NEET UG 2023 E3 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

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

(A) Osmosis
(B) Facilitated Diffusion

(C) Passive Transport
(D) Active Transport

Correct Answer: (D) Active Transport

Solution:

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

Step 2: Detailed Explanation:
Let's analyze the given transport mechanisms:

- **Osmosis:** This is the movement of solvent molecules (usually water) across a semipermeable membrane from a region of high solvent concentration to a region of low solvent concentration. It does not primarily move ions against a gradient.

- **Facilitated Diffusion:** This is a type of passive transport where ions or molecules move *down* their concentration gradient with the help of membrane proteins (channels or carriers). No energy is expended.

- **Passive Transport:** This is the general term for movement of substances *down* a concentration gradient without the use of metabolic energy. Simple diffusion and facilitated diffusion are types of passive transport.

- **Active Transport:** This process moves substances *against* their concentration gradient (uphill movement). This requires energy, typically in the form of ATP, and involves specific carrier proteins called pumps.

Since the question specifies movement "against their concentration gradient," the only correct answer is active transport.

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

Quick Tip

Think of a concentration gradient as a hill. Passive transport (including diffusion and facilitated diffusion) is like rolling down the hill—it happens spontaneously. Active transport is like pushing an object up the hill—it requires energy. The keyword "against" signals active transport.

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

Correct Answer: (A) 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 about ATP consumption in glycolysis and a Reason specifying the steps where it is consumed. We need to evaluate both statements and their relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A:
Glycolysis is a 10-step process. In the initial "preparatory phase" or "investment phase," energy is consumed to activate the glucose molecule. Indeed, two molecules of ATP are consumed in this phase. Therefore, **Assertion A is true**.

Analysis of Reason R:
The reason identifies the specific steps of ATP consumption:

1. **Step 1:** Glucose is phosphorylated to glucose-6-phosphate by the enzyme hexokinase. This reaction consumes one ATP molecule.
2. **Step 3:** Fructose-6-phosphate is phosphorylated to fructose-1, 6-bisphosphate by the enzyme phosphofructokinase. This reaction consumes a second ATP molecule.

The reason correctly identifies the two specific steps where ATP is utilized. Therefore, **Reason R is true**.

Connecting A and R:
The Reason (R) provides the exact biochemical reactions that account for the statement made in the Assertion (A). It explains *why* and *where* ATP is used twice. Thus, **R is the correct explanation of A**.

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

Quick Tip

Remember glycolysis in two parts: the 'investment phase' (first 5 steps) where 2 ATP are used, and the 'payoff phase' (last 5 steps) where 4 ATP and 2 NADH are produced. The net gain is 2 ATP and 2 NADH per glucose molecule.

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

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

Correct Answer: (B) S phase

Solution:

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

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

- **G_1 phase (Gap 1):** This is the phase of cell growth and metabolic activity, before DNA replication. The cell prepares for DNA synthesis.
- **S phase (Synthesis phase):** This is the period during which DNA synthesis or replication takes place. At the end of the S phase, the amount of DNA per cell doubles (from 2C to 4C), and each chromosome consists of two sister chromatids.
- **G_2 phase (Gap 2):** The cell continues to grow and synthesizes proteins and organelles in preparation for mitosis.
- **M phase (Mitosis phase):** This is the phase of actual cell division, including nuclear division (mitosis) and cytoplasmic division (cytokinesis).

Therefore, DNA replication is the defining event of the S phase.

Step 3: Final Answer:
DNA replication in eukaryotes occurs during the S phase of the cell cycle.

Quick Tip

Remember the cell cycle phases with the acronym **I-PMAT-C** (Interphase, Prophase, Metaphase, Anaphase, Telophase, Cytokinesis). Interphase itself is $G_1 \rightarrow \mathbf{S} \rightarrow G_2$. The 'S' stands for 'Synthesis', which is the key to remembering DNA replication.

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

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

Solution:

Step 1: Understanding the Question:
This Assertion-Reason question relates the structure of late wood to the activity of the cambium during different seasons.

Step 2: Detailed Explanation:
Analysis of Assertion A:
In temperate regions, the vascular cambium's activity changes with the seasons. The wood formed towards the end of the growing season (autumn or winter) is called 'late wood' or 'autumn wood'. This wood is characterized by having fewer xylem elements, which are smaller and have narrow vessels with thick walls. This structure makes late wood denser. Thus, **Assertion A is true**.

Analysis of Reason R:
The physiological activity of the cambium is influenced by environmental factors like temperature and water availability. During winter, conditions are unfavorable (low temperature, less water), and the cambium becomes less active. This reduced activity leads to the production of

fewer and smaller xylem elements. Therefore, **Reason R is true**.

Connecting A and R:
The reason (less active cambium in winter) directly explains the result described in the assertion (fewer xylary elements with narrow vessels in late wood). The reduced activity of the cambium is the direct cause for the specific anatomical features of late wood. Therefore, **R is the correct explanation of A**.

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

Quick Tip

Remember the contrast between spring wood and autumn wood. **Spring Wood (Early Wood):** Cambium very active, large and wide vessels, light in color, low density. **Autumn Wood (Late Wood):** Cambium less active, narrow vessels, dark in color, high density. This pair forms one annual ring.

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

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

Correct Answer: (B) Pachytene

Solution:

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

Step 2: Detailed Explanation:
Prophase I of meiosis is a long and complex phase divided into five sub-stages:

- **Leptotene:** Chromosomes become visible as long, thin threads.

- **Zygotene:** Homologous chromosomes pair up in a process called synapsis, forming bivalents. This pairing is mediated by the synaptonemal complex.

- **Pachytene:** This is the longest stage. The bivalents become shorter and thicker. A key event of this stage is crossing over, the exchange of genetic material between non-sister chromatids of homologous chromosomes. The sites where crossing over occurs are marked by the appearance of protein complexes called **recombination nodules**.

- **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.

- **Diakinesis:** The chromosomes condense further, chiasmata terminalize (move to the ends), the nuclear envelope breaks down, and the spindle apparatus begins to form.

The appearance of recombination nodules is the characteristic feature indicating that crossing over is occurring, which takes place during the pachytene stage.

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

Quick Tip

Use the mnemonic for Prophase I stages: **L**azy **Z**ebras **P**aint **D**irty **D**oors. (Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis). Associate Pachytene with the "P" in "Pairing and crossing over Points (nodules)".

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

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

Correct Answer: (B) Alfred Hershey and Martha Chase

Solution:

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

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

- **Frederick Griffith (1928):** Conducted the transformation experiment with *Streptococcus pneumoniae*. He showed that a "transforming principle" from heat-killed pathogenic bacteria could make non-pathogenic bacteria pathogenic, but he did not identify what this principle was.

- **Avery, Macleoid, and McCarthy (1944):** They expanded on Griffith's work and demonstrated through biochemical experiments that the transforming principle was DNA. While their evidence was strong, it was not universally accepted by the scientific community at the time, as many still believed protein was the more likely candidate for genetic material.

- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using T2 bacteriophages. They created two batches of viruses: one with radioactive phosphorus (^{32}P) to label the DNA, and another with radioactive sulfur (^{35}S) to label the protein coats. They found that only the ^{32}P (DNA) entered the bacterial host cells to direct the synthesis of new viruses. This provided the clear, unambiguous evidence that DNA, not protein, is the genetic material.

- **Wilkins and Franklin:** They were instrumental in using 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 about the structure of DNA, not proving its function as the genetic material.

The work of Hershey and Chase is considered the "unequivocal proof" because it elegantly and directly showed which molecule carried the genetic instructions.

Step 3: Final Answer:
The unequivocal proof was provided by Alfred Hershey and Martha Chase.

Quick Tip

Remember the key experiments in order: 1. **Griffith:** Finds a "transforming principle." 2. **Avery et al.:** Identifies the principle as DNA. 3. **Hershey & Chase:** Provides the *unequivocal proof* with radioactive labeling. The word "unequivocal" is a direct pointer to the Hershey-Chase experiment.

