NEET UG 2023 F3 Botany Question Paper with Solutions

Time Allowed :3 Hours	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. Among eukaryotes, replication of DNA takes place in :

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

(D) M phase

Correct Answer: (A) S phase

Solution:

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

Step 2: Detailed Explanation:
The eukaryotic cell cycle is divided into two main stages: Interphase and M phase (Mitotic phase).
Interphase is further subdivided into three phases:

- **G_1 phase (Gap 1):** This is the phase of cell growth where the cell synthesizes proteins and other molecules, but not DNA.
- **S phase (Synthesis):** This is the phase where DNA replication occurs, resulting in the duplication of the cell's chromosomes. Each chromosome, which initially consists of a single chromatid, is replicated to form two sister chromatids.
- **G_2 phase (Gap 2):** The cell continues to grow and prepares for mitosis.

M phase (Mitosis): This is the phase of nuclear and cell division.
Therefore, DNA replication is specifically confined to the S phase of the interphase.

Step 3: Final Answer:
Based on the stages of the cell cycle, DNA replication takes place during the S phase. Hence, option (A) is the correct answer.

Quick Tip

Remember the cell cycle order: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$. The 'S' in S phase stands for 'Synthesis', which refers to the synthesis of new DNA. This is a fundamental concept frequently tested in biology exams.

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102. Cellulose does not form blue colour with Iodine because

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

(D) It is a disaccharide

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

Solution:

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

Step 2: Detailed Explanation:
The iodine test is used to detect the presence of starch. Starch is a polysaccharide composed of two components: amylose and amylopectin.
Amylose has a helical secondary structure. When iodine solution (I_2-KI) is added, the iodine molecules (specifically, I_3^- and I_5^- ions) get trapped inside these helices, forming a charge-transfer complex that absorbs light, resulting in a characteristic blue-black color.
Cellulose is also a polysaccharide made of glucose units, but it has a different structure. It is a linear polymer of β-1,4-linked glucose units. This structure results in straight chains that form fibrils, but it does not form the complex helical structure necessary to hold iodine molecules.
Since cellulose cannot trap iodine molecules within its structure, it does not produce the blue color when treated with iodine.

Step 3: Final Answer:
Cellulose does not have a helical structure capable of trapping iodine molecules, which is why it doesn't turn blue with iodine. Therefore, the correct explanation is that it does not contain complex helices and hence cannot hold iodine molecules. Option (B) is correct.

Quick Tip

Associate the iodine test with the helical structure of starch (specifically amylose). Contrast this with the linear, fibrous structure of cellulose. This structural difference is key to their different chemical properties.

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

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

Correct Answer: (B) Tungsten or gold

Solution:

Step 1: Understanding the Question:
The question is about the gene gun method (biolistics), a technique in biotechnology for genetic transformation. It specifically asks which metals are used for the microparticles that carry the DNA.

Step 2: Detailed Explanation:
The gene gun method, also known as biolistics, is a physical method of introducing foreign DNA into cells. In this technique, microscopic particles (microprojectiles) are coated with the desired DNA.
These DNA-coated microparticles are then accelerated to a high velocity and fired into the target cells or tissues.
The metals used for these microparticles must be dense enough to have sufficient momentum to penetrate the cell walls and membranes, and they must also be chemically inert so they don't react with the DNA or cellular components.
Gold (Au) and Tungsten (W) are the metals of choice for this purpose due to their high density and biological inertness. Zinc, silver, and copper are not typically used as they can be toxic to cells or may not have the ideal physical properties.

Step 3: Final Answer:
The metals used as microparticles in the gene gun method are tungsten or gold. Therefore, option (B) is the correct answer.

Quick Tip

For biotechnology techniques, remember the key materials used. For the gene gun method, associate it with heavy, inert metals like gold and tungsten. This method is particularly useful for transforming plant cells, which have rigid cell walls.

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

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

Correct Answer: (A) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks about the function of "tassels in the corn cob". This phrasing is slightly ambiguous. In botany, the tassel is the male inflorescence at the top of the corn plant, which

produces pollen. The silks are the feathery threads that emerge from the top of the ear (cob), which are the stigmas of the female flowers and function to trap pollen. Given the options and the provided answer, the question likely uses the term "tassels" to refer to the silks of the corn cob, a common colloquial confusion.

Step 2: Detailed Explanation:
Let's analyze the structures of a corn plant:

- **Tassel:** This is the male flower cluster located at the apex of the plant. Its function is to produce and release (disperse) pollen grains. Corn is wind-pollinated, so the tassel releases large amounts of light pollen into the air.

- **Ear (Cob):** This is the female inflorescence, located on the side of the stalk. It contains the ovules that develop into kernels (seeds) after fertilization.

- **Silk:** These are the long, thread-like styles and stigmas of the female flowers on the cob. They emerge from the top of the husk. The function of the silks is to catch the airborne pollen grains released from the tassel.

Based on the official answer key, the correct answer is (A) "To trap pollen grains". This is the function of the corn silk, not the tassel. Therefore, we must infer that the question uses "tassels in the corn cob" to refer to the silks.
If we interpret the question this way, the function of the silks (referred to as tassels in the question) is indeed to trap pollen grains to facilitate fertilization.
Option (B) "To disperse pollen grains" is the function of the actual tassel at the top of the plant.

Step 3: Final Answer:
Assuming "tassels in the corn cob" refers to the corn silks, their function is to trap pollen grains. Therefore, option (A) is the correct answer.

Quick Tip

Be aware that exam questions can sometimes use imprecise or colloquial terms. If the botanically correct answer (dispersing pollen for tassels) isn't the keyed answer, consider alternative interpretations. In this case, "tassels in the corn cob" likely refers to the silks, whose function is to trap pollen.

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

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

Solution:

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

Step 2: Detailed Explanation:
Analyzing Assertion A:
In temperate regions, the cambium's activity varies with the seasons. The wood formed during the later part of the growing season (autumn/late summer) is called late wood or autumn wood. This wood is characterized by having fewer xylary elements, and the vessels are narrower and thicker-walled. This makes the late wood denser. So, Assertion A is true.

Analyzing Reason R:
The vascular cambium is responsible for secondary growth, producing secondary xylem and phloem. Its activity is influenced by environmental factors like temperature and light. During winters or unfavorable seasons, the cambium becomes less active. So, Reason R is true.

Relating R and A:
The reduced activity of the cambium during the unfavorable conditions of late summer and autumn (leading into winter) is the direct cause for the change in the structure of the wood produced. Because the cambium is less active, it produces fewer xylary elements, and the ones it does produce (like vessels) are smaller in diameter (narrower). This is an adaptation to reduced water availability and metabolic rate. Therefore, the reason (R) that the cambium is less active in winters correctly explains the assertion (A) that late wood has fewer xylary elements with narrow vessels.

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

Quick Tip

For Assertion-Reason questions, follow a three-step process:
1. Check if the Assertion is true.
2. Check if the Reason is true.
3. If both are true, check if the Reason correctly explains the Assertion by asking "Why?" or "Because". "Late wood has narrow vessels because the cambium is less active in winters." This logical connection holds true.

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

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

Correct Answer: (A) 1992

Solution:

Step 1: Understanding the Question:
This is a factual question asking for the year in which the Earth Summit, where the Convention on Biological Diversity was presented, took place in Rio de Janeiro.

Step 2: Detailed Explanation:
The United Nations Conference on Environment and Development (UNCED), commonly known as the Rio Summit or Earth Summit, was a major United Nations conference held in Rio de Janeiro, Brazil.
This historic event took place from June 3 to June 14, 1992.
One of the key outcomes of the Earth Summit was the opening for signature of the Convention on Biological Diversity (CBD), a multilateral treaty with objectives to conserve biological diversity, ensure the sustainable use of its components, and promote the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

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

Quick Tip

Remember key dates and locations of major environmental conferences. The 1992 Rio Earth Summit is a landmark event. Another important one is the Kyoto Protocol (1997) related to climate change.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the specific function of RNA polymerase III in eukaryotic transcription.

Step 2: Detailed Explanation:
In eukaryotes, there are at least three distinct types of RNA polymerases in the nucleus, each responsible for transcribing different classes of genes.

