

NEET UG 2023 E4 Botany Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :720	Total Questions :200
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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. 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 plant hormone responsible for the rapid elongation of internodes or petioles in deep water rice plants when they are submerged. This is a specific adaptation to keep the leaves above the water surface for photosynthesis.

Step 2: Detailed Explanation:

Deep water rice has a remarkable ability to grow rapidly when flooded. This response is primarily triggered by the hormone ethylene.

1. When the rice plant is submerged in water, ethylene accumulates in the submerged parts of the plant because its diffusion out of the plant is slowed in water.
2. This increased concentration of ethylene promotes the synthesis of gibberellins (like GA_3).
3. The gibberellins then stimulate cell division and elongation in the internodes, causing the stem to grow rapidly and push the leaves above the water level.

While gibberellin (GA_3) is directly involved in the elongation, ethylene is the primary hormonal trigger for this specific response in deep water rice. Kinetin is a cytokinin involved in cell division, and 2,4-D is a synthetic auxin often used as a herbicide.

Step 3: Final Answer:

Based on the mechanism of flood response in deep water rice, ethylene is the key hormone that initiates the rapid internode elongation. Therefore, option (C) is the correct answer.

Quick Tip

Remember the specific and sometimes unique roles of plant hormones. While gibberellins are the general promoters of stem elongation, for the special case of 'deep water rice', ethylene is the critical trigger that accumulates during submergence and initiates the rapid growth response.

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 (A) about ATP usage in glycolysis and a Reason (R) specifying the steps of this usage. We need to evaluate the truthfulness of both statements and determine if the Reason correctly explains the Assertion.

Step 2: Detailed Explanation:

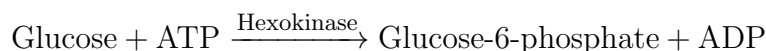
Analysis of Assertion A:

Glycolysis is the metabolic pathway that converts glucose into pyruvate. It consists of two main phases: the preparatory (or investment) phase and the payoff phase. In the preparatory phase, energy in the form of ATP is consumed to energize the glucose molecule. Specifically, two molecules of ATP are used per molecule of glucose. So, Assertion A is true.

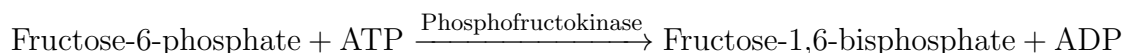
Analysis of Reason R:

Reason R describes the two specific steps where ATP is consumed:

1. **First step:** Glucose is phosphorylated to glucose-6-phosphate by the enzyme hexokinase. This reaction consumes one molecule of ATP.



2. **Third step:** Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate (not diphosphate) by the enzyme phosphofructokinase. This reaction consumes a second molecule of ATP.



The term "diphosphate" is sometimes used interchangeably with "bisphosphate" in older texts, but "bisphosphate" is more accurate as the phosphate groups are on different carbons. However, the statement is chemically correct in identifying the substrates and products. So, Reason R is also true.

Relationship between A and R:

Reason R correctly identifies the two precise enzymatic steps where ATP is invested in the glycolytic pathway. This directly and accurately explains why Assertion A (that ATP is used at two steps) is true.

Step 3: Final Answer:

Both Assertion A and Reason R are true, and Reason R provides the correct explanation for Assertion A. Therefore, option (A) is the correct choice.

Quick Tip

To master glycolysis, create a flowchart of the 10 steps. Clearly mark the two ATP investment steps (catalyzed by Hexokinase and Phosphofructokinase) and the two ATP generation steps (catalyzed by Phosphoglycerate kinase and Pyruvate kinase, which occur twice per glucose). This visual aid helps in quickly answering such assertion-reason questions.

3. 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 question asks us to evaluate two statements about the formation of wood in trees. Assertion A describes the characteristics of late wood (autumn wood), and Reason R provides a physiological cause related to cambial activity. We must determine if both are true and if R explains A.

Step 2: Detailed Explanation:

Analysis of Assertion A:

In temperate regions, the activity of the vascular cambium is seasonal. The wood formed during the later part of the growing season (autumn or late summer) is called late wood or autumn wood. Due to less favorable conditions (e.g., shorter days, cooler temperatures), the xylem elements (xylary elements) produced are fewer, smaller, and have narrower vessels with thick walls. This makes the late wood denser and darker in color. Thus, Assertion A is true.

Analysis of Reason R:

The vascular cambium is a layer of actively dividing cells responsible for secondary growth. Its activity is highly dependent on environmental conditions like temperature, water availability, and light. In winter, these conditions are unfavorable, causing the cambium to become less active or dormant. Thus, Reason R is true.

Relationship between A and R:

The reduced activity of the cambium during the unfavorable conditions of late summer and autumn (as stated in Reason R) is the direct cause for the production of fewer xylary elements with narrow vessels (as described in Assertion A). The plant conserves resources, leading to the formation of dense, structurally strong but less conductive late wood. Therefore, Reason R is the correct explanation for Assertion A.

Step 3: Final Answer:

Both statements are correct, and the reason correctly explains the assertion. Hence, option (A) is the correct answer.

Quick Tip

Associate seasons with cambial activity and wood type. **Spring/Earlywood:** Favorable conditions → High cambial activity → More, wider vessels → Less dense, lighter wood. **Autumn/Latewood:** Unfavorable conditions → Low cambial activity → Fewer, narrower vessels → Denser, darker wood. One ring of earlywood + one ring of latewood = one annual ring.

4. 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) exhibits its maximum absorption.

Step 2: Detailed Explanation:

In higher plants, photosynthesis is driven by two photosystems: Photosystem I (PS I) and Photosystem II (PS II).

Each photosystem consists of a light-harvesting complex (antenna molecules) and a reaction center.

The reaction center is a special chlorophyll 'a' molecule that traps the light energy and initiates the electron transport chain.

- The reaction center of **Photosystem II (PS II)** is a chlorophyll 'a' molecule that shows maximum absorption at a wavelength of **680 nm**. It is therefore called **P680**.

- The reaction center of **Photosystem I (PS I)** is a chlorophyll 'a' molecule that shows maximum absorption at a wavelength of **700 nm**. It is therefore called **P700**.

Step 3: Final Answer:

The question specifically asks about PS II. Therefore, its reaction center has an absorption maximum at 680 nm. Option (A) is correct.

Quick Tip

A simple mnemonic to remember the reaction centers: PS II comes before PS I in the Z-scheme of electron transport. Similarly, the number 680 comes before 700. So, PS II corresponds to P680, and PS I corresponds to P700.

5. 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 Dithecoust anthers
- (B) Polyadelphous and epipetalous stamens
- (C) Monadelphous and Monothecous anthers
- (D) Epiphyllous and Dithecoust anthers

Correct Answer: (A) Diadelphous and Dithecoust anthers

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

Let's analyze the stamen characteristics of the three families:

- **Fabaceae (e.g., Pea):** The androecium typically consists of ten stamens. The most common arrangement is **diadelphous**, where the filaments of nine stamens are fused to form a tube, and the tenth stamen is free (written as (9)+1). The anthers are **dithecoust** (having two lobes).
- **Solanaceae (e.g., Petunia, Potato):** The androecium has five stamens. They are **epipetalous**, meaning the filaments are attached to the petals. The anthers are dithecoust.
- **Liliaceae (e.g., Lily, Onion):** The androecium has six stamens, arranged in two whorls of three. They are **epiphyllous** or **epitepalous**, meaning the filaments are attached to the tepals (undifferentiated perianth lobes). The anthers are dithecoust.