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

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

Solution:

Step 1: Understanding the Question:
This Assertion-Reason question is about the gametophyte stage in the life cycle of a moss. We need to evaluate the correctness of the two statements and their logical connection.

Step 2: Detailed Explanation:
Analysis of Assertion A:
The life cycle of a moss (a bryophyte) has a dominant gametophytic phase. This phase starts with the germination of a haploid spore. The spore does not directly grow into the adult leafy plant. Instead, it germinates to form a filamentous, creeping, green, branched structure called the protonema. This is the juvenile, or first, stage of the gametophyte. Later, the leafy stage (the familiar moss plant) develops from buds on this protonema. Thus, the assertion that the first stage is the protonema is **correct**.

Analysis of Reason R:
The protonema originates from the germination of a haploid spore. These spores are produced by meiosis within the capsule of the sporophyte. The statement that the protonema develops directly from spores produced in a capsule is factually **correct**.

Connecting A and R:
The reason (R) explains the origin of the protonema. Since the entire gametophyte generation begins with the spore, and the protonema is what develops directly from this spore, it logically follows that the protonema must be the first stage of the gametophyte. The reason perfectly explains why the assertion is true. Therefore, **R is the correct explanation of A**.

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

Quick Tip

To remember the moss life cycle, think of the sequence: Spore (n) $\rightarrow$ Protonema (n, juvenile gametophyte) $\rightarrow$ Leafy gametophyte (n, adult) $\rightarrow$ Gametes (n) $\xrightarrow{fertilization}$ Zygote (2n) $\rightarrow$ Sporophyte (2n, grows on gametophyte) $\rightarrow$ Capsule $\xrightarrow{meiosis}$ Spores (n).

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

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

Correct Answer: (C) Tungsten or gold

Solution:

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

Step 2: Detailed Explanation:
The gene gun, or biolistic particle delivery system, is a physical method for introducing foreign DNA into cells, particularly plant cells which have a rigid cell wall. The method involves the following steps:

1. The DNA of interest (the gene) is coated onto microscopic particles.
2. These particles must be dense enough to have the momentum to penetrate the cell wall and membrane, and chemically inert so they do not harm the cell.
3. The most commonly used metals for these microparticles are **gold (Au)** and **tungsten (W)**.
4. These coated microparticles are then accelerated to a high velocity and fired into the target tissue. Some cells will survive the bombardment and successfully incorporate the foreign DNA into their genome.

Copper, zinc, and silver are not typically used because they can be toxic to cells and may not have the ideal density or inertness.

Step 3: Final Answer:
The metals used for microparticles in the gene gun method are tungsten or gold.

Quick Tip

Associate "gene gun" with valuable, heavy bullets. Gold and tungsten are dense, heavy metals, making them perfect for acting as microscopic "bullets" to carry DNA into a cell.

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9. Axile placentation is observed in

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

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

Solution:

Step 1: Understanding the Question:
The question asks to identify the group of plants that exhibit axile placentation. Axile placentation is a type of ovule arrangement where the placenta is axial (in the center) and ovules are attached to it in a multilocular (multi-chambered) ovary.

Step 2: Detailed Explanation:
Let's analyze the placentation types in the plants mentioned in the options:

- **Mustard:** Has parietal placentation.
- **Cucumber:** Has parietal placentation.
- **Primrose:** Has free-central placentation.
- **Beans, Lupin, Pea:** All belong to the family Fabaceae and have marginal placentation.
- **Dianthus:** Has free-central placentation.
- **Tomato:** Has axile placentation.
- **China rose (Hibiscus):** Belongs to the family Malvaceae and has a syncarpous, multilocular ovary with axile placentation.
- **Petunia:** Belongs to the family Solanaceae and has axile placentation.
- **Lemon (Citrus):** Has a multilocular ovary with axile placentation, which is clearly visible when you cut the fruit in cross-section.

Based on this analysis, the group in option (D) contains only plants with axile placentation.

Step 3: Final Answer:
The correct combination is China rose, Petunia, and Lemon, as all three show axile placentation.

Quick Tip

The best way to remember axile placentation is to visualize a cut lemon or tomato. You can see the central axis and the chambers (locules) with seeds attached to the center. Common examples are from families Solanaceae (Tomato, Petunia), Malvaceae (China rose, Cotton), and Rutaceae (Lemon, Orange).

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

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

Correct Answer: (C) Respiratory loss

Solution:

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

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

- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (like plants) during photosynthesis to create organic matter. It represents the total amount of food produced.

- **Producers' Metabolism:** Plants, like all living organisms, must respire to carry out their metabolic functions (growth, maintenance, transport). During respiration, they consume some of the organic matter they produced.
- **R (Respiratory Loss):** This term represents the energy lost by the producers through the process of respiration. It is the portion of GPP that is used up by the plants themselves for their life processes.

- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass that is actually available to the next trophic level (herbivores). It is the energy that remains after the producers have met their own respiratory needs.

Therefore, the relationship is:

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

where R stands for Respiratory loss.

Step 3: Final Answer:
In the given equation, R represents the Respiratory loss.

Quick Tip

Think of it like a personal budget. GPP is your total monthly salary (gross income). R (Respiration) is your essential monthly expenses (rent, food, bills). NPP is your savings or disposable income (net income) that is left over.

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

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

Correct Answer: (B) Dedifferentiation

Solution:

Step 1: Understanding the Question:
The question describes a process in plant tissue culture where specialized cells (leaf mesophyll) give rise to an undifferentiated mass of cells (callus). We need to identify the correct term for this phenomenon.

Step 2: Detailed Explanation:
Let's define the relevant terms in plant development:

- **Differentiation:** The process by which cells derived from meristems mature and undergo structural and functional specialization to form specific tissues (e.g., mesophyll, xylem, phloem).
- **Dedifferentiation:** The process by which already differentiated, permanent cells revert to a meristematic state and regain the capacity for cell division. Leaf mesophyll cells are differentiated parenchyma. When placed in a suitable culture medium with plant hormones (like auxins and cytokinins), they lose their specialization and start dividing to form a callus (an unorganized, undifferentiated mass of cells). This is exactly the process described in the question.
- **Redifferentiation:** The process by which the dedifferentiated cells of the callus once again differentiate to form new specialized cells, tissues, organs, and eventually a whole plant.
- **Senescence:** The process of aging in plants.

The conversion of specialized mesophyll cells into an unspecialized, actively dividing callus is a classic example of dedifferentiation.

Step 3: Final Answer:
The phenomenon described is called dedifferentiation.

Quick Tip

Remember the sequence in plant tissue culture:
1. Take an **explant** (e.g., leaf piece) made of **differentiated** cells.
2. Cells undergo **dedifferentiation** to form a callus.
3. Callus cells undergo **redifferentiation** to form a new plantlet.
The prefix "de-" means "to reverse or undo," so dedifferentiation is the reversal of differentiation.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
The roles of the three main eukaryotic RNA polymerases are as follows:

- **RNA Polymerase I:** Located in the nucleolus, it transcribes most ribosomal RNA (rRNA) genes, specifically the 28S, 18S, and 5.8S rRNA molecules.

- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes the precursors of messenger RNA (mRNA), called heterogeneous nuclear RNA (hnRNA), as well as most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).

- **RNA Polymerase III:** Located in the nucleoplasm, it transcribes transfer RNA (tRNA) genes, the 5S rRNA gene, and some small nuclear RNA (snRNA) genes (like U6 snRNA).

Based on this division of labor, option (B) correctly identifies the products of RNA polymerase III.

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

Quick Tip

To remember the functions of the three RNA polymerases, use a simple mnemonic. Think of the order 1, 2, 3 and the RNA types rRNA, mRNA, tRNA.

- Pol I → rRNA (the most abundant)
- Pol II → mRNA (the messenger)
- Pol III → tRNA (the smallest functional RNA)

Just remember that 5S rRNA is an exception and is transcribed by Pol III, not Pol I.