- **RNA Polymerase I:** Located in the nucleolus, it transcribes the genes for ribosomal RNAs (rRNAs), specifically the 28S, 18S, and 5.8S rRNA molecules.
- **RNA Polymerase II:** Located in the nucleoplasm, it is responsible for transcribing protein-coding genes into messenger RNA (mRNA) precursors (called hnRNA), as well as most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).
- **RNA Polymerase III:** Located in the nucleoplasm, it transcribes the genes for transfer RNA (tRNA), 5S rRNA (the only rRNA not transcribed by Pol I), and some other small RNAs, including the U6 snRNA.

Comparing these roles with the given options: (A) Transcription of tRNA, 5S rRNA and snRNA - This correctly describes the function of RNA Pol III. (B) Transcription of precursor of mRNA - This is the function of RNA Pol II. (C) Transcription of only snRNAs - This is incomplete; it transcribes other RNAs too, and Pol II also transcribes snRNAs. (D) Transcription of rRNAs (28S, 18S and 5.8S) - This is the function of RNA Pol I.

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

Quick Tip

Create a simple table to memorize the functions of eukaryotic RNA polymerases:

- Pol I → rRNA (most)
- Pol II → mRNA (and snRNA, miRNA)
- Pol III → tRNA, 5S rRNA

Use the mnemonic "R-M-T" for Polymerase "1-2-3".

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

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

Correct Answer: (A) Selaginella and Salvinia

Solution:

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

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 pteridophytes:** Produce only one type of spore, which develops into a bisexual gametophyte (possessing both antheridia and archegonia). Examples include most ferns, Lycopodium, Equisetum, and Psilotum.
- **Heterosporous pteridophytes:** Produce two distinct types of spores: smaller microspores and larger megaspores. Microspores develop into male gametophytes, and megaspores develop into female gametophytes. This condition is a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples are Selaginella, Salvinia, Marsilea, and Azolla.

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

Step 3: Final Answer:
The only pair where both members are heterosporous is Selaginella and Salvinia. Therefore, option (A) is correct.

Quick Tip

For exams, it's crucial to remember the key examples of homosporous vs. heterosporous pteridophytes. Selaginella and Salvinia are the most frequently cited examples of heterospory. Remember that heterospory is an important evolutionary step towards seed development.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Analyzing Statement I:
This statement refers to the transpiration pull theory, also known as the cohesion-tension theory, which explains the ascent of sap. The evaporation of water from leaves (transpiration) creates a negative pressure potential or tension in the xylem. This pull is transmitted down the continuous water column in the xylem to the roots. The cohesive forces between water molecules and adhesive forces between water and xylem walls allow this column to be pulled up against gravity. The magnitude of this transpiration pull is very high, sufficient to lift water to the tops of the tallest trees, which can exceed 100 meters (e.g., Redwood trees). Therefore, lifting a water column over 130 meters is a scientifically accepted capability of this mechanism. Statement I is correct.

Analyzing Statement II:
Transpiration is the process of water evaporation from the plant surface, primarily the leaves. Evaporation is a cooling process because it requires energy, known as the latent heat of vaporization. As water evaporates from the leaf surface, it absorbs heat from the leaf, thereby lowering its temperature. This evaporative cooling can prevent leaves from overheating when exposed to intense sunlight. The cooling effect can indeed lower the leaf temperature by 10 to 15 degrees Celsius compared to the surrounding air. Statement II is correct.

Step 3: Final Answer:
Both statements describe well-established physiological roles of transpiration. Both Statement I and Statement II are correct. Hence, option (D) is the correct answer.

Quick Tip

Remember the dual role of transpiration: it is both the 'engine' for water transport (ascent of sap) and a vital mechanism for thermoregulation (cooling) in plants. While often called a 'necessary evil' due to water loss, its benefits are crucial for plant survival.

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

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

Correct Answer: (D) 680 nm

Solution:

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

Step 2: Detailed Explanation:
In the light-dependent reactions of photosynthesis, two photosystems work in sequence: Photosystem II (PS II) and Photosystem I (PS I).
Each photosystem consists of a light-harvesting complex (antenna molecules) and a reaction center.
The reaction center is a special pair of chlorophyll 'a' molecules that can be excited by light energy and donate an electron to a primary electron acceptor.
The reaction centers of the two photosystems are named based on the wavelength of light at which they show maximum absorption:

- **Photosystem I (PS I):** The reaction center is called **P700** because it absorbs light most effectively at a wavelength of 700 nm.

- **Photosystem II (PS II):** The reaction center is called **P680** because it absorbs light most effectively at a wavelength of 680 nm.

The question specifically asks about PS II.

Step 3: Final Answer:
The reaction center in Photosystem II (PS II) is P680, which has an absorption maximum at 680 nm. Therefore, option (D) is the correct answer.

Quick Tip

A simple way to remember is that PS II comes before PS I in the electron flow path (non-cyclic photophosphorylation), but its name corresponds to a shorter wavelength (680 nm) compared to PS I (700 nm). Remember: PS II (P680) $\rightarrow$ PS I (P700).

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

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

Correct Answer: (D) Habitat loss and fragmentation

Solution:

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

Step 2: Detailed Explanation:
'The Evil Quartet' is a term used to describe the four main causes of biodiversity loss and species extinction. These are:

1. **Habitat Loss and Fragmentation:** This involves the destruction or division of natural habitats due to activities like deforestation, urbanization, and agriculture. It is widely regarded as the single most important cause of extinction. When an organism's habitat is destroyed, it loses its source of food, shelter, and breeding grounds, leading to a population decline and eventual extinction.
2. **Over-exploitation:** This refers to the harvesting of species from the wild at rates faster than natural populations can recover. This includes overfishing, overhunting, and excessive logging.

3. **Alien Species Invasions:** When non-native species are introduced into an ecosystem (intentionally or unintentionally), they can outcompete native species for resources, introduce diseases, or become predators, leading to the decline or extinction of native species.
4. **Co-extinctions:** This occurs when the extinction of one species causes the extinction of another species that depended on it. For example, a host-specific parasite will go extinct if its host goes extinct.

Among these four major causes, ecologists consider habitat loss and fragmentation to be the most significant driver of species extinction globally.

Step 3: Final Answer:
The most important cause driving the extinction of species among 'The Evil Quartet' is Habitat loss and fragmentation. Therefore, option (D) is the correct answer.

Quick Tip

Remember the four components of 'The Evil Quartet': Habitat Loss, Over-exploitation, Alien Species, and Co-extinctions. While all are significant threats, always prioritize Habitat Loss and Fragmentation as the number one cause of biodiversity loss in exam questions.

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

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

Correct Answer: (B) Anaphase II

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific stage of meiosis where the centromere, which holds sister chromatids together, divides.

Step 2: Detailed Explanation:
Meiosis is a two-stage cell division process.
Meiosis I: This is a reductional division. In Anaphase I, homologous chromosomes separate, but sister chromatids remain attached at the centromere. The centromeres do not divide.
Meiosis II: This is an equational division, similar to mitosis.
- **Metaphase II:** Chromosomes align at the metaphase plate.
- **Anaphase II:** The centromeres of each chromosome finally divide, and the sister chromatids are pulled apart to opposite poles. These separated chromatids are now considered individual

chromosomes.
- **Telophase:** The chromosomes arrive at the poles, and nuclear envelopes reform.
Therefore, the division of the centromere occurs during Anaphase II.

Step 3: Final Answer:
Based on the process of meiosis, the division of the centromere occurs in Anaphase II.

Quick Tip

Remember: Meiosis I separates homologous chromosomes, while Meiosis II separates sister chromatids. The separation of sister chromatids requires the division of the centromere, which happens in Anaphase II.

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

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

Correct Answer: (A) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks which plant hormone (phytohormone) is used to speed up the maturation process in young conifers to promote earlier seed production.