Now let's evaluate the options:

(A) **Diadelphous and Dithecouous anthers:** The diadelphous condition is the hallmark of the subfamily Papilionoideae within Fabaceae and is not found in Solanaceae or Liliaceae. Dithecouous anthers are common to all three, but the combination makes this specific to Fabaceae.

(B) **Polyadelphous and epipetalous stamens:** Polyadelphous (stamens in many bundles) is found in families like Rutaceae (Citrus). Epipetalous is found in Solanaceae, not Fabaceae.

(C) **Monadelphous and Monothealous anthers:** This combination is characteristic of the family Malvaceae (e.g., China rose).

(D) **Epiphyllous and Dithecouous anthers:** Epiphyllous condition is characteristic of Liliaceae.

Step 3: Final Answer:

The diadelphous condition of stamens is a distinctive feature of Fabaceae that is absent in Solanaceae and Liliaceae. Therefore, option (A) is the correct answer.

Quick Tip

Associate key androecium features with major plant families:

- **Fabaceae:** Diadelphous stamens ((9)+1)
- **Solanaceae:** Epipetalous stamens
- **Liliaceae:** Epitpalous/Epiphyllous stamens
- **Malvaceae:** Monadelphous stamens, monothealous anthers

Memorizing these key traits is essential for comparative questions.

6. 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:

The question asks to evaluate two statements about the life cycle of mosses (Bryophytes). Assertion A identifies the protonema as the first stage of the gametophyte, and Reason R describes its origin from a spore. We need to check their validity and relationship.

Step 2: Detailed Explanation:**Analysis of Assertion A:**

The life cycle of a moss has a dominant gametophytic generation. This generation has two distinct stages. When a haploid spore germinates, it does not immediately form the familiar leafy moss plant. Instead, it develops into a filamentous, creeping, green, branched structure called the **protonema**. This is the juvenile or first stage of the gametophyte. Later, lateral buds arise from this protonema, which then develop into the upright, leafy adult gametophyte (the leafy stage). So, Assertion A is correct.

Analysis of Reason R:

The life cycle alternates between a diploid sporophyte and a haploid gametophyte. The sporophyte, which is dependent on the gametophyte, consists of a foot, seta, and a capsule. Inside the capsule, meiosis occurs, producing haploid spores. These spores are released, and upon finding a suitable substrate, they germinate to form the protonema. Thus, the protonema develops directly from a spore produced in the capsule. So, Reason R is correct.

Relationship between A and R:

Reason R explains the origin of the protonema (from a spore), which correctly establishes it as the very first stage that develops after the sporophytic generation ends and the gametophytic generation begins. Therefore, Reason R is the correct explanation for Assertion A.

Step 3: Final Answer:

Both Assertion A and Reason R are correct, and R provides the correct explanation for A. Thus, option (A) is the correct choice.

Quick Tip

Remember the developmental sequence in the moss life cycle: Sporophyte ($2n$) $\rightarrow$ Capsule ($2n$) $\xrightarrow{\text{Meiosis}}$ Spore (n) $\xrightarrow{\text{Germination}}$ Protonema (n , 1st stage of gametophyte) $\rightarrow$ Leafy gametophyte (n , 2nd stage) $\rightarrow$ Gametes (n). This sequence clarifies the position of the protonema.

7. 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 requires identifying the group of plants from the given options that all exhibit axile placentation. Placentation refers to the arrangement of ovules within the ovary.

Step 2: Detailed Explanation:

Definition of Axile Placentation: In axile placentation, the ovary is partitioned into two or more chambers (locules) by septa, and the ovules are attached to the central axis where the septa meet.

Let's examine the placentation types for the plants in each option:

- **(A) Mustard, Cucumber and Primrose:**

- Mustard: Parietal placentation
- Cucumber: Parietal placentation
- Primrose: Free-central placentation

This option is incorrect.

- **(B) China rose, Beans and Lupin:**

- China rose: Axile placentation
- Beans and Lupin (Family Fabaceae): Marginal placentation

This option is incorrect.

- **(C) Tomato, Dianthus and Pea:**

- Tomato: Axile placentation
- Dianthus: Free-central placentation
- Pea (Family Fabaceae): Marginal placentation

This option is incorrect.

- **(D) China rose, Petunia and Lemon:**

- China rose (Family Malvaceae): Axile placentation
- Petunia (Family Solanaceae): Axile placentation
- Lemon (Family Rutaceae): Axile placentation

All three plants in this option show axile placentation. This option is correct.

Step 3: Final Answer:

The correct combination of plants that all exhibit axile placentation is China rose, Petunia, and Lemon. Therefore, option (D) is the correct answer.

Quick Tip

For morphology questions, memorizing one or two key examples for each type of placentation is very effective.

- **Marginal:** Pea
- **Axile:** Tomato, Lemon, China rose
- **Parietal:** Mustard, Argemone
- **Free-central:** Dianthus, Primrose
- **Basal:** Sunflower, Marigold

8. 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, mature cells (leaf mesophyll) are induced to divide and form an unorganized mass of cells called a callus. We need to identify the correct biological term for this process.

Step 2: Detailed Explanation:

Let's define the terms given in the options:

- **Differentiation:** The process by which cells, tissues, and organs acquire their specialized structure and function. Leaf mesophyll cells are already differentiated cells.
- **Dedifferentiation:** The process by which mature, differentiated, non-dividing cells revert to a meristematic (undifferentiated) state and regain the capacity for cell division. This is precisely what happens when a piece of plant tissue (explant), like leaf mesophyll, is placed on a nutrient medium and forms a callus. The specialized cells lose their specialization to become a mass of actively dividing, undifferentiated cells.

- **Redifferentiation:** The process where dedifferentiated cells (like those in a callus) are induced to differentiate again into new, specialized cells to form tissues, organs, or a whole plantlet.
- **Development:** The sum of all changes an organism undergoes throughout its life cycle, from germination to senescence. It includes both growth and differentiation.
- **Senescence:** The process of aging in plants, leading to death.

The formation of a callus from differentiated mesophyll cells is a classic example of dedifferentiation.

Step 3: Final Answer:

The phenomenon described is called dedifferentiation. Therefore, option (B) is the correct answer.

Quick Tip

Remember the sequence of events in micropropagation via callus formation: **Differentiated** cell (Explant) $\xrightarrow{\text{Dedifferentiation}}$ Callus (Undifferentiated) $\xrightarrow{\text{Redifferentiation}}$ Plantlet (with differentiated tissues). This D-D-R sequence is a key concept in plant tissue culture.