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

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

Correct Answer: (D) Bright orange colour

Solution:

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

Step 2: Detailed Explanation:
Agarose gel electrophoresis is a technique used to separate DNA fragments by size. After separation, the DNA in the gel is invisible to the naked eye. To visualize it, a fluorescent dye is used.

- **Ethidium bromide (EtBr)** is a fluorescent dye that acts as an intercalating agent. This means it inserts itself between the stacked base pairs of the DNA double helix.

- When the gel containing the DNA-EtBr complex is exposed to UV light, the ethidium bromide absorbs the UV energy and re-emits it as visible light, a process called fluores-

cence.

- The emitted light is in the orange region of the visible spectrum. Therefore, the DNA bands appear as bright orange bands against a dark background.

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

Quick Tip

Remember the combination used in DNA visualization: **Agarose Gel + Ethidium Bromide (EtBr) + UV light = Bright Orange Bands**. Be aware that EtBr is a potent mutagen, so safer alternatives are now often used.

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

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

Correct Answer: (A) Dobson units

Solution:

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

Step 2: Detailed Explanation:
Let's analyze the given units:

- **Dobson units (DU):** This is the standard unit used to measure the total amount of ozone in a vertical column of the atmosphere. One Dobson Unit is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at a temperature of 0 degrees Celsius and a pressure of 1 atmosphere.

- **Decibels (dB):** This is a unit used to measure the intensity of a sound or the power level of an electrical signal.

- **Decameter (dam):** This is a unit of length in the metric system, equal to 10 meters.

- **Kilobase (kb):** This is a unit of length for DNA or RNA molecules, equal to 1000 base pairs.

Therefore, the correct unit for measuring ozone layer thickness is the Dobson unit.

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

Quick Tip

Associate specific units with their measurements: Ozone → Dobson Units; Sound → Decibels; DNA length → Base pairs/Kilobases. This helps avoid confusion between different scientific contexts.

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

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

Correct Answer: (C) Ethylene

Solution:

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

Step 2: Detailed Explanation:
Deep-water rice is a variety that can survive flooding by rapidly elongating its internodes to keep its leaves above the water surface for photosynthesis.

- When the plant is submerged, the gaseous hormone **ethylene** accumulates in the submerged tissues because its diffusion into the atmosphere is blocked by water.

- This accumulation of ethylene triggers a signaling cascade that leads to a significant increase in cell division and elongation in the internodes.

- While Gibberellic acid (GA_3) is also involved in stem elongation (bolting), the primary trigger for the rapid escape response in submerged deep-water rice is ethylene. Ethylene increases the sensitivity of the cells to the already present gibberellins.

- Kinetin is a cytokinin, primarily involved in cell division.

- 2, 4-D is a synthetic auxin, often used as a herbicide.

Therefore, ethylene is the key hormone promoting this specific adaptation.

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

Quick Tip

Remember the dual roles of ethylene. It is known as the "ripening hormone" but also plays a crucial role in stress responses, such as promoting stem elongation in submerged plants and senescence. This specific example of deep-water rice is a classic case study for ethylene's function.

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

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

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

Solution:

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

Step 2: Detailed Explanation:
The process of double fertilization in angiosperms results in structures with different ploidy levels within the embryo sac:

- **Haploid (n) structures:** Before fertilization, the egg cell, synergids, and antipodals are all haploid. After fertilization, the synergids and antipodals begin to degenerate but are still considered haploid until they disappear.

- **Diploid (2n) structure:** The **zygote** is formed by the fusion of one male gamete (n) with the egg cell (n). Thus, the zygote is diploid (2n).
- **Triploid (3n) structure:** The **Primary Endosperm Nucleus (PEN)** is formed by the fusion of the second male gamete (n) with the central cell, which contains two polar nuclei (n + n). Thus, the PEN is triploid (3n).

Now let's evaluate the options based on the sequence (haploid, diploid, triploid):

- (A) Synergids (n), PEN (3n), Zygote (2n). Incorrect order.
- (B) Antipodals (n), Synergids (n), PEN (3n). Incorrect, contains two haploid structures.
- (C) **Synergids (n), Zygote (2n), Primary endosperm nucleus (3n)**. This matches the required sequence perfectly.
- (D) Synergids (n), Antipodals (n), Polar nuclei (n+n, not a single structure after fertilization). Incorrect.

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

Quick Tip

Master the ploidy levels resulting from double fertilization:

- **Syngamy:** Egg (n) + Male Gamete (n) $\rightarrow$ Zygote (2n)
- **Triple Fusion:** Central Cell (n+n) + Male Gamete (n) $\rightarrow$ Primary Endosperm Nucleus (3n)

All other cells in the embryo sac (synergids, antipodals) are haploid (n).

---

17. Cellulose does not form blue colour with Iodine because

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

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

Solution:

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

Step 2: Detailed Explanation:
The iodine test is specific for the presence of starch. The mechanism is as follows:

- Starch is a polysaccharide made of α-glucose units. It consists of two components: amylose and amylopectin.
- Amylose is a linear polymer that forms a **helical (coiled) structure**. This helical shape creates a central channel.
- When iodine (specifically, the I_3^- ion in the iodine solution) is added, the iodine molecules slip inside the amylose helix. This forms a charge-transfer complex, which absorbs light in a way that makes it appear blue-black.

- **Cellulose**, on the other hand, is also a polysaccharide, but it's made of β-glucose units. These units are linked in a way that forms a **straight, linear chain**. These chains align parallel to each other and are held by hydrogen bonds, forming strong microfibrils.

- Because cellulose does not have the helical secondary structure of starch, there are no channels to trap the iodine molecules. Therefore, no color complex is formed.

Statement (C) correctly explains this structural difference. Statement (A) is incorrect as cellulose is a polysaccharide. Statement (B) is incorrect as it's not helical. Statement (D) is incorrect as no significant breakdown occurs.

Step 3: Final Answer:
Cellulose does not turn blue with iodine because its linear structure lacks the complex helices needed to hold iodine molecules.

Quick Tip

Remember the structural basis for the iodine test: **Starch's helical coil** acts like a tube that traps iodine molecules. **Cellulose's straight chain** has no such structure. This fundamental difference in shape is key.

---

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

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

(D) Co-extinctions

Correct Answer: (A) Habitat loss and fragmentation

Solution:

Step 1: Understanding the Question:
The question asks to identify the primary driver 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 major causes of biodiversity loss:

1. **Habitat loss and fragmentation:** This involves the destruction of natural habitats (e.g., deforestation, urbanization, pollution) and the breaking up of large habitats into smaller, isolated patches. This is considered the single most important cause of extinction because it directly removes the places where species can live, find food, and reproduce.

2. **Over-exploitation:** This refers to harvesting species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting). This has been a major cause for the extinction of many species like the dodo and Steller's sea cow.

3. **Alien species invasions:** This occurs when non-native species are introduced into an ecosystem, where they can outcompete native species for resources, introduce diseases, or alter the habitat, leading to the decline and extinction of native species (e.g., Nile perch in Lake Victoria).

4. **Co-extinctions:** This happens when the extinction of one species causes the extinction of another species that depended on it (e.g., a host-specific parasite dying out after its host becomes extinct).

Among these four, ecologists universally agree that habitat loss and fragmentation is the most significant threat to biodiversity worldwide, affecting the largest number of species.

Step 3: Final Answer:
The most important cause driving species extinction among the Evil Quartet is Habitat loss and fragmentation.

Quick Tip

To remember the Evil Quartet, use the acronym **H-O-A-C**: **H**abitat loss **O**ver-exploitation **A**lien species invasion **C**o-extinction Always remember that **H**abitat loss is the number one cause.

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

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

Correct Answer: (B) Selaginella and Salvinia

Solution:

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

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

- **Homosporous pteridophytes:** Produce only one type of spore, which grows into a bisexual gametophyte (possessing both antheridia and archegonia). The majority of pteridophytes are homosporous. Examples include *Lycopodium*, *Equisetum*, and *Psilotum*.