Step 2: Detailed Explanation:
Phytohormones have various roles in plant growth and development.
- **Gibberellic Acid (GA):** Gibberellins are known to promote bolting (internode elongation just before flowering) and overcome juvenility. In conifers, the juvenile phase can be long. Spraying with gibberellic acid can hasten the transition to the mature, reproductive phase, leading to early cone and seed production.
- **Zeatin:** A type of cytokinin, primarily involved in cell division, chloroplast development, and delaying senescence. It does not hasten maturity.
- **Abscisic Acid (ABA):** A stress hormone involved in dormancy, stomatal closure, and inhibiting growth. It would delay, not hasten, maturity.
- **Indole-3-butyric Acid (IBA):** An auxin, primarily used to promote root formation in cuttings. It is not used for hastening maturity.
Thus, Gibberellic Acid is the correct phytohormone for this purpose.

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

Quick Tip

Associate Gibberellins with "bolting" and overcoming "juvenility". This is a direct application mentioned in many textbooks.

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

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

Solution:

Step 1: Understanding the Question:
The question requires evaluating five statements related to the process of decomposition and identifying the combination of correct statements.

Step 2: Detailed Explanation:
Let's analyze each statement:
A. Detrivores perform fragmentation. This is correct. Detritivores, such as earthworms, physically break down 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 at an extremely slow rate. It is eventually degraded by microbes, releasing inorganic nutrients in a process 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 nutrients, such as nitrates and phosphates, are washed down through the soil profile and can become unavailable to plants. The statement says they "get precipitated," which refers to them becoming unavailable as salts. This is part of the overall process of leaching.
D. The detritus food chain begins with living organisms. This is incorrect. The detritus food chain (DFC) begins with dead organic matter (detritus), whereas 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 called 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 includes only A, B, and C.

Quick Tip

Remember the key steps of decomposition: Fragmentation (physical breakdown), Leaching (nutrient movement), Catabolism (enzymatic breakdown), Humification (humus formation), and Mineralization (release of inorganic nutrients).

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

(A) Molybdenum
(B) Magnesium
(C) Copper
(D) Manganese

Correct Answer: (D) Manganese

Solution:

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

Step 2: Key Formula or Approach:
The overall reaction for photolysis of water is:

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

This reaction occurs in the oxygen-evolving complex (OEC) of Photosystem II.

Step 3: Detailed Explanation:
- **Manganese (Mn):** Manganese is a crucial component of the oxygen-evolving complex (OEC). A cluster of four manganese ions (Mn^{4+}) is central to the catalytic site that oxidizes water, releasing electrons, protons, and oxygen. Therefore, manganese is directly required for the splitting of water.

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

Step 4: Final Answer:
Manganese is the micronutrient required for the splitting of the water molecule during photosynthesis.

Quick Tip

To remember the elements for water splitting, use the mnemonic "Mangal Kal Clowngiri Karega" for Mn, Ca, and Cl (Manganese, Calcium, Chloride ions). Among the options, Manganese is the key one.

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116. Large, colourful, fragrant flowers with nectar are seen in

(A) Bird pollinated plants
(B) Bat pollinated plants
(C) Wind pollinated plants
(D) Insect pollinated plants

Correct Answer: (D) Insect pollinated plants

Solution:

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

Step 2: Detailed Explanation:
Different pollination agents are attracted by different floral characteristics. This is known as pollination syndrome.
- **Insect pollinated plants (Entomophily):** These plants have evolved features to attract insects. Their flowers are typically large, brightly coloured (to be visually conspicuous), fragrant (to attract insects from a distance), and produce nectar (as a food reward for the pollinator). This perfectly matches the description.
- **Bird pollinated plants (Ornithophily):** Flowers are often large and brightly coloured (especially red or orange), but they are usually odourless because birds have a poor sense of smell. They produce copious amounts of dilute nectar.

- **Bat pollinated plants (Chiropterophily):** Flowers are typically large, pale or white, open at night, and have a strong, musty, or fruity odour. They also produce abundant nectar.
- **Wind pollinated plants (Anemophily):** Flowers are small, inconspicuous, not colourful, lack fragrance, and do not produce nectar. They produce large amounts of light, non-sticky pollen.

Step 3: Final Answer:
The combination of large size, bright colours, fragrance, and nectar is a classic suite of adaptations for attracting insects. Therefore, these flowers are seen in insect-pollinated plants.

Quick Tip

Associate specific traits with pollinators: Insects = Colour + Fragrance + Nectar; Birds = Colour (often red) + Nectar (no scent); Wind = Small, dull, no nectar/scent, lots of pollen; Bats = Night-blooming, pale, musky odour.

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

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

Correct Answer: (C) Active Transport

Solution:

Step 1: Understanding the Question:
The question asks for the mechanism that explains the movement of ions across a cell membrane from a region of lower concentration to a region of higher concentration, i.e., "against their concentration gradient."

Step 2: Detailed Explanation:
Let's analyze the transport mechanisms:
- **Passive Transport:** This is the movement of substances across a membrane down the concentration gradient (from high to low concentration). It does not require metabolic energy. Simple diffusion is a type of passive transport.
- **Facilitated Diffusion:** This is a type of passive transport where substances move down the concentration gradient with the help of membrane proteins (channels or carriers). It does not require energy.
- **Osmosis:** This is the specific movement of water across a selectively permeable membrane from a region of high water potential (low solute concentration) to a region of low water potential (high solute concentration). It is a type of passive transport.

- **Active Transport:** This is the movement of substances across a membrane against their concentration gradient (from low to high concentration). This process requires carrier proteins and the expenditure of metabolic energy, typically in the form of ATP. The term "accumulation of ions" implies moving them to a place where they are already concentrated, which requires energy.

Step 3: Final Answer:
The movement of ions against a concentration gradient is the defining characteristic of active transport.

Quick Tip

Remember the key phrase: "Against the gradient". Whenever you see this, the answer is always active transport, which requires energy (ATP). "Down the gradient" refers to passive transport (diffusion, osmosis, facilitated diffusion).

---

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

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

Correct Answer: (D) Dobson units

Solution:

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

Step 2: Detailed Explanation:
- **Decibels (dB):** This is a unit used to measure the intensity of sound or the power level of an electrical signal.
- **Decameter (dam):** This is a unit of length equal to 10 meters. It is not used for measuring atmospheric gases.
- **Kilobase (kb):** This is a unit of length for DNA or RNA molecules, equal to 1000 base pairs.
- **Dobson units (DU):** This is the standard unit used to measure 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.

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

Quick Tip

Associate "Ozone layer" with "Dobson units". This is a standard factual point in environmental science.

---

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

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

Correct Answer: (C) Bright orange colour

Solution:

Step 1: Understanding the Question:
The question asks about the appearance of DNA when it is stained with ethidium bromide and then exposed to ultraviolet (UV) radiation. This is a standard technique in molecular biology.

Step 2: Detailed Explanation:
The technique described is related to visualizing DNA after agarose gel electrophoresis.
1. **Ethidium Bromide (EtBr):** This is a fluorescent dye that is commonly used as a stain for nucleic acids (DNA and RNA).
2. **Intercalation:** EtBr molecules insert themselves, or intercalate, between the stacked base pairs of the DNA double helix.
3. **Fluorescence:** When the DNA-EtBr complex is exposed to UV radiation, the ethidium bromide absorbs the UV light and re-emits it as visible light. This process is called fluorescence.
4. **Colour:** The emitted light is in the orange part of the visible spectrum. Therefore, the DNA bands on the gel appear as a bright orange colour under UV light.

Step 3: Final Answer:
DNA stained with ethidium bromide fluoresces bright orange when exposed to UV radiation.

Quick Tip

Remember the combination: DNA + Ethidium Bromide + UV light = Bright Orange. This is a fundamental visualization method in molecular biology labs.

---

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

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

Correct Answer: (A) Alfred Hershey and Martha Chase

Solution:

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

Step 2: Detailed Explanation:
- **Frederick Griffith (1928):** Conducted the "transforming principle" experiment with *Streptococcus pneumoniae*. He showed that some substance from dead virulent bacteria could transform non-virulent bacteria into virulent ones, but he did not identify this substance.
- **Avery, Macleoid, and McCarthy (1944):** They expanded on Griffith's work and demonstrated through biochemical experiments that the transforming principle was DNA. This was strong evidence, but some scientists were still skeptical, believing that protein contaminants could be responsible.
- **Wilkins and Franklin:** Used X-ray diffraction to study the structure of DNA, which was crucial for Watson and Crick to build their double helix model. Their work was on structure, not on proving DNA's function as genetic material.
- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using bacteriophage T2. They differentially labeled the phage's DNA with radioactive phosphorus (^{32}P) and its protein coat with radioactive sulfur (^{35}S). They found that only the ^{32}P (DNA) entered the bacterial cells during infection and was passed on to the next generation of phages. This provided the unambiguous proof that DNA is the genetic material.

