: M $\rightarrow$ G_1 $\rightarrow$ S $\rightarrow$ G_2 $\rightarrow$ M. - G_1 is the gap between Mitosis and Synthesis. - S is Synthesis of DNA. - G_2 is the gap between Synthesis and Mitosis. - G_0 is an exit ramp from G_1 for cells that stop dividing.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the essential components required for the process of chemiosmosis, which is responsible for ATP synthesis.

Step 2: Detailed Explanation:
Chemiosmosis, as proposed by Peter Mitchell, is the mechanism by which ATP is produced during cellular respiration and photosynthesis. It requires four key components:
1. A **membrane**: This must be an intact, impermeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) to create a separate compartment and maintain a concentration gradient.
2. A **proton pump**: This is a mechanism to actively transport protons (H^+) across the membrane from one side to the other. In respiration and photosynthesis, this is accomplished by the electron transport chain (ETC), which uses the energy from electrons to pump protons.
3. A **proton gradient**: The pumping of protons creates a difference in proton concentration and electrical charge across the membrane. This stored potential energy is called the proton-motive force.
4. **ATP synthase**: This is a large enzyme complex embedded in the membrane. It has a

channel that allows protons to flow back down their electrochemical gradient. The energy released by this flow is used by the enzyme to synthesize ATP from ADP and inorganic phosphate.

Analyzing the options, option (C) includes all four essential components. Option (A) is missing the membrane. Options (B) and (D) incorrectly list NADP synthase (the enzyme is NADP reductase) and an electron gradient instead of a proton gradient.

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

Quick Tip

Think of chemiosmosis like a hydroelectric dam:
- **Membrane** = The dam wall.
- **Proton Pump** = The pump that fills the reservoir with water (protons).
- **Proton Gradient** = The high water level in the reservoir (stored potential energy).
- **ATP Synthase** = The turbine that generates electricity (ATP) as water flows through it.
All four parts are essential for the system to work.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to evaluate two statements. The first defines the Competitive Exclusion Principle, and the second compares the effect of competition on carnivores and herbivores.

Step 2: Detailed Explanation:
Analysis of Statement I: This statement provides a precise and accurate definition of Gause's 'Competitive Exclusion Principle'. The principle posits that when two species have completely overlapping niches (i.e., compete for the exact same limited resources), one species will be able to use the resources more efficiently and will eventually drive the other species to local extinction. Thus, Statement I is correct.

Analysis of Statement II: This statement is a broad generalization that is not necessarily true and is considered false in ecology. Competition can be intense at any trophic level. While carnivores may compete for mobile and scarce prey, herbivores often compete for limited high-quality forage, water, or territory. Herbivores are also subject to both competition from other herbivores and predation pressure from carnivores. It cannot be stated as a general rule that carnivores are *more* adversely affected than herbivores. The intensity of competition depends on resource availability and the degree of niche overlap, not simply the trophic level. Thus, Statement II is false.

Step 3: Final Answer:
Statement I is a correct definition, while Statement II is an incorrect generalization. Therefore, option (A) is the correct answer.

Quick Tip

Gause's principle is a fundamental concept in community ecology. Remember its key condition: it applies only when two species compete for the *exact same limiting resources* (i.e., their niches are identical). In nature, species often avoid exclusion through resource partitioning or niche differentiation.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Analysis of Assertion A: This statement is correct. Most gymnosperms are anemophilous, meaning they are pollinated by wind. Their pollen grains are light and produced in large quantities, and are released from the microsporangia to be carried by air currents.

Analysis of Reason R: This statement is incorrect. While air currents do carry the pollen grains towards the ovule (not directly to the archegonia), the last part of the statement, "pollen tube is not formed," is definitively false. Most gymnosperms exhibit siphonogamy, which is the formation of a pollen tube. The pollen grain germinates on the nucellus near the micropyle and forms a pollen tube that grows towards the archegonium to deliver the male gametes for fertilization.

Step 3: Final Answer:
Assertion A is a true statement about gymnosperm pollination. Reason R is a false statement because gymnosperms do form a pollen tube. Therefore, option (A) is the correct answer.

Quick Tip

A key evolutionary advancement in both gymnosperms and angiosperms is the development of the pollen tube (siphonogamy). This adaptation eliminated the need for water for fertilization, allowing these plants to colonize a wider range of terrestrial habitats.

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

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching different types of ecological interactions with the symbols representing their effect on the two interacting species (A and B). The symbols are: + (benefit), - (harm), O (no effect).

Step 2: Detailed Explanation:
Let's define each interaction and find its corresponding symbolic representation:
- **A. Mutualism:** An interaction where both species benefit. This is represented as (+, +). So, **A matches with IV**.
- **B. Commensalism:** An interaction where one species benefits, and the other is neither harmed nor benefited (unaffected). This is represented as (+, O). So, **B matches with I**.
- **C. Amensalism:** An interaction where one species is harmed, and the other is unaffected. This is represented as (-, O). So, **C matches with II**.
- **D. Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other (the host). This is represented as (+, -). So, **D matches with III**.

The correct set of matches is A-IV, B-I, C-II, D-III.

Step 3: Final Answer:
Comparing our matches with the given options, option (D) correctly represents the relationships: A-IV, B-I, C-II, D-III.

Quick Tip

Memorize the symbolic representations for all major population interactions: - Mutualism (+,+) - Competition (-,-) - Predation (+,-) - Parasitism (+,-) - Commensalism (+,0) - Amensalism (-,0) This is a frequently tested concept.

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149. 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.

Step 2: Detailed Explanation:
Ribosomes are complex molecular machines, found in all living cells, that serve as the site of biological protein synthesis (translation). They are composed of ribosomal RNA (rRNA) and proteins. The exact number of proteins differs between prokaryotic and eukaryotic ribosomes.
- **Prokaryotic (70S) ribosomes** consist of about 55 different proteins.
- **Eukaryotic (80S) ribosomes** are larger and more complex, consisting of approximately **80** different proteins.

Since the question does not specify the type of organism, and "80" is a prominent option, it is referring to the eukaryotic ribosome. The other options are either too low (20, 40) or not as accurate as 80.

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

Quick Tip

Remember that eukaryotic structures are generally more complex than their prokaryotic counterparts. The eukaryotic 80S ribosome is larger, has larger rRNA molecules, and contains more proteins (80) than the prokaryotic 70S ribosome (55 proteins).

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

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) regarding the morphological nature of a flower and asks to evaluate their correctness and relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A: This statement provides the standard botanical definition of a flower. Morphologically, a flower is considered a highly modified and condensed shoot, specialized for reproduction. The transition from a vegetative shoot to a flower involves the transformation of the shoot apical meristem into a floral meristem, which has determinate growth. So, Assertion A is true.

Analysis of Reason R: This statement explains the process of modification described in the assertion. When the shoot becomes a flower, the axis (receptacle) becomes condensed because the internodes do not elongate. At the nodes of this condensed axis, floral appendages (sepals, petals, stamens, and carpels—which are homologous to leaves) develop laterally instead of normal foliage leaves. So, Reason R is also true.

Relationship between A and R: Reason R details the specific changes—condensation of internodes and development of floral appendages instead of leaves—that characterize the "modified shoot" mentioned in Assertion A. It correctly explains *how* and *why* a flower is considered a modified shoot. Therefore, R is the correct explanation of A.

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

Quick Tip

Remember that all parts of a flower—sepals, petals, stamens, and carpels—are considered evolutionarily modified leaves. The receptacle on which they are borne is a modified, condensed stem. This "modified shoot" concept is central to understanding floral morphology.