- **Heterosporous pteridophytes:** Produce two distinct types of spores: smaller microspores (which develop into male gametophytes) and larger megaspores (which develop into female gametophytes). This condition is a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples are *Selaginella*, *Salvinia*, *Marsilea*, and *Azolla*.

Let's analyze the options:

- (A) *Lycopodium* (homosporous) and *Selaginella* (heterosporous).
- (B) ***Selaginella* (heterosporous) and *Salvinia* (heterosporous)**. This is the correct pair.
- (C) *Psilotum* (homosporous) and *Salvinia* (heterosporous).
- (D) *Equisetum* (homosporous) and *Salvinia* (heterosporous).

Step 3: Final Answer:
Both *Selaginella* and *Salvinia* are heterosporous pteridophytes.

Quick Tip

Memorizing the four common examples of heterosporous pteridophytes is highly beneficial for exams: **Selaginella, Salvinia, Marsilea, and Azolla**. Most other commonly mentioned pteridophytes (Lycopodium, Equisetum, Dryopteris, Pteris) are homosporous.

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

Correct Answer: (A) Diadelphous and Dithecous anthers

Solution:

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

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

- **Fabaceae (specifically subfamily Papilionoideae):** The androecium typically consists of 10 stamens. A very common and characteristic arrangement is **diadelphous**, where the filaments of nine stamens are fused into a tube, and the tenth stamen is free (written as (9)+1). The anthers are **dithecous** (two-lobed).

- **Solanaceae:** The androecium has 5 stamens that are **epipetalous** (fused to the petals). The stamens are free from each other (not adelphous).

- **Liliaceae:** The androecium has 6 stamens, arranged in two whorls of three (3+3). They are often **epiphyllous** or **epitepalous** (fused to the tepals). The stamens are free from each other.

From this comparison, the diadelphous condition is a unique and defining feature of Fabaceae. While dithecous anthers are common in all three, the combination of diadelphous stamens and dithecous anthers is specific to Fabaceae in this context.

Step 3: Final Answer:
The specific characteristic of stamens in Fabaceae is the diadelphous arrangement and dithecous anthers.

Quick Tip

Associate key floral features with plant families:

- **Fabaceae:** Papilionaceous corolla (vexillary aestivation), **diadelphous stamens ((9)+1)**.
- **Solanaceae:** Persistent calyx, **epipetalous stamens**, swollen placenta.
- **Liliaceae:** Perianth (tepals), **epitepalous stamens**, trimerous flower.

---

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

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

Correct Answer: (B) 1992

Solution:

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

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

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

Quick Tip

Memorize key dates for major environmental protocols and summits:

- **1987:** Montreal Protocol (on ozone-depleting substances).
- **1992:** Rio Earth Summit (on biodiversity, climate change).
- **1997:** Kyoto Protocol (on greenhouse gas emissions).

These are frequently asked in competitive exams.

---

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

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

Correct Answer: (B) DNA

Solution:

Step 1: Understanding the Question:
The question asks which macromolecule is precipitated out of an aqueous solution by adding chilled ethanol during DNA purification.

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

1. **Lysis:** Breaking open the cells to release the cellular contents, including DNA, RNA, proteins, and lipids.
2. **Purification:** Removing other macromolecules. Enzymes like proteases are used to digest proteins (like histones), and RNases are used to digest RNA.
3. **Precipitation:** After the other components are removed, the DNA is still dissolved in the aqueous solution. DNA is a polar molecule and is soluble in water, but it is insoluble in ethanol. When cold ethanol is added to the solution, it causes the DNA to precipitate out of the solution, as it disrupts the hydration shell around the DNA molecules. The DNA appears as a mass of fine, white threads that can be spooled out of the solution using a glass rod. Using chilled ethanol enhances the precipitation.

This step selectively isolates the DNA from the remaining soluble components.

Step 3: Final Answer:
Addition of chilled ethanol precipitates out DNA.

Quick Tip

Remember the key principle: DNA is soluble in water but insoluble in alcohol. The addition of chilled ethanol is the standard final step to visualize and collect purified DNA from a solution.

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

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

Correct Answer: (B) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the function of "tassels in the corn cob". It is important to clarify the terminology as it is slightly confusing.

Step 2: Detailed Explanation:
The corn plant (maize) is monoecious, meaning it has separate male and female flowers on the same plant.

- The **tassel** is the male inflorescence located at the very top of the corn plant. Its function is to produce and **disperse pollen grains**, which are carried by the wind (anemophily). So, the function of the tassel is dispersal, which matches option (C).
- The **corn cob** (or ear) is the female inflorescence, located at a leaf axil lower down the stalk. Emerging from the tip of the cob are long, silky threads called **silks**. Each silk is a style and stigma. The function of the feathery silks is to **trap the airborne pollen grains**. This is option (B).

The question is phrased imprecisely as "tassels in the corn cob". Tassels are not located in the cob. However, given the provided answer is (B), it is clear that the question intended to ask about the function of the **silks** of the corn cob, not the tassels of the corn plant. The silks are the structures on the cob responsible for trapping pollen.

Step 3: Final Answer:
Interpreting the question as referring to the silks on the corn cob, their function is to trap pollen grains.

Quick Tip

For corn/maize, remember the division of labor:

- **Tassel (Top):** Male part, **releases** pollen.
- **Silk (on Cob):** Female part (style/stigma), **traps** pollen.

Be aware of potentially confusing question phrasing and choose the answer that best fits the function of the structures on the cob.

---

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

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

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

Solution:

Step 1: Understanding the Question:
The question presents two statements about the effects of transpiration, and we need to evaluate their correctness.

Step 2: Detailed Explanation:
Analysis of Statement I:
This statement refers to the transpiration pull, which is the main driving force for water movement in the xylem according to the Cohesion-Tension Theory. The strong cohesive forces between water molecules and adhesive forces between water and xylem walls create an unbroken water column. The evaporation of water from the leaves (transpiration) generates a negative pressure potential or tension that pulls this entire column of water upwards. This force is remarkably strong, capable of lifting water to the tops of the tallest trees, such as redwoods, which can exceed 100 meters in height. Therefore, lifting water over 130 meters is within the established capabilities of this mechanism. **Statement I is correct**.

Analysis of Statement II:
This statement describes the phenomenon of evaporative cooling. Transpiration is essentially the evaporation of water from the leaf surface. For water to change from a liquid to a gas,

it must absorb energy from its surroundings in the form of latent heat of vaporization. This energy is drawn from the leaf tissue, thereby lowering the leaf's temperature. This cooling effect is crucial for preventing the leaf from overheating in direct sunlight. A temperature reduction of 10 to 15 degrees Celsius is a well-documented and accepted value for the cooling effect of transpiration. **Statement II is correct**.

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

Quick Tip

Remember the two primary, vital roles of transpiration: 1. Transport: It's the 'engine' that pulls the water and mineral stream from roots to leaves. 2. Thermoregulation: It acts as the plant's 'air conditioner', preventing leaves from damage due to high temperatures.

---

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

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

Correct Answer: (B) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks to identify the plant hormone used to speed up the maturation process in juvenile conifers, which in turn leads to earlier production of seeds.

Step 2: Detailed Explanation:
The functions of the listed phytohormones are as follows:

- **Indole-3-butyric Acid (IBA):** This is an auxin, primarily used to promote root formation in plant cuttings.

- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including stem elongation (bolting) and breaking seed dormancy. A significant commercial application is spraying juvenile conifers with gibberellins to hasten their maturity. This allows them to produce cones and seeds much earlier than they would naturally, which is highly beneficial

for the breeding and forestry industries.

- **Zeatin:** This is a cytokinin, which primarily promotes cell division, delays senescence, and overcomes apical dominance.