9. Frequency of recombination between gene pairs on the 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 proposed and used the frequency of genetic recombination to determine the relative distances between genes on a chromosome, thereby creating the first genetic maps.

Step 2: Detailed Explanation:

Let's review the contributions of the scientists listed:

- **Thomas Hunt Morgan (T.H. Morgan):** Working with fruit flies (*Drosophila melanogaster*), he provided experimental proof for the Chromosomal Theory of Inheritance. He discovered concepts like linkage (genes on the same chromosome tend to be inherited together) and recombination (crossing over can separate linked genes).
- **Sutton and Boveri:** They independently formulated 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 an undergraduate student in T.H. Morgan's lab. He had the key insight that the *frequency* of recombination between two linked genes is proportional to the physical distance separating them on the chromosome. Using this principle, he constructed the first-ever genetic map for the X-chromosome of *Drosophila* in 1913. The unit of genetic distance, the centimorgan (cM), is named in honor of his mentor.
- **Henking:** In 1891, while studying spermatogenesis in an insect, he observed a specific nuclear structure which he named the X-body. This was later identified as the X chromosome.

While Morgan discovered linkage and recombination, it was his student, Alfred Sturtevant, who first used the recombination frequency data to map the genes.

Step 3: Final Answer:

The scientist who first used recombination frequency to map gene positions was Alfred Sturtevant. Therefore, option (C) is the correct answer.

Quick Tip

Remember the hierarchy of discoveries: Sutton and Boveri proposed the theory. T.H. Morgan provided the proof and discovered linkage/recombination. Alfred Sturtevant, Morgan's student, used recombination frequencies to create the first genetic map.

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

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

Correct Answer: (B) Gibberellic Acid

Solution:

Step 1: Understanding the Question:

The question asks which plant hormone is used to accelerate the transition from the juvenile

phase to the mature, reproductive phase in conifers, thereby allowing for earlier seed production.

Step 2: Detailed Explanation:

Let's analyze the functions of the given phytohormones:

- **Indole-3-butyric Acid (IBA):** This is a type of auxin. Auxins are primarily involved in cell elongation, apical dominance, and root initiation. IBA is commercially used to promote rooting in plant cuttings.
- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including stem elongation (bolting), breaking seed dormancy, and promoting flowering. A significant commercial application is spraying juvenile conifers with GAs to hasten the maturation process. This overcomes the long juvenile period and leads to early cone and seed production, which is important for breeding programs.
- **Zeatin:** This is a type of cytokinin. Cytokinins promote cell division (cytokinesis), help overcome apical dominance, and delay leaf senescence.
- **Abscisic Acid (ABA):** This is generally an inhibitory hormone. It plays a role in seed dormancy, stomatal closure during water stress, and abscission (shedding of leaves, flowers, and fruits).

The specific function of hastening maturity in conifers is a well-established role of gibberellic acid.

Step 3: Final Answer:

Spraying with Gibberellic Acid helps in hastening the maturity period of juvenile conifers. Therefore, option (B) is the correct answer.

Quick Tip

For competitive exams, focus on the key commercial and agricultural applications of each plant hormone:

- **Auxins (like IBA, NAA):** Rooting cuttings, preventing fruit drop, herbicide.
- **Gibberellins (GA):** Increasing fruit size (grapes), elongating stems (sugarcane), speeding up malting (brewing), hastening conifer maturity.
- **Cytokinins:** Delaying senescence, tissue culture.
- **Ethylene:** Fruit ripening.
- **ABA:** Stress hormone, promotes dormancy.

11. 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 (large, colourful, fragrant, with nectar) and asks to identify the corresponding mode of pollination. This relates to the concept of pollination syndromes, where flower traits are adapted to attract specific pollinators.

Step 2: Detailed Explanation:

Let's analyze the typical features associated with each pollination type:

- **Insect pollinated plants (Entomophily):** Flowers have evolved to attract insects. They are typically **large** to be conspicuous, **colourful** (especially in blue, purple, yellow ranges visible to insects), **fragrant** to provide an olfactory cue, and produce **nectar** as a food reward for the pollinator. This perfectly matches the description in the question.
- **Bird pollinated plants (Ornithophily):** Flowers are often large and brightly coloured (especially red or orange), produce copious amounts of dilute nectar, but are usually odorless because birds have a poor sense of smell.
- **Bat pollinated plants (Chiropterophily):** Flowers are typically large, open at night, pale or dull-coloured (white, green), and emit a strong, musty, or fermented fruity odour. They also produce large amounts of nectar.
- **Wind pollinated plants (Anemophily):** Flowers do not need to attract pollinators, so they are generally small, inconspicuous, lack bright colours, fragrance, and nectar. They produce large quantities of light, dry pollen that can be easily carried by the wind.

The combination of all four characteristics - large size, colour, fragrance, and nectar - is a classic suite of adaptations for attracting insects.

Step 3: Final Answer:

The described floral characteristics are most commonly found in insect-pollinated plants. Therefore, option (A) is the correct answer.

Quick Tip

To solve pollination syndrome questions, think from the pollinator's perspective. What senses does it use?

- **Insects:** Good vision (colour) and smell → colourful, fragrant flowers.
- **Birds:** Excellent vision (especially red), poor smell → colourful, odorless flowers.
- **Bats:** Nocturnal, good smell, use echolocation → night-blooming, pale, smelly flowers.
- **Wind/Water:** Non-living agents → no need for attractants like colour, scent, or nectar.

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

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

Correct Answer: (B) 18 ATP and 12 NADPH₂

Solution:

Step 1: Understanding the Question:

The question asks for the total number of ATP and NADPH molecules (referred to as NADPH₂ in the question, an older notation for NADPH + H⁺) needed to produce one molecule of glucose (C₆H₁₂O₆) through the Calvin cycle.

Step 2: Detailed Explanation:

The Calvin cycle, or C₃ cycle, is the process where carbon dioxide is fixed into organic sugars. The synthesis of one molecule of glucose requires the fixation of 6 molecules of CO₂. We can analyze the energy requirements per CO₂ molecule fixed and then multiply by 6.

For one turn of the Calvin cycle (fixing 1 CO₂):

1. **Carboxylation:** 1 CO₂ combines with 1 RuBP. No energy is used here.
2. **Reduction:** The resulting 2 molecules of 3-PGA are reduced to 2 molecules of glyceraldehyde-3-phosphate (G3P). This step requires **2 ATP** and **2 NADPH** per CO₂.
3. **Regeneration:** For every 3 CO₂ fixed, 6 G3P are made. One G3P exits the cycle, and the other five are used to regenerate 3 molecules of RuBP. This regeneration process requires **1 ATP** per CO₂ fixed.

Total for 1 CO₂: 2 ATP (Reduction) + 1 ATP (Regeneration) = **3 ATP** and **2 NADPH**.

For synthesis of 1 molecule of Glucose (C₆H₁₂O₆):

Since glucose is a 6-carbon sugar, the cycle must fix 6 molecules of CO₂.

Total ATP required = 6 CO₂ × 3 ATP/CO₂ = **18 ATP**.