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

Quick Tip

Key experiments timeline: Griffith (transformation) → Avery, Macleoid, McCarthy (identified DNA as the principle) → Hershey-Chase (unequivocal proof using radioactive tracers).

---

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

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

Correct Answer: (A) Dedifferentiation

Solution:

Step 1: Understanding the Question:
The question describes a process in plant tissue culture where mature, specialized cells (leaf mesophyll) are induced to revert to a state of active cell division to form an unorganized mass of cells called a callus. It asks for the name of this phenomenon.

Step 2: Detailed Explanation:
Let's define the terms:
- **Differentiation:** The process by which cells become specialized in structure and function (e.g., a meristematic cell becoming a mesophyll cell).
- **Dedifferentiation:** The process by which differentiated, mature cells lose their specialization and regain the ability to divide. This is exactly what happens when leaf mesophyll cells (the explant) form a callus. The specialized cells revert to a meristematic-like state.
- **Redifferentiation:** The process by which dedifferentiated cells (like those in a callus) differentiate again to form new, specialized cells, tissues, and organs.
- **Development:** A broad term encompassing all the changes an organism undergoes from its origin to maturity.
- **Senescence:** The process of aging in plants.

Step 3: Final Answer:
The phenomenon where differentiated leaf mesophyll cells revert to an undifferentiated state to form a callus is called dedifferentiation.

Quick Tip

Remember the sequence in plant tissue culture: Differentiated explant → **Dedifferentiation** → Undifferentiated callus → **Redifferentiation** → Differentiated plantlet.

---

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

Correct Answer: (D) 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) related to the use of ATP in glycolysis. We need to evaluate the truthfulness of both statements and determine if the reason correctly explains the assertion.

Step 2: Detailed Explanation:
Analysis of Assertion A: "ATP is used at two steps in glycolysis." Glycolysis is the metabolic pathway that converts glucose into pyruvate. The initial phase of glycolysis is the "preparatory" or "investment" phase, where energy is consumed.
- Step 1: Glucose is phosphorylated to Glucose-6-phosphate by the enzyme hexokinase. This step consumes one molecule of ATP.
- Step 3: Fructose-6-phosphate is phosphorylated to Fructose-1,6-bisphosphate by the enzyme phosphofructokinase. This step consumes a second molecule of ATP.
So, the assertion that ATP is used at two steps is **true**.

Analysis of Reason R: "First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1, 6-diphosphate." This statement correctly identifies the two specific steps in glycolysis where ATP is consumed. This statement is also **true**.

Relationship between A and R: Reason R provides the exact details of the two steps mentioned in Assertion A. It perfectly explains why Assertion A is true. Therefore, R is the correct explanation of A.

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

Quick Tip

For glycolysis, remember the energy balance: "Invest 2 ATP, Get 4 ATP". The investment happens at steps 1 (Glucose $\rightarrow$ G6P) and 3 (F6P $\rightarrow$ F1,6-BP). The payoff happens later. Knowing these specific steps is crucial.

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

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

Correct Answer: (A) Pachytene

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific sub-stage of Prophase I of meiosis where recombination nodules are observed. These nodules are the sites of crossing over.

Step 2: Detailed Explanation:
Prophase I of meiosis is a complex phase divided into five sub-stages:
1. **Leptotene:** Chromosomes condense and become visible.
2. **Zygotene:** Homologous chromosomes pair up in a process called synapsis, forming bivalents. The synaptonemal complex begins to form.
3. **Pachytene:** This is a relatively long stage where synapsis is complete. The paired chromosomes are called bivalents or tetrads. During this stage, crossing over (the exchange of genetic material between non-sister chromatids of homologous chromosomes) occurs. The sites of crossing over 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:** Chiasmata terminalize (move towards the ends of the chromatids), and the nuclear envelope breaks down, preparing for Metaphase I.

Step 3: Final Answer:
Based on the sequence of events, recombination nodules, the sites of crossing over, appear during the Pachytene stage.

Quick Tip

Use the mnemonic "Lazy Zebra Prefers Drinking Darjeeling" for Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis. Remember 'P' for Pachytene and 'Pairing is perfect', which allows 'crossing over' at recombination nodules.

---

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

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

Correct Answer: (B) Respiratory loss

Solution:

Step 1: Understanding the Question:
The question provides the standard ecological equation relating Gross Primary Productivity (GPP), Net Primary Productivity (NPP), and a variable 'R'. We need to identify what 'R' represents.

Step 2: Detailed Explanation:
- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (like plants) to create organic matter through photosynthesis. It represents the total amount of food or energy produced.
- Producers need to use some of this captured energy for their own life processes, such as growth, maintenance, and metabolism. The primary metabolic process that consumes this energy is cellular respiration.
- **R (Respiratory Loss):** This variable represents the amount of energy consumed by the producers for their own respiration. It is the energy that is 'lost' from the total GPP and is not available to the next trophic level.
- **Net Primary Productivity (NPP):** This is the remaining energy or organic matter after the producers have met their own respiratory needs. It is calculated as GPP minus R (NPP = GPP - R). NPP is the energy that is available to consumers (herbivores) in the ecosystem.

Step 3: Final Answer:
In the equation GPP - R = NPP, R stands for the energy lost through respiration, i.e., Respiratory loss.

Quick Tip

Think of it like a personal budget: GPP is your gross income, R (Respiration) is your essential living expenses, and NPP is your net savings (the amount you can spend or transfer to others).

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125. The phenomenon of pleiotropism refers to

(A) Presence of two alleles, each of the two genes controlling a single trait
(B) A single gene affecting multiple phenotypic expression
(C) More than two genes affecting a single character

(D) Presence of several alleles of a single gene controlling a single crossover

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

Solution:

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

Step 2: Detailed Explanation:
- **Pleiotropy:** This is a genetic phenomenon where a single gene influences two or more seemingly unrelated phenotypic traits. A mutation in a pleiotropic gene can have a range of effects on the organism. A classic example is the human genetic disorder phenylketonuria (PKU). A mutation in a single gene that codes for the enzyme phenylalanine hydroxylase leads to multiple symptoms, including mental retardation, reduced hair and skin pigmentation.
- Let's analyze the other options: - (A) This describes a dihybrid cross scenario, not pleiotropy. - (C) This describes polygenic inheritance, where a single trait (like skin colour or height) is controlled by multiple genes. It is the opposite of pleiotropy. - (D) This is an incorrect and confusing statement. The presence of several alleles of a single gene is called multiple allelism. It does not relate to controlling a crossover.

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

Quick Tip

Remember the prefixes: "Pleio-" means many and "tropy" means effects. So, pleiotropy is "one gene, many effects". This is the opposite of "polygenic", which is "many genes, one effect".

---

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

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

Correct Answer: (A) DNA

Solution:

Step 1: Understanding the Question:
The question asks which macromolecule is precipitated out of solution when chilled ethanol is

added during the DNA purification process in biotechnology.

Step 2: Detailed Explanation:
The isolation of DNA involves several steps:
1. **Lysis:** The cell wall and membranes are broken down using enzymes (like lysozyme, cellulase, chitinase) and detergents to release the cellular contents, including DNA.
2. **Removal of contaminants:** Other macromolecules like RNA, proteins, and polysaccharides are removed. RNA is removed by treatment with ribonuclease (RNase), and proteins (like histones) are removed by treatment with protease.
3. **Precipitation of DNA:** After the other macromolecules are removed, the purified DNA is in an aqueous solution. DNA is insoluble in alcohols like ethanol or isopropanol. When chilled ethanol is added to the solution, the DNA precipitates out of the aqueous solution as a mass of fine, white threads. This process is called ethanol precipitation. The chilling of ethanol helps to increase the yield of precipitated DNA.

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

Quick Tip

A key step in any DNA isolation protocol is precipitation using chilled ethanol. The DNA appears as visible threads that can be spooled out of the solution.