- **Abscisic Acid (ABA):** This is a growth-inhibiting hormone, often called the "stress hormone." It induces dormancy and stomatal closure and is not used to hasten maturity.

Therefore, gibberellic acid is the correct hormone for this purpose.

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

Quick Tip

Remember the key commercial applications of gibberellins: increasing grape stalk length, improving fruit shape (e.g., in apples), delaying senescence in fruits, and speeding up the malting process in brewing. Hastening maturity in conifers is another important application to remember.

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

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

Correct Answer: (A) Manganese

Solution:

Step 1: Understanding the Question:
The question asks for the specific micronutrient that is essential for the photolysis, or splitting, of water during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation:
The splitting of water molecules ($2H_2O \rightarrow 4H^+ + O_2 + 4e^-$) occurs on the inner side of the thylakoid membrane and is associated with Photosystem II (PS II). This reaction is catalyzed by the Oxygen-Evolving Complex (OEC).
The OEC requires the presence of specific inorganic ions to function:

- **Manganese (Mn):** A cluster of four manganese ions is at the core of the OEC and is directly involved in the oxidation of water.

- **Calcium (Ca^{2+}) and Chloride (Cl^-) ions** are also essential cofactors for this process.

Let's consider the other options:

- **Molybdenum (Mo):** It is a component of the enzyme nitrogenase, involved in nitrogen fixation.

- **Magnesium (Mg):** It is a macronutrient and is the central atom of the chlorophyll molecule. It is not directly involved in splitting water.

- **Copper (Cu):** It is a component of plastocyanin, an electron carrier in the electron transport chain between photosystems.

Step 3: Final Answer:
Manganese (Mn) is the crucial micronutrient required for the splitting of water.

Quick Tip

To remember the key ions for water splitting, think of the phrase "Mighty classy cleavage" for **Mn**, **Ca^{2+}**, and **Cl^-** being involved in the cleavage (splitting) of water.

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

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

Solution:

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

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 and it increases the surface area for microbial action.

- **B. The humus is further degraded by some microbes during mineralization.** This is **correct**. Humus is a dark, amorphous, and colloid-rich substance that is highly resistant to microbial action and decomposes slowly. The slow process of its degradation by microbes to release inorganic nutrients is called mineralization.

- **C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.** This is **correct**. Leaching is the process by which water-soluble substances (like inorganic nutrients released during decomposition) are washed down through the soil profile and can sometimes precipitate as unavailable salts.

- **D. The detritus food chain begins with living organisms.** This is **incorrect**. The detritus food chain begins with dead organic matter (detritus). The grazing food chain begins with living organisms (producers).

- **E. Earthworms break down detritus into smaller particles by a process called catabolism.** This is **incorrect**. The physical breakdown of detritus by earthworms is fragmentation. Catabolism is the enzymatic, chemical degradation of detritus into simpler inorganic substances by bacteria and fungi.

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

Quick Tip

Remember the key steps in decomposition in order: 1. **Fragmentation:** Physical breakdown by detritivores. 2. **Leaching:** Soluble nutrients wash away. 3. **Catabolism:** Chemical breakdown by microbes. 4. **Humification:** Formation of humus. 5. **Mineralization:** Release of inorganic nutrients from humus.

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

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

Correct Answer: (C) Anaphase II

Solution:

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

Step 2: Detailed Explanation:
Let's review the key events of the meiotic anaphases:

- **Anaphase I:** Homologous chromosomes separate and move to opposite poles. However, each chromosome still consists of two sister chromatids joined by a single centromere. The centromeres **do not** divide in Anaphase I. This is a key difference from mitosis.

- **Anaphase II:** Meiosis II is an equational division, very similar to mitosis. During Anaphase II, the centromere of each chromosome finally divides (splits). This allows the sister chromatids to separate and move to opposite poles. Once separated, each chromatid is now considered an individual chromosome.

The other stages listed are incorrect:

- **Metaphase I:** Homologous pairs align at the metaphase plate.
- **Metaphase II:** Individual chromosomes align at the metaphase plate.
- **Telophase:** Chromosomes arrive at the poles and decondense.

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

Quick Tip

A crucial distinction to remember:

- **Anaphase I:** Separates homologous chromosomes (centromeres intact).
- **Anaphase II:** Separates sister chromatids (centromeres divide).

This is the fundamental event that reduces the chromosome number in Meiosis I and then separates the chromatids in Meiosis II.

---

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

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

Correct Answer: (A) 680 nm

Solution:

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

Step 2: Detailed Explanation:
In the light-dependent reactions of photosynthesis, there are two photosystems, PS I and PS II. Each photosystem consists of a light-harvesting complex (antenna molecules) and a reaction center. The reaction center is a specific chlorophyll a molecule that becomes excited and donates an electron, initiating the electron transport chain.

- The reaction center of **Photosystem II (PS II)** is a chlorophyll a molecule that has an absorption peak at **680 nm**. It is therefore designated as **P680**.

- The reaction center of **Photosystem I (PS I)** is a chlorophyll a molecule that has an absorption peak at **700 nm**. It is therefore designated as **P700**.

The other wavelengths listed are not the maxima for the reaction centers.

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

Quick Tip

Remember the photosystems by their numbers and wavelengths:

- PS II comes second in the electron flow path but absorbs a shorter wavelength: P680.
- PS I comes first in the electron flow path (historically discovered first) and absorbs a longer wavelength: P700.

Think "2 comes before 1" and "680 comes before 700".

---

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Analysis of Statement I:
The terms 'endarch' and 'exarch' describe the pattern of development and position of **primary xylem**, not secondary xylem. These terms refer to the relative position of the first-formed primary xylem (protoxylem) and the later-formed primary xylem (metaxylem).

- **Endarch:** Protoxylem is located towards the center (pith) and metaxylem is located towards the periphery. This is characteristic of stems.
- **Exarch:** Protoxylem is located towards the periphery and metaxylem is located towards the center. This is characteristic of roots.

Since the statement refers to secondary xylem, **Statement I is incorrect**.

Analysis of Statement II:
As defined above, the exarch condition, where the protoxylem is on the outside and development proceeds inwards, is the defining anatomical feature of the vascular bundle arrangement

in the roots of vascular plants. Therefore, **Statement II is correct**.

Step 3: Final Answer:
Statement I is incorrect, but Statement II is true.

Quick Tip

Use mnemonics to remember xylem arrangement:

- **EX**arch = **EX**ternal protoxylem (found in roots, which **EX**it the plant into the soil).
- **EN**darch = **IN**ternal protoxylem (found in stems, which are **IN** the air).

Also, remember these terms apply only to PRIMARY xylem.

---

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

Correct Answer: (C) Alfred Sturtevant

Solution:

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

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

- **Thomas Hunt Morgan:** Working with *Drosophila melanogaster*, he provided experimental proof for the Chromosomal Theory of Inheritance and discovered the phenomena of linkage and recombination. He showed that genes are located on chromosomes.

- **Sutton and Boveri:** They independently proposed the Chromosomal Theory of Inheritance, which states that genes are located on chromosomes and that the behavior of chromosomes during meiosis can explain Mendel's laws.

- **Alfred Sturtevant:** He was a student in T.H. Morgan's lab. Sturtevant was the one who had the groundbreaking insight that the frequency of recombination between linked genes could be used as a measure of the physical distance separating them on the chromosome. Using this principle, he constructed the very first genetic map in 1913.

- **Henking:** He was an early cytologist who discovered the X chromosome in insects, referring to it as the 'X-body'.

Therefore, while Morgan discovered recombination, it was his student Sturtevant who first used its frequency for gene mapping.

Step 3: Final Answer:
Alfred Sturtevant first used recombination frequency for gene mapping.

Quick Tip

Differentiate the roles in Morgan's lab:

- **Morgan (The Boss):** Discovered linkage and recombination.
- **Sturtevant (The Student):** Used Morgan's data to **map** the genes.