Total NADPH required = 6 CO₂ × 2 NADPH/CO₂ = **12 NADPH**.

Step 3: Final Answer:

To synthesize one molecule of glucose, the Calvin cycle requires 18 ATP and 12 NADPH. Therefore, option (B) is correct.

Quick Tip

Remember the 3:2 ratio of ATP to NADPH for fixing one CO₂ in the C3 cycle. To make glucose (a 6-carbon sugar), you need to fix 6 CO₂. So, just multiply the requirements by 6: (6 × 3 ATP) and (6 × 2 NADPH).

13. 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 in meiosis where the centromere, the structure holding two sister chromatids together, splits.

Step 2: Detailed Explanation:

Meiosis is a two-step cell division process, Meiosis I and Meiosis II.

- **Meiosis I** is a reductional division where homologous chromosomes separate. Throughout Meiosis I (Prophase I, Metaphase I, Anaphase I, Telophase I), the sister chromatids remain attached at their centromeres. In **Anaphase I**, homologous chromosomes move to opposite poles, but the centromeres do not divide.
- **Meiosis II** is an equational division, similar to mitosis, where sister chromatids separate.
 - In **Metaphase II**, individual chromosomes (each consisting of two sister chromatids) align at the metaphase plate.

- In **Anaphase II**, the centromere of each chromosome finally divides. This allows the sister chromatids to separate and move to opposite poles. Once separated, each chromatid is now considered an individual chromosome.

Therefore, the division of the centromere is the defining event of Anaphase II.

Step 3: Final Answer:

The division of the centromere occurs during Anaphase II of meiosis. Thus, option (C) is the correct answer.

Quick Tip

A key distinction:

- **Anaphase I of Meiosis:** Separation of homologous chromosomes. Centromeres do **not** divide.
- **Anaphase of Mitosis & Anaphase II of Meiosis:** Separation of sister chromatids. Centromeres **do** divide.

14. 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 to identify the micronutrient that is essential for the photolysis, or splitting of water, which occurs during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation:

The splitting of water molecules ($2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + \text{O}_2 + 4\text{e}^-$) takes place in the lumen of the thylakoids and is associated with Photosystem II (PS II). This reaction is catalyzed by a protein complex called the Oxygen-Evolving Complex (OEC).

The catalytic core of the OEC requires the presence of certain inorganic ions to function. The most crucial of these is **Manganese (Mn)**. A cluster of four manganese ions is directly involved in the oxidation of water. Chloride ions (Cl^-) are also required for this process.

Let's look at the roles of the other options:

- **Molybdenum (Mo):** A component of enzymes like nitrogenase and nitrate reductase, involved in nitrogen metabolism.
- **Magnesium (Mg):** A macronutrient that is the central atom of the chlorophyll molecule and also acts as an activator for many enzymes, including RuBisCO.
- **Copper (Cu):** A component of plastocyanin, which is an electron carrier protein in the photosynthetic electron transport chain between Cytochrome b6f complex and PS I.

The specific role in water splitting is performed by Manganese.

Step 3: Final Answer:

Manganese (Mn) is the essential micronutrient for the splitting of water during photosynthesis. Therefore, option (A) is correct.

Quick Tip

Associate key mineral elements with their primary roles in photosynthesis:

- **Magnesium (Mg):** Core of chlorophyll.
- **Manganese (Mn):** Water splitting (photolysis) at PS II.
- **Copper (Cu):** Plastocyanin (electron transport).

15. 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 what biomolecule is precipitated from a solution by adding chilled ethanol, a common step in DNA isolation protocols used in recombinant DNA technology.

Step 2: Detailed Explanation:

The process of isolating DNA from cells involves several steps:

1. **Lysis:** Breaking open the cells to release their contents, including DNA.

2. **Purification:** Removing other macromolecules like RNA, proteins (e.g., histones), lipids, and polysaccharides. This is often done using enzymes like RNase (to digest RNA) and protease (to digest proteins).
3. **Precipitation:** After purification, the DNA is precipitated from the aqueous solution. DNA is a polar molecule and soluble in water. However, it is insoluble in ethanol. When chilled ethanol is added to the aqueous solution containing DNA (and salts, which help neutralize the negative charge of the DNA's phosphate backbone), the DNA aggregates and precipitates out of the solution as a mass of fine white threads.

Other small molecules like RNA fragments, amino acids, and simple sugars remain dissolved in the ethanol-water mixture.

Step 3: Final Answer:

The addition of chilled ethanol causes the DNA to precipitate. This is a standard method for concentrating and purifying DNA. Therefore, option (B) is the correct answer.

Quick Tip

Remember the phrase "DNA precipitation with chilled ethanol." This is a fundamental and widely used technique in molecular biology to isolate DNA. The cold temperature helps to reduce the solubility of DNA further, leading to a better yield.

16. 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, one of the three main RNA polymerases found in eukaryotic cells.

Step 2: Detailed Explanation:

Eukaryotic cells have a clear division of labor among their nuclear RNA polymerases:

- **RNA Polymerase I:** Located in the nucleolus, it is responsible for transcribing the genes for most of the ribosomal RNAs (rRNAs). Specifically, it synthesizes the precursor for the 28S, 18S, and 5.8S rRNA molecules.

- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes all protein-coding genes into precursor messenger RNA (pre-mRNA or hnRNA). It also synthesizes most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).
- **RNA Polymerase III:** Located in the nucleoplasm, it is responsible for transcribing the genes for smaller RNA molecules, including transfer RNA (tRNA), the 5S ribosomal RNA (5S rRNA, a component of the large ribosomal subunit), and some small nuclear RNAs (snRNAs, such as U6 snRNA).

Based on this division:

- Option (A) describes the function of RNA polymerase I.
- Option (B) correctly describes the function of RNA polymerase III.
- Option (C) describes the function of RNA polymerase II.
- Option (D) is incorrect as RNA pol III synthesizes more than just snRNAs, and RNA pol II synthesizes most snRNAs.

Step 3: Final Answer:

The role of RNA polymerase III is the transcription of tRNA, 5S rRNA, and some snRNAs. Therefore, option (B) is correct.

Quick Tip

Use a mnemonic to remember the roles:

- Polymerase **I** → **r**RNA (ribosomal)
- Polymerase **II** → **m**RNA (messenger)
- Polymerase **III** → **t**RNA (transfer) and other small RNAs.

Just remember I, II, III corresponds to r, m, t in that order.

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

Step 2: Detailed Explanation:

The iodine test is specific for starch. The color change occurs because of the unique structure of one of starch's components, amylose.

- **Starch Structure:** Starch is a polysaccharide made of α -glucose units. Its amylose component forms a **helical** secondary structure. When iodine is added, iodine molecules (I_3^- and I_5^-) slip inside this helix and form a charge-transfer complex, which absorbs light and appears blue-black.
- **Cellulose Structure:** Cellulose is also a polysaccharide of glucose, but it is composed of β -glucose units linked by β -1,4 glycosidic bonds. This β -linkage results in a **straight, linear chain** rather than a helix. These linear chains are packed closely together and held by extensive hydrogen bonding, forming strong, rigid microfibrils.