---

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's determine the ploidy level of the structures in a fertilized embryo sac:
- **Haploid (n) structures:** Before fertilization, the egg cell, synergids, and antipodal cells are all haploid. After fertilization, the synergids and antipodals begin to degenerate, but they are still present for some time and remain haploid.

- **Diploid (2n) structure:** The zygote is formed by the fusion of one haploid male gamete (n) with the haploid egg cell (n). Therefore, 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 secondary nucleus (or central cell, which contains two polar nuclei, n+n). This fusion of three haploid nuclei results in a triploid (3n) structure.

Now let's evaluate the options based on the required sequence (haploid, diploid, triploid):
(A) Antipodals (n), synergids (n), PEN (3n) - Incorrect sequence (n, n, 3n).
(B) **Synergids (n), Zygote (2n), Primary endosperm nucleus (3n)** - This matches the required n, 2n, 3n sequence perfectly.
(C) Synergids (n), antipodals (n), Polar nuclei (n+n, before fertilization) - Incorrect sequence and structures.
(D) Synergids (n), PEN (3n), zygote (2n) - Incorrect sequence (n, 3n, 2n).

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

Quick Tip

Remember the double fertilization event: 1st male gamete (n) + egg (n) → Zygote (2n). 2nd male gamete (n) + Central cell (2n) → PEN (3n). The remaining cells like synergids and antipodals are haploid (n).

---

128. Axile placentation is observed in

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

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

Solution:

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

Step 2: Detailed Explanation:
In **axile placentation**, the ovary is septate (divided by septa into two or more chambers or locules), and the ovules are attached to the central axis where the septa meet. Let's examine the placentation type for the plants listed in each option:

- (A) China rose (*Hibiscus*) has axile placentation. However, Beans and Lupin (both from family Fabaceae) have marginal placentation. So, this option is incorrect.
- (B) Tomato has axile placentation. Dianthus and Primrose (not given) have free-central placentation. Pea (family Fabaceae) has marginal placentation. So, this option is incorrect.
- (C) **China rose** (*Hibiscus*), **Petunia** (from family Solanaceae), and **Lemon** (*Citrus*) all exhibit axile placentation. This option is correct.
- (D) Mustard has parietal placentation. Cucumber has parietal placentation. Primrose has free-central placentation. So, this option is incorrect.

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

Quick Tip

Memorize key examples for each placentation type. For Axile placentation, remember the mnemonic "China Lemon Tomato" (China rose, Lemon, Tomato). Members of Solanaceae like Petunia and Tobacco also show axile placentation.

---

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

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

Correct Answer: (B) Ethylene

Solution:

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

Step 2: Detailed Explanation:
Deep water rice is a variety of rice that has adapted to grow in flooded conditions. Its survival mechanism involves rapid elongation to keep its leaves above the water surface for photosynthesis and gas exchange.
- The primary trigger for this response is the accumulation of the gaseous hormone **Ethylene** in the submerged parts of the plant. Waterlogging reduces the diffusion of gases, causing ethylene to build up.
- This high concentration of ethylene stimulates the synthesis of Gibberellic Acid (GA).
- Gibberellic Acid then promotes cell division and elongation in the internodes, causing the stem to grow rapidly.
- While GA_3 (Gibberellic Acid) is the hormone that directly causes the elongation, Ethylene

is the primary hormone that initiates and promotes this entire response to submergence. The question asks what "promotes" the elongation, and ethylene is the key promoter in this specific context.
- Kinetin is a cytokinin (promotes cell division). 2,4-D is a synthetic auxin (used as a herbicide).

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

Quick Tip

Remember that in deep water rice, submergence traps Ethylene. This accumulated Ethylene acts as a signal to trigger rapid stem elongation, allowing the plant to escape the flood.

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130. Given below are two statements: One labelled as Assertion A and the other 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 options given below:

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

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

Solution:

Step 1: Understanding the Question:
We need to evaluate the Assertion (A) and Reason (R) about the moss life cycle. We must determine if each statement is true and if R correctly explains A.

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

Analysis of Reason R: "Protonema develops directly from spores produced in capsule." The capsule is part of the sporophyte, which grows on the gametophyte. Inside the capsule, spore

mother cells undergo meiosis to produce haploid spores. When these spores are released and land on a suitable substrate, they germinate and develop directly into the protonema. So, the reason is also **true**.

Relationship between A and R: The reason states how the protonema is formed (from a spore). Since the protonema is the structure that emerges from the spore, it is logically the "first stage" of the gametophyte's development. Thus, the reason correctly explains the assertion.

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

Quick Tip

Remember the moss life cycle order: Spore → Protonema (first stage of gametophyte) → Leafy gametophyte → Gametes → Zygote → Sporophyte (with capsule) → Spores.

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

Correct Answer: (B) Alfred Sturtevant

Solution:

Step 1: Understanding the Question:
The question asks to identify the scientist who first used recombination frequencies to create genetic maps.

Step 2: Detailed Explanation:
- **Sutton and Boveri** independently proposed the Chromosomal Theory of Inheritance, which states that genes are located on chromosomes.
- **Henking** was one of the early cytologists who discovered the X chromosome.
- **Thomas Hunt Morgan**, through his extensive work on *Drosophila melanogaster*, provided experimental proof for the Chromosomal Theory of Inheritance and discovered concepts like linkage and recombination. He observed that the frequency of recombination between linked genes varied.
- **Alfred Sturtevant**, who was a student in T.H. Morgan's lab, had a crucial insight. In 1913, he proposed that the percentage of recombination between two genes is proportional to the

physical distance between them on the chromosome. He used this concept to construct the first-ever genetic map for the X chromosome of *Drosophila*.

Step 3: Final Answer:
Alfred Sturtevant was the first to use recombination frequency to map the positions of genes on a chromosome.

Quick Tip

While T.H. Morgan is the father of experimental genetics with *Drosophila*, his student Alfred Sturtevant is credited with being the "map maker." Remember Sturtevant = Genetic Maps.

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

Correct Answer: (D) Diadelphous and Dithecous anthers

Solution:

Step 1: Understanding the Question:
The question asks to identify the characteristic feature of the stamens in the family Fabaceae that distinguishes it from the families Solanaceae and Liliaceae.

Step 2: Detailed Explanation:
Let's analyze the stamen characteristics of the three families:
- **Fabaceae:** The androecium typically consists of ten stamens. A very common and characteristic arrangement is **diadelphous**, where the stamens are united into two bundles, usually in a (9)+1 arrangement (nine filaments are fused to form a tube, and one is free). The anthers are **dithecous** (having two lobes).
- **Solanaceae:** The androecium has five stamens which are **epipetalous** (attached to the petals). The anthers are dithecous.
- **Liliaceae:** The androecium has six stamens, arranged in two whorls of three (3+3). They are **epiphyllous** or epitepalous (attached to the tepals). The anthers are dithecous.

Now let's check the options: (A) Polyadelphous (many bundles) is seen in Citrus. Epipetalous is in Solanaceae. (B) Monoadelphous (one bundle) is seen in China rose (Malvaceae). Monothecous anthers are also found in Malvaceae. (C) Epiphyllous is in Liliaceae. (D) **Diadelphous**

is a hallmark feature of Fabaceae (specifically the subfamily Papilionoideae). Dithecous anthers are common to all three, but the diadelphous condition is specific to Fabaceae among the choices and differentiates it from the other two families.

Step 3: Final Answer:
The characteristic combination of diadelphous stamens and dithecous anthers is specific to Fabaceae in this context.

Quick Tip

Associate key floral features with families: Fabaceae = Diadelphous stamens (9)+1; Solanaceae = Epipetalous stamens; Liliaceae = Epiphyllous/Epitepalous stamens.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the total number of ATP and NADPH molecules (written as $NADPH_2$ in older convention, meaning NADPH + H^+) required to produce one molecule of glucose via the Calvin cycle.

Step 2: Key Formula or Approach:
The Calvin cycle must turn multiple times to produce one molecule of glucose ($C_6H_{12}O_6$). - The Calvin cycle fixes one molecule of CO_2 per turn. - To make one molecule of glucose (a 6-carbon sugar), 6 molecules of CO_2 must be fixed. - Therefore, the cycle must complete 6 turns.