The unit of genetic distance, the centiMorgan (cM), is named in honor of Morgan but represents the concept developed by Sturtevant.

---

32. The phenomenon of pleiotropism refers to

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's analyze the options:

- (A) This is an incorrect description. The presence of several alleles of a single gene is called multiple allelism.

- (B) This describes a typical Mendelian trait controlled by one gene with two alleles, which is not pleiotropy.
- (C) This is the correct definition of **pleiotropy**. It is the phenomenon where a single gene influences two or more distinct and seemingly unrelated phenotypic traits. A classic example in humans is the gene causing phenylketonuria (PKU), which leads to mental retardation, reduced skin pigmentation, and light hair color, all due to a defect in a single enzyme.
- (D) More than two genes affecting a single character is the definition of **polygenic inheritance**. For example, human skin color is controlled by multiple genes.

Step 3: Final Answer:
Pleiotropism is when a single gene affects multiple phenotypic expressions.

Quick Tip

To avoid confusion, remember the prefixes:

- **Pleio-** (more) → One gene has **more** than one effect.
- **Poly-** (many) → **Many** genes have one effect.

Pleiotropy: One Gene → Many Traits. Polygenic Inheritance: Many Genes → One Trait.

---

33. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

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

Step 2: Detailed Explanation:
ESTs are a tool used to identify transcribed regions of a genome. The process is as follows:

1. All the messenger RNA (mRNA) from a cell or tissue is isolated. mRNA is present only if a gene is being 'expressed' or transcribed.

2. An enzyme called reverse transcriptase is used to make a complementary DNA (cDNA) copy of each mRNA molecule.
3. Short, single-pass sequences are generated from one or both ends of these cDNA clones. These short sequences are the **Expressed Sequence Tags**.

Therefore, ESTs represent fragments of genes that are being actively expressed in the cell in the form of RNA. Option (A) is the most accurate description of what ESTs represent collectively. They are not limited to genes expressed as proteins (since some RNAs are non-coding) and they certainly do not represent unexpressed genes.

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

Quick Tip

Break down the name:

- **Expressed:** Because they come from mRNA, which represents expressed genes.
- **Sequence:** They are short DNA sequences.
- **Tags:** They act as "tags" or markers to identify which genes are active in a particular cell type.

---

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

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

Correct Answer: (B) 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 $NADPH_2$) needed to synthesize one molecule of glucose through the Calvin cycle.

Step 2: Key Formula or Approach:
We first need to know the energy requirement for fixing a single molecule of CO_2 in the Calvin cycle, and then scale it up for the synthesis of one glucose molecule ($C_6H_{12}O_6$).

Step 3: Detailed Explanation:
The Calvin cycle has three main stages: Carboxylation, Reduction, and Regeneration.

- For every single molecule of CO_2 that is fixed:
  - **Reduction Phase:** 2 molecules of ATP and 2 molecules of NADPH are used.
  - **Regeneration Phase:** 1 molecule of ATP is used.
- **Total per CO_2 fixed = 3 ATP + 2 NADPH.**

To synthesize one molecule of glucose ($C_6H_{12}O_6$), which has 6 carbon atoms, the cycle must 'turn' 6 times, fixing 6 molecules of CO_2.
Therefore, the total requirement is:

$$\text{Total ATP} = 6 \text{ turns} \times \frac{3 \text{ ATP}}{1 \text{ turn}} = 18 \text{ ATP}$$

$$\text{Total NADPH} = 6 \text{ turns} \times \frac{2 \text{ NADPH}}{1 \text{ turn}} = 12 \text{ NADPH}$$

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

Quick Tip

Simply memorize the requirements for one turn of the Calvin cycle: **3 ATP and 2 NADPH per CO_2**. To get the answer for one glucose, just multiply these numbers by **6**.

---

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

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

Correct Answer: (A) Insect pollinated plants

Solution:

Step 1: Understanding the Question:
The question describes a set of floral characteristics and asks to identify the type of pollination associated with them.

Step 2: Detailed Explanation:
The characteristics described are all adaptations to attract pollinators. Let's see how they relate to different pollination syndromes:

- **Insect pollinated plants (Entomophily):** To attract insects like bees and butterflies, flowers are typically:
  - **Large and colourful:** To be visually conspicuous.
  - **Fragrant:** To provide an olfactory cue.
  - **Contain nectar:** To offer a food reward.

  This perfectly matches the description.

- **Bird pollinated plants (Ornithophily):** Flowers are often large and brightly colored (especially red or orange), produce copious nectar, but are typically odorless as birds have a poor sense of smell.

- **Bat pollinated plants (Chiropterophily):** Flowers are usually large, dull-colored (white or greenish), open at night, and have a strong, musty, or fermented odor. They also produce abundant nectar.

- **Wind pollinated plants (Anemophily):** Flowers do not need to attract pollinators, so they are typically small, inconspicuous, lacking color, nectar, and fragrance. They produce large amounts of light, non-sticky pollen.

Step 3: Final Answer:
The combination of large, colorful, fragrant flowers with nectar is characteristic of insect pollinated plants.

Quick Tip

Think of pollination as a marketing strategy. To "sell" pollen transfer to an animal, a plant offers "advertisements" (color, scent) and a "payment" (nectar). Wind pollination doesn't need marketing, so the flowers are plain and functional.

Section - B

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

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

Solution:

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

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

- **A. M Phase:** This is the mitotic phase, where the cell divides. Mitosis is also known as equational division because the chromosome number in the daughter cells is the same as in the parent cell. Thus, **A matches IV**.

- **B. G_2 Phase:** This is the second gap phase, which occurs after DNA synthesis (S phase) and before mitosis (M phase). During this phase, the cell continues to grow and synthesizes proteins (like tubulin for spindle fibers) needed for mitosis. Thus, **B matches I**.

- **C. Quiescent stage (G_0):** This is a non-dividing state that cells can enter from the G_1 phase. Cells in G_0 are metabolically active but are not proliferating. It is considered an inactive phase with respect to the cell cycle. Thus, **C matches II**.

- **D. G_1 Phase:** This is the first gap phase. It is the interval between the completion of mitosis (M phase) and the beginning of the next S phase (initiation of DNA replication). Thus, **D matches III**.

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

Quick Tip

Visualize the cell cycle as a clock: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

- G_1: Growth, prepares for S.
- S: Synthesis (DNA replication).
- G_2: Growth, prepares for M.
- M: Mitosis (division).
- G_0: An exit from G_1 into a resting state.

---

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

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

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

Solution:

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

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

- **(A)** This statement is **correct**. The decomposition of organic matter by microorganisms is an aerobic process that consumes dissolved oxygen. High levels of sewage lead to a high Biochemical Oxygen Demand (BOD), depleting the water of oxygen and causing fish and other aquatic animals to die.

- **(B)** This statement is **incorrect**. Algal blooms, caused by nutrient enrichment (eutrophication), severely degrade water quality. They block sunlight, and when the algae die, their decomposition by bacteria consumes vast amounts of dissolved oxygen, leading to hypoxic conditions that kill fish. Thus, algal blooms are detrimental to fisheries, not promotional.

- **(C)** This statement is **correct**. Water hyacinth is an invasive species that thrives in nutrient-rich (eutrophic) waters. Its rapid growth can cover the entire water surface, disrupting the ecosystem.

- **(D)** This statement is **correct**. It accurately describes biomagnification, where the concentration of persistent toxins (like heavy metals or DDT) increases at successively higher levels in a food chain.

Step 3: Final Answer:
The statement that is not correct is (B), as algal blooms harm water quality and fisheries.

Quick Tip

Remember that "eutrophication" and "algal bloom" are negative terms in ecology. They are associated with pollution, oxygen depletion, and a loss of biodiversity. They never improve water quality or help fisheries.

---

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Analysis of Assertion A:
The assertion states that a flower is a modified shoot, which is the standard botanical definition. The shoot apical meristem, which normally gives rise to vegetative parts like stems and leaves,

transforms into a floral meristem, which is committed to producing the parts of a flower. This statement is **true**.