Since cellulose molecules are linear and do not form helices, there is no space for the iodine molecules to be trapped. Therefore, the characteristic blue-black complex cannot be formed.

Step 3: Final Answer:

Cellulose does not react with iodine because its linear structure lacks the complex helices needed to trap iodine molecules. Option (C) provides the correct explanation. Options (A) and (B) are factually incorrect statements about cellulose's structure. Option (D) is also incorrect.

Quick Tip

Remember the key structural difference:

- **Starch (α -glucose):** Helical structure $\rightarrow$ Traps iodine $\rightarrow$ Blue color.
- **Cellulose (β -glucose):** Linear structure $\rightarrow$ Cannot trap iodine $\rightarrow$ No color change.

The type of glycosidic bond dictates the overall 3D shape of the polysaccharide.

18. 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 identifying a pair of plants from the options where both are pteridophytes that exhibit heterospory.

Step 2: Detailed Explanation:

Pteridophytes are classified based on the types of spores they produce:

- **Homosporous Pteridophytes:** They produce only one type of spore, which germinates to form a bisexual (monoecious) gametophyte. The majority of pteridophytes are homosporous. Examples include *Psilotum*, *Lycopodium*, *Equisetum*, and most ferns like *Dryopteris*.
- **Heterosporous Pteridophytes:** They produce two distinct types of spores - small microspores (which develop into male gametophytes) and large megaspores (which develop into female gametophytes). This condition is an important evolutionary step towards the seed habit. Key examples are *Selaginella*, *Salvinia*, *Marsilea*, and *Azolla*.

Now let's analyze the given pairs:

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

Step 3: Final Answer:

Both *Selaginella* and *Salvinia* are well-known examples of heterosporous pteridophytes. Therefore, option (B) is the correct pair.

Quick Tip

For pteridophytes, it is crucial to memorize the key examples of heterospory: *Selaginella* and the aquatic ferns *Salvinia*, *Azolla*, and *Marsilea*. Most other common pteridophytes like *Lycopodium*, *Equisetum*, and terrestrial ferns are homosporous.

19. 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" or ESTs, a concept related to the methodologies of genomics, especially the Human Genome Project.

Step 2: Detailed Explanation:

Let's break down the term:

- **Expressed:** This refers to genes that are actively being transcribed into RNA. In any given cell type at a specific time, only a subset of all genes in the genome are "expressed." The primary product of gene expression is messenger RNA (mRNA).
- **Sequence Tags:** This means they are short, single-pass sequences of DNA, which act as "tags" or identifiers for a longer DNA molecule.

The methodology for generating ESTs involves:

1. Isolating all the mRNA from a particular tissue or cell type.
2. Using the enzyme reverse transcriptase to synthesize complementary DNA (cDNA) from these mRNA templates.
3. Sequencing short portions (tags) of these cDNA molecules.

Therefore, ESTs represent fragments of genes that are being expressed as RNA in the source cells. They provide a quick and efficient way to identify and catalog active genes in a genome. Option (A) is the most accurate description. Option (B) is less accurate because not all transcribed RNA is translated into protein. Option (C) is incorrect as ESTs only represent expressed genes. Option (D) is incorrect as the method identifies all expressed genes in the sample, not just "certain important" ones.

Step 3: Final Answer:

ESTs are used to identify all genes that are transcribed into RNA in a given tissue. Thus, the term refers to all genes that are expressed as RNA. Option (A) is the correct answer.

Quick Tip

Focus on the word "Expressed" in ESTs. Gene expression's first step is transcription into RNA. Therefore, ESTs are derived from mRNA and serve as tags for all genes currently being expressed as RNA.

20. Identify the correct statements:

- A. Detritivores perform fragmentation.
- B. The humus is further degraded by some microbes during mineralization.
- C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
- D. The detritus food chain begins with living organisms.
- E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the correct answer from the options given below:

- (A) 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 presents five statements related to the process of decomposition in an ecosystem and asks to identify the combination of correct statements.

Step 2: Detailed Explanation:

Let's evaluate each statement:

- **A. Detritivores perform fragmentation.** This statement is **correct**. Fragmentation is the mechanical breakdown of detritus into smaller particles by organisms like earthworms and termites (detritivores), increasing the surface area for microbial action.
- **B. The humus is further degraded by some microbes during mineralization.** This statement is **correct**. Humus is a dark, amorphous substance that is highly resistant to microbial action and decomposes very slowly. The process by which microbes eventually break down this humus to release inorganic nutrients is called mineralization.
- **C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.** This statement is considered **correct** in this context. Leaching is the process where water-soluble inorganic nutrients percolate down through the soil horizon and can become unavailable salts. While "precipitated" might not be the most precise term for all cases, the essence of nutrients moving down and becoming unavailable is what leaching describes.
- **D. The detritus food chain begins with living organisms.** This statement is **incorrect**. The detritus food chain (DFC) begins with dead organic matter (detritus). The grazing food chain (GFC) begins with living producers (plants).
- **E. Earthworms break down detritus into smaller particles by a process called catabolism.** This statement is **incorrect**. The process performed by earthworms is **fragmentation** (a physical process). **Catabolism** is the enzymatic, chemical degradation of detritus into simpler inorganic substances, primarily carried out by bacteria and fungi.

Thus, statements A, B, and C are correct, while D and E are incorrect.

Step 3: Final Answer:

The correct statements are A, B, and C. Therefore, the correct option is (A).

Quick Tip

Clearly distinguish between the key terms in decomposition:

- **Fragmentation:** Physical breakdown by detritivores (e.g., earthworm).
- **Catabolism:** Chemical breakdown by microbial enzymes.
- **Leaching:** Downward movement of soluble nutrients with water.
- **Humification:** Formation of humus.
- **Mineralization:** Release of inorganic nutrients from humus.

21. 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 cause of species extinction from the four major causes, collectively known as 'The Evil Quartet'.

Step 2: Detailed Explanation:

'The Evil Quartet' is a term used to describe the four main anthropogenic causes of biodiversity loss:

1. **Habitat loss and fragmentation:** This involves the destruction of natural habitats (e.g., deforestation, urbanization, conversion to agriculture) and the division of large, continuous habitats into smaller, isolated fragments.
2. **Over-exploitation:** This is the harvesting of species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting, excessive logging).
3. **Alien species invasions:** The introduction of non-native species into an ecosystem, where they can outcompete native species, introduce diseases, or alter the habitat.
4. **Co-extinctions:** The loss of a species leading to the extinction of other species that are dependent on it, such as a specialist pollinator and its plant.

Among these four, **habitat loss and fragmentation is overwhelmingly considered the most significant and primary driver of species extinction worldwide.** When an organism's home is destroyed or reduced, it loses the resources it needs to survive and reproduce.

For example, the destruction of tropical rainforests, which hold more than half of the world's species, is the single greatest threat to global biodiversity.