Step 3: Detailed Explanation:
Let's calculate the requirements for one turn of the Calvin cycle (fixing 1 CO_2):
1. **Carboxylation:** No energy required.
2. **Reduction:** This phase converts 3-PGA to G3P. It requires 2 molecules of ATP and 2 molecules of NADPH per CO_2 fixed.
3. **Regeneration:** This phase regenerates the starting molecule, RuBP. It requires 1 molecule of ATP per CO_2 fixed.
Total per turn (for 1 CO_2): - ATP required = 2 (from reduction) + 1 (from regeneration)

= 3 ATP - NADPH required = 2 (from reduction) = 2 NADPH

Now, to synthesize one molecule of glucose (C_6), the cycle must run 6 times:
- **Total ATP required** = 6 turns × 3 ATP/turn = **18 ATP**
- **Total NADPH required** = 6 turns × 2 NADPH/turn = **12 NADPH**

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

Quick Tip

Remember the magic numbers for Calvin cycle per CO_2: 3 ATP and 2 NADPH. To make glucose (C_6), just multiply by 6.

---

134. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

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

Step 2: Detailed Explanation:
- Expressed Sequence Tags (ESTs) are a tool used in genomics, particularly in identifying genes.
- The process starts with isolating messenger RNA (mRNA) from a specific tissue or cell type. The presence of mRNA indicates that a gene is being 'expressed' because transcription (DNA → RNA) is the first step of gene expression.
- The isolated mRNA is then used as a template to synthesize complementary DNA (cDNA) using the enzyme reverse transcriptase.
- The cDNAs are then sequenced, but usually only a short stretch of a few hundred bases from one or both ends is sequenced. These short sequence fragments are called Expressed Sequence Tags (ESTs).
- Since ESTs are derived from mRNA, they represent parts of genes that are actively being transcribed into RNA. This includes genes that code for proteins (which are translated from mRNA) as well as genes that produce non-coding RNAs (like tRNA, rRNA, etc., which are also transcribed but not translated).
- Therefore, the most accurate and comprehensive definition is that ESTs represent all genes that are expressed as RNA.

- Option (A) is too narrow because it excludes non-coding RNA genes.
- Option (B) is incorrect because ESTs only come from expressed genes.
- Option (C) is too vague ("certain important").

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

Quick Tip

The key is in the name: "Expressed" Sequence Tags. Gene expression begins with transcription into RNA. Therefore, ESTs are tags for genes that are being turned into RNA.

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135. 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:

(1) Both Statement I and Statement II are false
(2) Statement I is correct but Statement II is false
(3) Statement I is incorrect but Statement II is true
(4) Both Statement I and Statement II are true

Correct Answer: (3) Statement I is incorrect but Statement II is true

Solution:

Step 1: Understanding the Question:
The question presents two statements related to the terminology used in plant biology, specifically in the context of xylem and root system structure. We need to evaluate their correctness.

Step 2: Key Formula or Approach:
We need to understand the concepts of endarch and exarch conditions. These terms are used to describe the orientation of vascular tissues in plants, particularly in roots and stems. Exarch conditions are common in the roots of plants.

Step 3: Detailed Explanation:
- Statement I: Endarch and exarch refer to the position of xylem in relation to phloem. In an endarch condition, the xylem is towards the center of the stem, and phloem is on the outer side. On the other hand, in an exarch condition, the xylem is arranged outward, and the phloem is towards the center. These terms primarily apply to the arrangement in stems and roots. However, the term "secondary xylem" doesn't directly align with endarch and exarch in describing the position of vascular tissues. Therefore, Statement I is incorrect.
- Statement II: The exarch condition is indeed the most common feature of the root system.

In many plants, the xylem is arranged exarch in the root, especially in younger roots. Hence, Statement II is true.

Step 4: Final Answer:
Therefore, the correct answer is (3) because Statement I is incorrect, and Statement II is true.

Quick Tip

Exarch arrangement in roots is common, where xylem develops at the outer part, while endarch arrangement occurs in stems.

Section - B

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

(1) Membrane, proton pump, proton gradient, NADP synthase
(2) Proton pump, electron gradient, ATP synthase
(3) Proton pump, proton gradient, NADP synthase
(4) Membrane, proton pump, proton gradient, ATP synthase

Correct Answer: (4) Membrane, proton pump, proton gradient, ATP synthase

Solution:

Step 1: Understanding the Question:
Chemiosmosis is a process by which ATP is generated in cellular respiration and photosynthesis, driven by a proton gradient across a membrane. We need to identify the correct combination of components necessary for chemiosmosis.

Step 2: Key Formula or Approach:
Chemiosmosis requires the presence of a proton gradient, a proton pump to establish the gradient, and ATP synthase to utilize the gradient to produce ATP.

Step 3: Detailed Explanation:
- Proton pump: This is necessary to move protons (H^+) across the membrane, creating a proton gradient.
- Proton gradient: The gradient is the driving force that powers ATP synthesis via ATP synthase.
- ATP synthase: This enzyme utilizes the energy stored in the proton gradient to synthesize ATP from ADP and inorganic phosphate.
The combination of these components is required for chemiosmosis to occur. NADP synthase,

though important in photosynthesis, is not directly involved in chemiosmosis for ATP production.

Step 4: Final Answer:
Therefore, the correct combination is option (4) - membrane, proton pump, proton gradient, and ATP synthase.

Quick Tip

Chemiosmosis requires a proton gradient, a proton pump to create it, and ATP synthase to utilize it for ATP production.

---

137. How many different proteins does the ribosome consist of?
(1) 60
(2) 40
(3) 20
(4) 80

Correct Answer: (4) 80

Solution:

Step 1: Understanding the Question:
This question asks for the number of different proteins present in a ribosome. Ribosomes are complex molecular machines involved in protein synthesis.

Step 2: Key Formula or Approach:
The ribosome consists of ribosomal RNA (rRNA) and ribosomal proteins. In eukaryotes, ribosomes are composed of two subunits, and the total number of proteins is a specific figure.

Step 3: Detailed Explanation:
- In eukaryotic ribosomes, the large subunit consists of approximately 49 proteins, and the small subunit contains about 33 proteins. Therefore, the total number of ribosomal proteins in a typical eukaryotic ribosome is around 80.
- This number may vary slightly between different species, but it is generally around 80 in eukaryotic cells.

Step 4: Final Answer:
Hence, the ribosome consists of approximately 80 proteins, and the correct answer is option (4).

Quick Tip

Eukaryotic ribosomes have about 80 proteins, while prokaryotic ribosomes have slightly fewer.

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138. 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 a 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 node instead of leaves.
In the light of the above statements, choose the correct answer from the options given below:

(1) Both A and R are true but R is NOT the correct explanation of A
(2) A is true but R is false
(3) A is false but R is true
(4) Both A and R are true and R is the correct explanation of A

Correct Answer: (4) 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 and a reason related to flower development. We need to determine if both statements are true and if the reason correctly explains the assertion.

Step 2: Key Formula or Approach:
We need to analyze both the assertion about flower structure and the reason behind it.

Step 3: Detailed Explanation:
- Assertion A: A flower is indeed a modified shoot. The shoot apical meristem of a plant can transform into a floral meristem, leading to the formation of flowers. This transformation is a critical aspect of flower development.
- Reason R: The internode (the space between nodes) in the shoot gets condensed, and instead of leaves, floral appendages (such as petals, sepals, etc.) are produced laterally at successive nodes. This process accurately describes floral formation. Thus, Reason R correctly explains the Assertion A.

Step 4: Final Answer:
Both Assertion A and Reason R are true, and Reason R correctly explains Assertion A. Therefore, the correct answer is option (4).

Quick Tip

The transformation of a shoot apical meristem into a floral meristem leads to flower formation, with internode condensation producing floral appendages.

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139. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching the phases of the cell cycle listed in List I with their correct descriptions in List II.

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

- **A. M Phase:** The M phase, or Mitotic phase, is where the actual cell division occurs. Mitosis is known as equational division because the number of chromosomes in the parent and daughter cells remains the same. Thus, A matches with IV.