Analysis of Reason R:
The reason describes the process of this modification. In a flower, the axis (the shoot) stops elongating, and the internodes become highly condensed, bringing the nodes very close together. From these nodes, modified leaves arise, which are the floral appendages (sepals, petals, stamens, carpels). This statement accurately describes the morphological changes that occur. This statement is **true**.

Connecting A and R:
The Reason (R) provides a detailed explanation of *how* a shoot is modified to become a flower. It explains the condensation of internodes and the development of floral parts from nodes, which is the direct mechanism behind the transformation mentioned in the Assertion (A). Therefore, **R is the correct explanation of A**.

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

Quick Tip

Remember that the parts of a flower are homologous to leaves. The thalamus or receptacle is the condensed stem (with nodes and internodes), and the sepals, petals, stamens, and carpels are all modified leaves arranged in whorls on this condensed stem.

---

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to arrange the given steps of recombinant DNA technology in the correct

chronological order.

Step 2: Detailed Explanation:
Let's analyze the standard workflow for creating recombinant DNA and transforming a host.

1. The process begins with isolating the total DNA from a source organism.
2. **Step B: Cutting of DNA at specific location by restriction enzyme.** The isolated genomic DNA is treated with restriction enzymes, which cut the DNA into many fragments. The vector DNA (e.g., plasmid) is also cut with the same enzyme.
3. **Step C: Isolation of desired DNA fragment.** From the mixture of DNA fragments, the specific fragment containing the gene of interest is isolated, typically using gel electrophoresis followed by elution.
4. **Step D: Amplification of gene of interest using PCR.** To obtain a sufficient quantity of the gene for ligation, it is amplified using the Polymerase Chain Reaction (PCR).
5. *(Ligation - not listed)* The amplified gene of interest is then joined (ligated) into the cut vector DNA to create the recombinant DNA molecule.
6. **Step A: Insertion of recombinant DNA into the host cell.** Finally, the complete recombinant DNA is introduced into a suitable host organism (e.g., bacteria) through transformation.

Based on this detailed workflow, the correct sequence of the given options is B $\rightarrow$ C $\rightarrow$ D $\rightarrow$ A.

Step 3: Final Answer:
The correct sequence of steps is B, C, D, A, which corresponds to option (A).

Quick Tip

Think of the process as finding and copying a specific sentence from a book.

- **B (Cut):** You use scissors (restriction enzymes) to cut out all the pages of the book.
- **C (Isolate):** You search through the pages to find the specific one with your sentence (gel electrophoresis).
- **D (Amplify):** You make many photocopies of that sentence (PCR).
- **A (Insert):** You paste the sentence into a new document (ligation and transformation).

---

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

(A) 80
(B) 60

(C) 40
(D) 20

Correct Answer: (A) 80

Solution:

Step 1: Understanding the Question:
The question asks for the approximate number of different proteins that constitute a ribosome, which is a complex of ribosomal RNA (rRNA) and proteins.

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

- **Prokaryotic Ribosome (70S):** It is composed of a 30S small subunit (containing ∼21 proteins) and a 50S large subunit (containing ∼34 proteins), for a total of about 55 different proteins.
- **Eukaryotic Ribosome (80S):** It is composed of a 40S small subunit (containing ∼33 proteins) and a 60S large subunit (containing ∼49 proteins).

The total number of proteins in a eukaryotic ribosome is approximately 33 + 49 = 82. In the context of a general biology question, "ribosome" usually refers to the eukaryotic type unless specified otherwise. The closest answer choice to 82 is 80.

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

Quick Tip

For competitive exams, it's useful to remember the approximate protein count for ribosomes: ∼55 for prokaryotic (70S) and ∼80 for eukaryotic (80S). The number 80 is a standard figure for eukaryotic ribosomes.

---

41. Match List I with List II:

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

Choose the correct answer from the options given below:

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

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's analyze each mineral nutrient and its function:

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

- **B. Zinc (Zn):** Zinc is an activator for many enzymes, especially carboxylases. Importantly, it is also required for the **synthesis of auxin** (specifically, indole-3-acetic acid or IAA). So, **B matches I**.

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

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

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

Quick Tip

Create flashcards for mineral nutrients with the element on one side and its key functions/deficiency symptoms on the other. Key associations to memorize are: Zn $\rightarrow$ Auxin synthesis; Mo $\rightarrow$ Nitrate reductase; Fe $\rightarrow$ Catalase/Chlorophyll synthesis; B $\rightarrow$ Pollen germination.

---

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

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

Solution:

Step 1: Understanding the Question:
This is an Assertion-Reason question about the process of pollination and fertilization in gymnosperms. We must evaluate the truthfulness of both statements and their logical relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A:
The assertion states that gymnosperm pollen is dispersed by wind (air currents). This mode of pollination is known as anemophily and is the characteristic method for most gymnosperms, such as pines and other conifers. The pollen grains are light and produced in large quantities to facilitate wind dispersal. Thus, **Assertion A is true**.

Analysis of Reason R:
The reason describes the post-pollination events. While it correctly states that air currents carry the pollen to the ovule (which contains the archegonia), it makes a critical error by stating that a "pollen tube is not formed." In fact, the formation of a pollen tube (siphonogamy) is a hallmark of all seed plants (gymnosperms and angiosperms). The pollen grain germinates, grows a pollen tube that digests its way through the nucellus to the archegonium, and then discharges the male gametes near the egg cell. The statement that the pollen tube is not formed is definitively incorrect. Therefore, **Reason R is false**.

Step 3: Final Answer:
Assertion A is a true statement, but Reason R is a false statement. This corresponds to option (C).

Quick Tip

Remember that the pollen tube is a key evolutionary innovation that freed seed plants from the need for water for fertilization. Both gymnosperms and angiosperms have pollen tubes. The absence of a pollen tube and reliance on motile sperm swimming in water is a feature of pteridophytes and bryophytes.

---

43. Match List I with List II :

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

Choose the correct answer from the options given below:

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching different types of population interactions (List I) with their symbolic representations (List II). In these representations, '+' signifies a benefit, '-' signifies harm, and 'O' signifies a neutral or no effect.

Step 2: Detailed Explanation:
Let's analyze each interaction type:

- **A. Mutualism:** An interaction where both interacting species benefit from each other. This is represented as (+, +). So, **A matches IV**.
- **B. Commensalism:** An interaction where one species benefits, and the other is neither harmed nor benefited. This is represented as (+, O). So, **B matches I**.
- **C. Amensalism:** An interaction where one species is harmed, and the other is unaffected. This is represented as (-, O). So, **C matches II**.
- **D. Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other (the host), which is harmed. This is represented as (+, -). So, **D matches III**.

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

Quick Tip

Create a simple table to memorize these interactions. Use columns for Interaction Name, Species A, and Species B, and fill in the symbols (+, -, O). This visual aid is very effective for quick recall during exams.

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

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

Correct Answer: (A) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks to identify the enzyme whose activity is inhibited by malonate (spelled 'Melonate' in the question), leading to the inhibition of bacterial growth. This is a question about enzyme inhibition.

Step 2: Detailed Explanation:
The concept being tested is competitive inhibition. A competitive inhibitor is a molecule that is structurally similar to the enzyme's natural substrate and competes for the same active site.

- **Succinic dehydrogenase** is an enzyme in the Krebs cycle that catalyzes the oxidation of succinate to fumarate.
- **Malonate** is a structural analogue of **succinate**.
- Because of this structural similarity, malonate can bind to the active site of succinic dehydrogenase, blocking the substrate (succinate) from binding.
- This inhibition stops the Krebs cycle, which is a vital pathway for cellular respiration and energy production. By halting this pathway, malonate effectively inhibits the growth and survival of the bacteria.

The other enzymes listed are not inhibited by malonate.

Step 3: Final Answer:
Malonate acts as a competitive inhibitor of the enzyme succinic dehydrogenase.