Step 3: Final Answer:

The most important cause driving the extinction of species is habitat loss and fragmentation. Therefore, option (A) is correct.

Quick Tip

When considering threats to biodiversity, always remember that habitat is fundamental. If there's no place for a species to live, no other conservation effort can save it. That's why habitat destruction is the number one threat. Remember the acronym H.O.A.C (Habitat loss, Over-exploitation, Alien species, Co-extinction), with 'H' being the most critical.

22. 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 correct definition of pleiotropy (or pleiotropism).

Step 2: Detailed Explanation:

Let's analyze the genetic terms in the options:

- **Pleiotropy:** This is a genetic phenomenon where a **single gene** influences **multiple, often unrelated, phenotypic traits**. A classic example is the genetic disease Phenylketonuria (PKU), where a defect in a single gene leads to a wide range of symptoms, including mental retardation, eczema, and reduced skin and hair pigmentation.
- **Option (A)** describes multiple alleles, which is the existence of more than two alleles for a gene in a population, but it's incorrectly linked to crossover.
- **Option (B)** is a confusing description of a dihybrid cross scenario.
- **Option (C)** correctly states that a single gene affects multiple phenotypic expressions. This is the definition of pleiotropy.

- **Option (D)** describes **polygenic inheritance**, where a single trait (like human height or skin color) is controlled by the cumulative effect of multiple genes. This is the opposite of pleiotropy.

Step 3: Final Answer:

The correct definition of pleiotropy is a single gene affecting multiple phenotypic expressions. Therefore, option (C) is the correct answer.

Quick Tip

To avoid confusion:

- **Pleiotropy:** One gene → Many traits. (Think: Phenylketonuria)
- **Polygenic Inheritance:** Many genes → One trait. (Think: Skin color)

They are essentially opposite concepts in terms of gene-to-trait ratio.

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

- (A) M phase
- (B) S phase
- (C) G₁ phase
- (D) G₂ 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 a series of events that leads to cell division and duplication. It is divided into two main stages: Interphase and M phase.

- **Interphase:** This is the longest phase, where the cell grows and prepares for division. It is subdivided into three stages:
 - **G₁ phase (Gap 1):** The cell grows in size and synthesizes proteins and mRNA needed for DNA synthesis.
 - **S phase (Synthesis):** This is the crucial stage where the cell's entire DNA is replicated. At the beginning of S phase, each chromosome consists of one DNA molecule (chromatid). By the end of S phase, each chromosome consists of two identical sister chromatids joined at the centromere. The total amount of DNA in the cell doubles.

- **G₂ phase (Gap 2):** The cell continues to grow and produce proteins and organelles in preparation for mitosis.
- **M phase (Mitosis phase):** This is the phase of nuclear division (mitosis) and cytoplasmic division (cytokinesis), leading to two daughter cells.

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

Step 3: Final Answer:

DNA replication takes place during the S phase (Synthesis phase) of the eukaryotic cell cycle. Option (B) is the correct answer.

Quick Tip

Remember the cell cycle order: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$. The letter 'S' stands for 'Synthesis', which directly refers to the synthesis or replication of DNA. This is the most fundamental event of the S phase.

24. 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 substage of Prophase I of meiosis where recombination nodules are observed. These nodules are linked to the process of genetic exchange between homologous chromosomes.

Step 2: Detailed Explanation:

Prophase I is the longest phase of meiosis and is divided into five substages:

1. **Leptotene:** Chromosomes begin to condense and become visible.
2. **Zygotene:** Homologous chromosomes pair up in a process called synapsis, forming bivalents. The synaptonemal complex, a protein structure, forms between the paired chromosomes.
3. **Pachytene:** This is the stage where crossing over (genetic recombination) occurs between non-sister chromatids of homologous chromosomes. The sites where crossing over happens

are marked by the appearance of protein complexes called **recombination nodules**. These nodules contain the enzymes required to cut and rejoin the DNA strands.

4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes begin to separate, but they remain attached at the sites of crossing over, which are now visible as X-shaped structures called chiasmata.
5. **Diakinesis:** Chromosomes become fully condensed, and the chiasmata undergo terminalization (move towards the ends of the chromatids). The nuclear envelope breaks down.

The appearance of recombination nodules is a key characteristic of the pachytene stage, as they are the sites of crossing over.

Step 3: Final Answer:

Recombination nodules appear during the Pachytene substage of Prophase I. Therefore, option (B) is the correct answer.

Quick Tip

Associate key events with each substage of Prophase I:

- Zygotene → Zipping up (synapsis)
- Pachytene → Patching over (crossing over/recombination nodules)
- Diplotene → Dissolving of complex, visibility of chiasmata

25. 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 is about the visualization of DNA in a common molecular biology technique, agarose gel electrophoresis. It asks for the color observed when DNA, stained with ethidium bromide, is exposed to UV light.

Step 2: Detailed Explanation:

Agarose gel electrophoresis is a technique used to separate DNA fragments based on their size.

1. Since DNA is colorless, it needs to be stained to be visualized in the gel.

2. A common stain used is **ethidium bromide (EtBr)**. EtBr is an intercalating agent, which means it inserts itself between the stacked base pairs of the DNA double helix.
3. After the electrophoresis is complete, the gel is placed under an ultraviolet (UV) transilluminator.
4. When exposed to UV radiation, the EtBr molecules that are intercalated into the DNA absorb the UV light and fluoresce, emitting light in the visible spectrum.
5. The characteristic color of this fluorescence is a **bright orange**.

This allows the separated DNA bands to be seen and photographed.

Step 3: Final Answer:

DNA stained with ethidium bromide fluoresces with a bright orange colour when exposed to UV radiation. Therefore, option (D) is the correct answer.

Quick Tip

This is a standard fact from molecular biology labs. Create a simple association: **DNA + Ethidium Bromide + UV light = Bright Orange bands**. This combination is frequently asked in exams.

26. 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 in which the 'Earth Summit', where the Convention on Biological Diversity was opened for signature, took place in Rio de Janeiro.

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 in **June 1992**.

- It was a landmark event for global environmental policy. One of its key outcomes was the **Convention on Biological Diversity (CBD)**, an international treaty with three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.
- Another major outcome was the United Nations Framework Convention on Climate Change (UNFCCC).
- The year 2002 is associated with the World Summit on Sustainable Development held in Johannesburg, South Africa.

Step 3: Final Answer:

The Earth Summit in Rio de Janeiro was held in 1992. Therefore, option (B) is the correct answer.

Quick Tip

Remember key years for environmental conventions:

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

Associating the city/protocol with the year is helpful.

27. 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 provides the fundamental equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP) and asks for the identity of the term 'R'.

Step 2: Detailed Explanation:

Let's define the terms involved in ecosystem productivity:

- **Gross Primary Productivity (GPP):** This is the total rate at which photosynthetic producers (like plants and algae) capture and store chemical energy as biomass in an ecosystem. It is the total amount of photosynthesis that occurs.
- The producers must use some of this captured energy for their own metabolic processes to stay alive, primarily through cellular **respiration**. The energy used in respiration is converted to ATP to fuel cellular activities and is ultimately lost as heat. This portion of energy is not stored as biomass and is not available to the next trophic level.
- **Net Primary Productivity (NPP):** This is the energy that remains as biomass after the producers have met their own energetic needs. It is the rate of production of new biomass available for consumption by herbivores (primary consumers).