- **B. G_2 Phase:** The G_2 phase, or Gap 2 phase, is the period after DNA synthesis (S phase) and before the start of mitosis (M phase). During this phase, the cell continues to grow and synthesizes proteins and organelles necessary for mitosis. Thus, B matches with I.

- **C. Quiescent stage (G_0):** This is a stage where cells exit the cell cycle and are in a non-dividing state. They are metabolically active but do not proliferate unless called on to do so. This is considered an inactive phase with respect to division. Thus, C matches with II.

- **D. G_1 Phase:** The G_1 phase, or Gap 1 phase, is the first growth phase of the interphase. It is the interval between the end of mitosis (M phase) and the beginning of DNA replication (S phase). Thus, D matches with III.

Step 3: Final Answer:
Based on the matching above, the correct combination is:
A $\rightarrow$ IV
B $\rightarrow$ I
C $\rightarrow$ II
D $\rightarrow$ III
This corresponds to the option (B) A-IV, B-I, C-II, D-III.

Quick Tip

To solve cell cycle questions, remember the sequence: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$. G_1 is for growth, S is for synthesis (DNA replication), G_2 is for preparation for mitosis (protein synthesis), and M is for division. G_0 is an exit from this cycle.

Topic - Cell Cycle and Division

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
Choose the correct answer from the options given below :

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's analyze the logical flow of the recombinant DNA technology process.

- The process begins with the source DNA, which contains the gene of interest. This source DNA (e.g., genomic DNA) must be cut to excise the gene.

- **B. Cutting of DNA at specific location by restriction enzyme:** A restriction enzyme is used to cut the source DNA at specific recognition sites, generating multiple DNA fragments.

- **C. Isolation of desired DNA fragment:** After cutting the DNA, the mixture of fragments is separated (usually by gel electrophoresis), and the specific fragment containing the gene of interest is identified and isolated.

- **D. Amplification of gene of interest using PCR:** Polymerase Chain Reaction (PCR) is used to make millions of copies of the isolated DNA fragment. This ensures that there is enough of the gene for the subsequent steps.

- *(Implied Step: Ligation)* The amplified gene of interest is then ligated (joined) into a vector (like a plasmid) that has been cut with the same restriction enzyme. This creates the recombinant DNA molecule.

- **A. Insertion of recombinant DNA into the host cell:** The final step is to introduce the recombinant DNA into a suitable host cell (like a bacterium) through a process called transformation. The host cell will then replicate, making many copies of the recombinant DNA.

Step 3: Final Answer:
The correct sequence of the given steps is B $\rightarrow$ C $\rightarrow$ D $\rightarrow$ A. This corresponds to option (D).

Quick Tip

Remember the core mantra of rDNA technology: "Cut, Paste, Copy, Insert". First, you cut the DNA (B), then you isolate the piece you want (C), then you might amplify it (D) or paste it into a vector, and finally, you insert it into a host (A).

---

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

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

Solution:

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

Step 2: Detailed Explanation:

- **Analysis of Statement I:**
  Statement I provides the definition of Gause's 'Competitive Exclusion Principle'. This principle posits that when two species compete for the exact same limited resources within a stable environment, one species will always have an advantage, however slight, that will eventually lead to the elimination of the other species. The statement accurately describes this principle. Therefore, **Statement I is correct**.

- **Analysis of Statement II:**
  Statement II makes a broad generalization that carnivores are more adversely affected by competition than herbivores. This is a simplification and is not universally true. Competition can be a strong limiting factor for both carnivores and herbivores, and its intensity depends on various factors like resource availability, population density, niche overlap, and presence of predators. While carnivores compete for prey which is a limited resource, herbivores can also face intense competition, especially at high population densities, leading to overgrazing and resource depletion. It is difficult to generalize that one trophic level is always more affected by competition than another. Therefore, **Statement II is considered false** as a general rule.

Step 3: Final Answer:
Since Statement I is correct and Statement II is false, the correct option is (B).

Quick Tip

In ecology, be cautious with broad generalizations like "always" or "more than". Ecological interactions are complex and context-dependent. Gause's Principle is a fundamental concept, so know its precise definition.

142. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

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

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

- **A. Cohesion:** This is the intermolecular attraction between like-molecules. In the context of water, it refers to the attraction of water molecules to each other, primarily due to hydrogen bonds. Thus, A matches with II (**Mutual attraction among water molecules**).

- **B. Adhesion:** This is the attraction between unlike molecules. In plants, it refers to the attraction of water molecules to the surfaces of the xylem elements (tracheids and vessels), which are polar surfaces. Thus, B matches with IV (**Attraction towards polar surfaces**).

- **C. Surface tension:** This is a property of a liquid surface that allows it to resist an external force. It is a direct result of cohesion. Water molecules at the surface are more strongly attracted to the water molecules in the liquid phase below them than to the gas molecules in the air above. This results in a net inward pull, creating tension. Thus, C matches with I (**More attraction in liquid phase**).

- **D. Guttation:** This is the process of exudation of water droplets from the pores (hydathodes) on the leaf margin or tip. This phenomenon is a form of water loss from the plant in its liquid phase, which occurs when root pressure is high and transpiration is low. Thus, D matches with III (**Water loss in liquid phase**).

Step 3: Final Answer:
Based on the matching, the correct combination is:
A $\rightarrow$ II
B $\rightarrow$ IV
C $\rightarrow$ I
D $\rightarrow$ III
This corresponds to the option (D) A-II, B-IV, C-I, D-III.

Quick Tip

Remember the C/A mnemonic: **C**ohesion is with **C**ompanions (like molecules), and **A**dhesion is to **A**nother surface (unlike molecules). Guttation is like the plant "sweating" liquid water, not vapor (transpiration).

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

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

Correct Answer: (D) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks to identify the enzyme whose activity is inhibited by malonate, thereby stopping the growth of pathogenic bacteria. This question relates to enzyme inhibition.

Step 2: Key Formula or Approach:
This question is based on the concept of competitive inhibition. A competitive inhibitor is a molecule that is structurally similar to the substrate of an enzyme and competes with the substrate for binding to the active site.
Substrate: Succinate
Enzyme: Succinic dehydrogenase
Inhibitor: Malonate
Malonate has a structure very similar to succinate.

Step 3: Detailed Explanation:
Succinic dehydrogenase is a key enzyme in the Krebs cycle (or tricarboxylic acid cycle), which is a central pathway for energy production in both prokaryotic and eukaryotic cells. This enzyme catalyzes the oxidation of succinate to fumarate.
Malonate is a structural analogue of succinate. Due to this structural similarity, malonate can

bind to the active site of the succinic dehydrogenase enzyme. However, the enzyme cannot act on malonate. By occupying the active site, malonate prevents the actual substrate, succinate, from binding. This process is called competitive inhibition.
By inhibiting succinic dehydrogenase, malonate disrupts the Krebs cycle, leading to a halt in ATP production and ultimately inhibiting the growth of or killing the pathogenic bacteria.

Step 4: Final Answer:
Therefore, malonate inhibits the activity of succinic dehydrogenase. Option (D) is the correct answer.

Quick Tip

Remember the classic example of competitive inhibition: succinic dehydrogenase is inhibited by malonate because malonate is a structural mimic of the substrate succinate.

---

144. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

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

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

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

- **B. Glycolysis:** This is the initial pathway in cellular respiration that breaks down glucose into pyruvate. It is also known as the Embden-Meyerhof-Parnas (EMP) pathway. Thus, **B matches with IV**.

- **C. Oxidative phosphorylation:** This is the final stage of aerobic respiration where the majority of ATP is produced. It involves the transfer of electrons through a series of protein complexes known as the electron transport system (ETS), located in the inner mitochondrial membrane. Thus, **C matches with III**.

- **D. Tricarboxylic acid cycle (TCA cycle):** Also known as the Krebs cycle, this is a series of chemical reactions to release stored energy. The first step of the cycle is the condensation of acetyl-CoA with oxaloacetate to form citrate, a reaction catalyzed by the enzyme citrate synthase. Thus, **D matches with I**.

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

Quick Tip

To master cellular respiration, associate key terms with each stage: Glycolysis → EMP pathway; Link reaction → Pyruvate dehydrogenase; Krebs Cycle → Citrate synthase (first enzyme); ATP synthesis → Oxidative phosphorylation/ETS.