Quick Tip

The trio of Succinate (Substrate), Malonate (Inhibitor), and Succinic dehydrogenase (Enzyme) is the most classic example of competitive inhibition taught in biology. Memorizing this specific interaction is highly beneficial.

---

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

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

Solution:

Step 1: Understanding the Question:
The question asks to match the terms related to the properties of water and its movement in plants (List I) with their correct definitions (List II).

Step 2: Detailed Explanation:
Let's define each term in List I and match it with List II.

- **A. Cohesion:** This is the property of water molecules being attracted to each other due to hydrogen bonds. It refers to the **mutual attraction among water molecules**. So, **A matches II**.

- **B. Adhesion:** This is the property of water molecules being attracted to other types of molecules, especially polar ones. In plants, this is the **attraction towards polar surfaces** like the walls of xylem vessels. So, **B matches IV**.

- **C. Surface tension:** This property is a result of cohesion. Water molecules at the surface are more strongly attracted to each other (in the liquid) than to the molecules in the air

above. This results in **more attraction in the liquid phase** and minimizes the surface area. So, **C matches I**.

- **D. Guttation:** This is a physiological process where water is exuded from the tips of leaves as liquid droplets through special pores called hydathodes. It represents **water loss in the liquid phase**. So, **D matches III**.

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

Quick Tip

Remember the difference between cohesion and adhesion:

- **Cohesion** = Water to Water (co-worker, same team)
- **Adhesion** = Water to Other surfaces (adhesive tape, sticks to other things)

Guttation is often confused with dew; remember guttation is water from inside the plant, while dew is condensation from the air.

---

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the essential components needed for the process of chemiosmosis, which is the mechanism used to generate ATP during cellular respiration and photosynthesis.

Step 2: Detailed Explanation:
According to Peter Mitchell's chemiosmotic theory, ATP synthesis is driven by a proton gradient across a membrane. The process requires four key components:

1. **A membrane:** An intact membrane (inner mitochondrial membrane or thylakoid membrane) that is impermeable to protons, creating two separate compartments.

2. **A proton pump:** Protein complexes within the electron transport chain use the energy from electron flow to pump protons (H^+) across the membrane from one compartment to the other.

3. **A proton gradient:** The pumping of protons creates an electrochemical potential difference across the membrane, also known as the proton-motive force. This gradient stores potential energy.

4. **ATP synthase:** A specialized enzyme complex embedded in the membrane that provides a channel for protons to flow back down their gradient. The energy released by this flow is used by ATP synthase to phosphorylate ADP, producing ATP.

Option (A) correctly lists all four of these components. The other options are incorrect because they mention an "electron gradient" (it's a proton gradient) or "NADP synthase" (the enzyme is ATP synthase).

Step 3: Final Answer:
The combination required for chemiosmosis is a membrane, a proton pump, a proton gradient, and ATP synthase.

Quick Tip

Use the hydroelectric dam analogy for chemiosmosis: The **dam** is the **membrane**, the **pumps** force water up to create a reservoir, the stored water is the **proton gradient**, and the water flowing through the **turbine** to generate electricity is like protons flowing through **ATP synthase** to generate ATP.

---

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

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

Correct Answer: (B) A and D only

Solution:

Step 1: Understanding the Question:
The question asks to identify which of the given statements about plant anatomy are correct.

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

- **A. Lenticels are the lens-shaped openings permitting the exchange of gases.** This is **correct**. Lenticels are pores in the periderm of woody stems that allow for gas exchange between the internal tissues and the atmosphere.

- **B. Bark formed early in the season is called hard bark.** This is **incorrect**. Bark formed early in the season (spring) is called 'soft bark', while bark formed late in the season is called 'hard bark'.

- **C. Bark is a technical term that refers to all tissues exterior to vascular cambium.** This statement is broadly true, but it's a non-technical definition. Statement D provides a more precise, technical definition. In the context of choosing the best answer, D is superior.

- **D. Bark refers to periderm and secondary phloem.** This is the precise botanical definition of bark. It includes all tissues outside the vascular cambium, which are the periderm and the secondary phloem. This is **correct**.

- **E. Phellogen is single-layered in thickness.** This is **incorrect**. Phellogen (cork cambium) is a meristematic layer and is typically a couple of layers thick, not strictly a single layer.

Step 3: Final Answer:
The clearly and precisely correct statements are A and D.

Quick Tip

To remember the components of bark, think in layers from the outside in: **Bark** = **Periderm** (Outer Bark) + **Secondary Phloem** (Inner Bark). Remember that Periderm itself has three layers: Phellem (cork), Phellogen (cork cambium), and Phelloderm.

---

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

Correct Answer: (C) B and E only

Solution:

Step 1: Understanding the Question:
The question asks to identify the correct statements describing Klinefelter's Syndrome from the given list. Klinefelter's Syndrome is a genetic condition caused by an extra X chromosome in males (47, XXY).

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

- **A.** This is **incorrect**. Langdon Down described Down's Syndrome. Klinefelter's Syndrome was described by Harry Klinefelter in 1942.

- **B.** This is **correct**. Individuals with Klinefelter's Syndrome are phenotypically male but have an extra X chromosome, which leads to some female characteristics, such as the development of breasts (gynaecomastia), alongside overall masculine development.

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

- **D.** This is **incorrect**. While some learning disabilities may be present, severe mental retardation is not a typical feature of Klinefelter's Syndrome. This statement is more characteristic of Down's Syndrome.

- **E.** This is **correct**. The presence of the extra X chromosome leads to underdeveloped testes (testicular atrophy) and results in very low or no sperm production, causing infertility or sterility.

Step 3: Final Answer:
The correct statements are B and E.

Quick Tip

To avoid confusion between chromosomal disorders, create a small table comparing Down's, Klinefelter's, and Turner's syndromes. List the karyotype, typical sex, stature, fertility, and key physical features for each.

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

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

Solution:

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

Step 2: Detailed Explanation:
Analysis of Statement I:
This statement accurately defines Gause's Competitive Exclusion Principle. The principle posits that if two species have identical niches (i.e., they compete for the exact same limited resources), they cannot coexist in the same place. The species that is even slightly more efficient will eventually outcompete and eliminate the other. This statement is **correct**.

Analysis of Statement II:
This statement makes a broad generalization that carnivores are more affected by competition than herbivores. This is not a valid ecological rule. The intensity of competition depends on the degree of resource limitation and niche overlap, not on the trophic level. Competition can be extremely fierce among herbivores for specific host plants, or among carnivores for prey. There is no general principle stating that one trophic level is more adversely affected than another. This statement is **false**.

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

Quick Tip

Remember Gause's principle with the classic example of *Paramecium aurelia* and *Paramecium caudatum*. When grown together, *P. aurelia* always outcompeted *P. caudatum* for the limited food, leading to the elimination of the latter.

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50. Match List I with List II:

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

Choose the correct answer from the options given below :

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

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

Solution:

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

Step 2: Detailed Explanation:
Let's analyze each process in List I:

- **A. Oxidative decarboxylation:** This refers to the link reaction, where pyruvate is converted to acetyl-CoA. This reaction is catalyzed by the **Pyruvate dehydrogenase** enzyme complex. So, **A matches II**.

- **B. Glycolysis:** This is the initial pathway of glucose breakdown. It is also known as the **EMP pathway**, named after its discoverers (Embden, Meyerhof, and Parnas). So, **B matches IV**.

- **C. Oxidative phosphorylation:** This is the final stage where the bulk of ATP is produced. It involves the transfer of electrons through the **Electron transport system** to generate a proton gradient that drives ATP synthase. So, **C matches III**.

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

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

Quick Tip

To master cellular respiration, create a flowchart that links all the stages: Glycolysis → Link Reaction (Oxidative Decarboxylation) → TCA Cycle → Oxidative Phosphorylation (ETS and Chemiosmosis). Label the key inputs, outputs, and enzymes for each stage.