The relationship between these three is:

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

Here, **R** represents the energy lost by the producers through **Respiration**. Thus, 'R' stands for **Respiratory loss**.

Step 3: Final Answer:

In the productivity equation, R represents the energy consumed by producers for respiration. Therefore, it is Respiratory loss. Option (C) is correct.

Quick Tip

Think of productivity like personal finance. GPP is your gross income (total money earned). R (Respiration) is your essential expenses (rent, food, taxes). NPP is your net income or savings (the money you actually accumulate and can be used by others, i.e., your family/the next trophic level).

28. 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 scientist(s) who provided the definitive or "unequivocal" experimental proof that DNA, and not protein, is the molecule that carries genetic information.

Step 2: Detailed Explanation:

Let's review the timeline of key discoveries:

1. **Frederick Griffith (1928):** His experiment with *Streptococcus pneumoniae* demonstrated a "transforming principle" that could change harmless R-strain bacteria into virulent S-strain bacteria, but he did not identify the chemical nature of this principle.
2. **Avery, Macleoid, and McCarthy (1944):** They conducted biochemical experiments to identify Griffith's transforming principle. They systematically treated heat-killed S-strain bacteria with enzymes that destroy different macromolecules (proteases, RNases, DNases). Only when DNA was destroyed (using DNase) did the transformation of R-strain bacteria fail to occur. This provided strong evidence that DNA was the genetic material, but some scientists remained skeptical, suggesting possible protein contamination in their DNA extracts.
3. **Alfred Hershey and Martha Chase (1952):** They performed the famous "blender experiment" using bacteriophages (viruses that infect bacteria). They used radioactive isotopes to label the two main components of the virus:
 - Protein coats were labeled with radioactive sulfur (^{35}S), as sulfur is found in proteins but not DNA.
 - DNA was labeled with radioactive phosphorus (^{32}P), as phosphorus is found in DNA but not proteins.

They allowed the phages to infect bacteria and then used a blender to separate the viral coats from the bacteria. They found that the ^{32}P (DNA) had entered the bacterial cells, while the ^{35}S (protein) remained outside. Since the bacteria then produced new phages, this proved that DNA was the material that carried the genetic instructions. This experiment was widely accepted as the **unequivocal proof**.

4. **Wilkins and Franklin:** They used X-ray diffraction to study the structure of DNA, which provided crucial data for Watson and Crick's model of the double helix.

Step 3: Final Answer:

The Hershey and Chase experiment provided the definitive and conclusive proof that DNA is the genetic material. Therefore, option (B) is correct.

Quick Tip

Remember the key contributions:

- **Griffith:** Transformation principle exists.
- **Avery et al.:** Principle is DNA (biochemical proof).
- **Hershey & Chase:** Unequivocal proof using radioactive phages.

The word "unequivocal" is the keyword pointing to Hershey and Chase.

29. 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 used to measure the concentration or thickness of the ozone layer in the atmosphere.

Step 2: Detailed Explanation:

Let's examine the units given in the options:

- **Dobson Units (DU):** This is the standard unit for measuring the total amount of ozone in a vertical column of the atmosphere. One Dobson Unit (1 DU) refers to a layer of ozone that would be 0.01 mm thick at standard temperature (0°C) and pressure (1 atm). The average thickness of the ozone layer is about 300 DU.
- **Decibels (dB):** This is a logarithmic unit used to measure the intensity of 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.

The correct unit for measuring atmospheric ozone thickness is the Dobson unit.

Step 3: Final Answer:

The thickness of the ozone layer is measured in Dobson units. Therefore, option (A) is correct.

Quick Tip

Associate specific scientific measurements with their unique units. For environmental science, "Ozone thickness" is almost always linked to "Dobson Units (DU)". It's a key factual point to memorize.

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 presents two statements about the arrangement of xylem in plants. We need to evaluate the correctness of each statement.

Step 2: Detailed Explanation:

Analysis of Statement I:

The terms 'endarch' and 'exarch' describe the pattern of development and arrangement of **primary xylem**, not secondary xylem. These terms refer to the position of the first-formed primary xylem (protoxylem) in relation to the later-formed primary xylem (metaxylem). Secondary xylem is formed from the vascular cambium and does not have this protoxylem-metaxylem distinction. Therefore, Statement I is **incorrect**.

Analysis of Statement II:

Let's define the conditions:

- **Exarch:** The protoxylem is located towards the periphery (outside) of the vascular cylinder, and the metaxylem is located towards the center. Development is centripetal. This is the characteristic condition found in the **roots** of vascular plants.
- **Endarch:** The protoxylem is located towards the center (pith), and the metaxylem is located towards the periphery. Development is centrifugal. This is the characteristic condition found in the **stems** of vascular plants.

Thus, the exarch condition is indeed the most common feature of the root system. Therefore, Statement II is **true**.

Step 3: Final Answer:

Statement I is incorrect because the terms apply to primary xylem, and Statement II is true. This corresponds to option (D).

Quick Tip

A simple mnemonic to remember xylem arrangement:

- **EX**arch → **EX**ternal protoxylem → found in Roots.
- **EN**darch → **EN**ternal (internal) protoxylem → found in Stems.

Also, crucially remember these terms apply only to **primary** vascular tissues.

31. 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 responsible for moving ions across a cell membrane from a region of lower concentration to a region of higher concentration, i.e., "against their concentration gradient".

Step 2: Detailed Explanation:

Let's define the different modes of transport across a membrane:

- **Passive Transport:** The movement of substances across a membrane **down** the concentration gradient (from high to low concentration). This process does not require metabolic energy. Simple diffusion and facilitated diffusion are types of passive transport.
- **Osmosis:** A specific type of passive transport involving the movement of water molecules across a selectively permeable membrane from a region of higher water potential to a region of lower water potential.
- **Facilitated Diffusion:** A type of passive transport where substances move down their concentration gradient with the help of membrane proteins (channels or carriers). It does not require energy.
- **Active Transport:** The movement of substances **against** their concentration gradient (from low to high concentration). This process is an "uphill" movement and requires the expenditure of metabolic energy, typically in the form of ATP. It is carried out by specific membrane proteins called pumps.

The key phrase in the question is "against their concentration gradient," which is the defining characteristic of active transport.

Step 3: Final Answer:

The movement of ions against a concentration gradient is accomplished by active transport. Therefore, option (D) is the correct answer.

Quick Tip

Remember the "hill" analogy for membrane transport:

- Movement **downhill** (high to low concentration) is **Passive** and requires no energy.
- Movement **uphill** (low to high concentration) is **Active** and requires energy (ATP).

The phrase "against the gradient" always means active transport.

32. 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 provides two statements about the effects of transpiration in plants. We need to assess the scientific validity of both statements.