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145. 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 developement 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) C and D only
(B) B and E only
(C) A and E only
(D) A and B only

Correct Answer: (B) B and E only

Solution:

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

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

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

- **Statement B:** This is correct. Klinefelter's Syndrome is characterized by the karyotype 47, XXY. Individuals are males but have an extra X chromosome, leading to overall masculine development along with the expression of some feminine characteristics, such as gynaecomastia (development of breasts).

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

- **Statement D:** This is generally incorrect as a defining feature. While some individuals may have learning disabilities, it is not a universal or primary characteristic to say that development is 'retarded'. The most prominent features are physical and reproductive.

- **Statement E:** This is correct. Individuals with Klinefelter's Syndrome have underdeveloped testes and are sterile due to azoospermia (absence of sperm).

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

Quick Tip

To differentiate chromosomal disorders: Klinefelter's = 47, XXY (tall, sterile male with some female traits); Turner's = 45, XO (short, sterile female); Down's = Trisomy 21 (described by Langdon Down, characteristic facial features).

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

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

at successive trophic levels
(D) 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

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

Solution:

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

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

- **(A) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries:** This statement is incorrect. Algal blooms are a result of eutrophication, where excess nutrients (like nitrates and phosphates from organic matter decomposition or runoff) cause explosive growth of algae. This degrades water quality by blocking sunlight to submerged plants. When the algae die, their decomposition by bacteria consumes large amounts of dissolved oxygen, leading to hypoxic or anoxic conditions that cause mass fish kills. Therefore, algal blooms harm water quality and fisheries.

- **(B) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body:** This statement is correct. Water hyacinth is an invasive aquatic plant that thrives in nutrient-rich (eutrophic) water. Its rapid growth covers the water surface, blocking light, reducing dissolved oxygen, and outcompeting native species, thus disrupting the ecosystem.

- **(C) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels:** This statement is correct. It accurately describes the phenomenon of biomagnification, where non-biodegradable toxins like DDT or mercury accumulate in tissues and their concentration increases up the food chain.

- **(D) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms:** This statement is correct. When sewage is added to water, aerobic decomposer microbes multiply rapidly to break down the organic matter. This process consumes a large amount of dissolved oxygen from the water, increasing the Biochemical Oxygen Demand (BOD). The resulting oxygen depletion can be fatal to fish and other aquatic organisms.

Step 3: Final Answer:
The question asks for the statement that is NOT correct. Statement (A) is factually incorrect.

Quick Tip

Remember that "bloom" in the context of algae is a negative event. Algal blooms are a symptom of eutrophication and lead to oxygen depletion and fish kills, which is detrimental to water quality and fisheries.

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147. Given below are two statements: One labelled as Assertion A and the other 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) Both A and R are true but R is NOT the correct explanation of A
(B) A is true but R is false
(C) A is false but R is true
(D) Both A and R are true and R is the correct explanation of A

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

Solution:

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

Step 2: Detailed Explanation:

- **Analysis of Assertion A:** "In gymnosperms the pollen grains are released from the microsporangium and carried by air currents." This statement is correct. Most gymnosperms exhibit anemophily, which is pollination by wind. The pollen grains are light, dry, and produced in large quantities to facilitate wind dispersal.

- **Analysis of Reason R:** "Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed." This statement is partially correct but contains a major error. While air currents do carry the pollen grains to the vicinity of the ovule (which contains the archegonia), the statement that a "pollen tube is not formed" is false. Upon landing on the nucellus of the ovule, the pollen grain germinates to form a pollen tube. This tube grows through the nucellus and delivers the

non-motile male gametes to the egg cell within the archegonium. This process is called siphonogamy.

Step 3: Final Answer:
Assertion A is a true statement. Reason R is a false statement because a pollen tube is indeed formed in gymnosperms. Therefore, the correct option is (B).

Quick Tip

A key evolutionary advancement in seed plants (gymnosperms and angiosperms) is siphonogamy – the formation of a pollen tube to deliver male gametes. This process eliminates the need for water for fertilization. Any statement claiming its absence in gymnosperms is incorrect.

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148. Match List I with List II:

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

Choose the correct answer from the options given below:

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's match each mineral element with its primary role.

- **A. Iron (Fe):** Iron is a crucial component of proteins involved in electron transport, such as cytochromes and ferredoxin. It is also essential for the activation of the enzyme catalase, which breaks down hydrogen peroxide. Thus, **A matches with III**.

- **B. Zinc (Zn):** Zinc is an activator for various enzymes, notably carboxylases. It is also required for the synthesis of auxin (specifically, tryptophan, which is a precursor to auxin). Thus, **B matches with I**.

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

- **D. Molybdenum (Mo):** Molybdenum is a component of several important enzymes, including nitrogenase (involved in nitrogen fixation) and nitrate reductase (involved in nitrate assimilation). Thus, **D matches with II**.

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

Quick Tip

Associate key functions with micronutrients: Zn → Auxin synthesis; Mo → Nitrogen metabolism (Nitrate reductase, Nitrogenase); B → Pollen germination/Cell elongation; Fe → Catalase/Cytochromes.

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149. Match List I with List II :

List I (Interaction)		List II (Species A and B)	
A.	Mutualism	I.	-(A), 0(B)
B.	Commensalism	II.	+(A), 0(B)
C.	Amensalism	III.	+(A), -(B)
D.	Parasitism	IV.	+(A), +(B)

Choose the correct answer from the options given below:

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

Correct Answer: (A) A-IV, B-II, C-I, D-III (Note: Options A and D are identical, both are correct based on the matching.)

Solution:

Step 1: Understanding the Question:
The question asks to match different types of ecological interactions (List I) with their symbolic representation (List II), where '+' indicates a benefit, '-' indicates harm, and '0' indicates no

effect.

Step 2: Detailed Explanation:
Let's define each interaction and find its corresponding representation.

- **A. Mutualism:** An interaction where both species benefit from the relationship. This is represented as (+/+). Thus, **A matches with IV**.
- **B. Commensalism:** An interaction where one species benefits, and the other is unaffected. This is represented as (+/0). Thus, **B matches with II**.
- **C. Amensalism:** An interaction where one species is harmed, and the other is unaffected. This is represented as (-/0). Thus, **C matches with I**.
- **D. Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other (the host). This is represented as (+/-). Thus, **D matches with III**.

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

Quick Tip

Use a simple table to memorize population interactions: Mutualism (+,+), Commensalism (+,0), Parasitism/Predation (+,-), Amensalism (-,0), Competition (-,-), Neutralism (0,0).

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

Correct Answer: (A) A and D only

Solution:

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

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

- **A. Lenticels are the lens-shaped openings permitting the exchange of gases.** This statement is correct. Lenticels are porous tissues consisting of cells with large intercellular spaces in the periderm of secondarily thickened organs and the bark of woody stems and roots of dicotyledonous flowering plants. They function as pores, providing a pathway for the direct exchange of gases between the internal tissues and atmosphere through the bark, which is otherwise impermeable to gases.

- **B. Bark formed early in the season is called hard bark.** This statement is incorrect. Bark formed early in the season (spring) is called 'early' or 'soft' bark. Bark formed towards the end of the season (autumn) is called 'late' or 'hard' bark.

- **C. Bark is a technical term that refers to all tissues exterior to vascular cambium.** This statement is imprecise. While "bark" as a non-technical term includes everything outside the vascular cambium, the more precise botanical definition is given in statement D. Statement C includes primary tissues that might have been sloughed off.

- **D. Bark refers to periderm and secondary phloem.** This statement is correct. Botanically, the term "bark" includes two main components: the inner bark, which is the secondary phloem, and the outer bark, which is the periderm. The periderm itself consists of phellogen (cork cambium), phellem (cork), and phelloderm.

- **E. Phellogen is single-layered in thickness.** This statement is incorrect. Phellogen, or cork cambium, is a meristematic tissue and is usually composed of a couple of layers of cells, not just a single layer.

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

Quick Tip

Remember the precise definitions: Bark = Secondary Phloem + Periderm. Periderm = Phellem (cork) + Phellogen (cork cambium) + Phelloderm (secondary cortex). Lenticels are the "stomata" of the stem.