Step 2: Detailed Explanation:**Analysis of Statement I:**

The ascent of sap in tall trees is primarily explained by the cohesion-tension-transpiration pull model.

- **Transpiration** from leaves creates a negative pressure potential or tension in the xylem.
- Due to the strong cohesive forces between water molecules and adhesive forces between water and xylem walls, this tension pulls the entire column of water upwards from the roots.

- The physical properties of water give it high tensile strength, allowing this column to be maintained without breaking.
- This mechanism is powerful enough to lift water to the tops of the tallest trees on Earth, such as the Coast Redwood (*Sequoia sempervirens*), which can exceed 115 meters in height. Therefore, the claim that the force can lift water over 130 meters is physically plausible and accepted in plant physiology. Statement I is **correct**.

Analysis of Statement II:

Transpiration is the process of water evaporation from the plant surface, primarily through stomata on the leaves.

- Evaporation is a cooling process. When water turns into vapor, it absorbs a significant amount of energy (latent heat of vaporization) from its surroundings.
- This absorption of heat energy cools the leaf surface, preventing it from overheating, especially under intense sunlight.
- The cooling effect can be substantial, and a reduction in leaf temperature by 10 to 15 degrees Celsius compared to the surrounding air or non-transpiring surfaces is a well-documented phenomenon. Statement II is **correct**.

Step 3: Final Answer:

Both statements accurately describe two major functions of transpiration: the pulling force for water ascent and the cooling of leaf surfaces. Therefore, both Statement I and Statement II are correct, making option (A) the right choice.

Quick Tip

Remember the two main purposes of transpiration: 1. Transport: It's the engine that pulls the water and mineral "elevator" up the plant. 2. Thermoregulation: It acts as the plant's "air conditioner" through evaporative cooling. Both statements given are direct consequences of these two functions.

33. 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 to identify the type of metal used for the microparticles (or microprojectiles) in the gene gun method of genetic transformation.

Step 2: Detailed Explanation:

The gene gun method, also known as biolistics or microprojectile bombardment, is a physical method for delivering foreign DNA into cells.

1. In this technique, the DNA of interest (the transgene) is coated onto the surface of microscopic particles.
2. These particles must be dense enough to have sufficient momentum to penetrate the cell wall and membrane of the target cells (especially plant cells).
3. They must also be chemically inert to avoid causing a toxic reaction within the cells.
4. The most commonly used metals for these microparticles are **gold (Au)** and **tungsten (W)**. They are chosen because they are very dense and have very low chemical reactivity.
5. These DNA-coated microparticles are then accelerated to a high velocity by a "gun" (using pressurized gas, for example) and shot into the target tissue.

Other metals like copper, zinc, or silver are generally not used as they are either not dense enough or can be toxic to the cells.

Step 3: Final Answer:

The microparticles used in the gene gun method are typically made of tungsten or gold. Therefore, option (C) is the correct answer.

Quick Tip

Think of the gene gun firing "golden bullets". This mnemonic helps to remember that dense, precious, and inert metals like **gold** and **tungsten** are used in the biolistics method to carry DNA into cells.

34. 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 sequence, haploid (n), diploid ($2n$), and triploid ($3n$).

Step 2: Detailed Explanation:

In angiosperms, a process called double fertilization occurs, leading to structures with different ploidy levels within the embryo sac. Let's determine the ploidy of the key structures after fertilization:

- **Haploid (n):** The synergids and antipodal cells are haploid components of the original embryo sac. After fertilization, they typically degenerate but are still present for a short time.
- **Diploid ($2n$):** The **zygote** is formed by the fusion of one haploid (n) male gamete with the haploid (n) egg cell. This process is called syngamy. ($n + n = 2n$).
- **Triploid ($3n$):** The **Primary Endosperm Nucleus (PEN)** is formed by the fusion of the second haploid (n) male gamete with the diploid ($n+n$) central cell (which contains two polar nuclei). This process is called triple fusion. ($n + (n+n) = 3n$).

Now, let's check the sequence (haploid, diploid, triploid) for each option:

- (A) Synergids (n), Primary endosperm nucleus ($3n$), zygote ($2n$). The sequence is n , $3n$, $2n$. Incorrect.
- (B) Antipodals (n), synergids (n), and primary endosperm nucleus ($3n$). The sequence is n , n , $3n$. Incorrect.
- (C) **Synergids (n), Zygote ($2n$) and Primary endosperm nucleus ($3n$).** The sequence is n , $2n$, $3n$. **Correct.**
- (D) This option lists structures before fertilization is fully complete (polar nuclei). Synergids (n), antipodals (n). Incorrect sequence.

Step 3: Final Answer:

The correct sequence of haploid, diploid, and triploid structures is Synergids (n), Zygote ($2n$), and Primary endosperm nucleus ($3n$). Therefore, option (C) is correct.

Quick Tip

For questions on double fertilization, immediately list the ploidy levels:

- Haploid (n): Synergids, Antipodals.
- Diploid ($2n$): Zygote.
- Triploid ($3n$): PEN/Endosperm.

Then, simply match this n , $2n$, $3n$ pattern with the options provided.

35. 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 a corn plant. It's important to understand the structure of the corn plant's reproductive organs. The phrasing "tassels in the corn cob" is slightly ambiguous, as tassels are at the top of the plant and the cob is the female part lower down.

Step 2: Detailed Explanation:

Corn (*Zea mays*) is a monoecious plant, meaning it has separate male and female flowers on the same plant. It is wind-pollinated (anemophilous).

- The **tassel** is the male inflorescence located at the apex (top) of the plant. Its function is to produce a large amount of light, powdery pollen. When mature, the tassel releases this pollen into the wind. Therefore, the primary function of the tassel is **to disperse pollen grains** (Option C).
- The **ear** or **cob** is the female inflorescence, located at a leaf axil lower on the stalk. The cob is covered in long, silky threads called **silks**. Each silk is an elongated style and stigma. The function of the feathery and sticky silks is **to trap the airborne pollen grains** (Option B).

Reconciling the Question with the Provided Answer:

Biologically, the correct function of the tassel is to disperse pollen (Option C). The function of the silks (which are associated with the cob) is to trap pollen (Option B). The provided answer key indicates that (B) is the correct answer. This suggests a common issue where the question is flawed and likely meant to ask about the function of the silks, which are the pollen-receiving structures emerging from the cob. Assuming the question intended to ask about the structure responsible for capturing pollen for the cob, the function is to trap pollen grains.

Step 3: Final Answer:

Based on the provided answer key, which points to the function of the pollen-receiving structures associated with the cob (the silks), the function is to trap pollen grains. Therefore, option (B) is the intended correct answer.

Quick Tip

For corn pollination, remember the division of labor:

- **Tassel (Top/Male):** Produces and **Disperses** pollen.
- **Silk (from Cob/Female):** **Traps** pollen.

Be aware that exam questions can sometimes be poorly phrased. If asked about the tassel, think dispersal. If asked about the silk or cob's role in pollination, think trapping.

Section - B

36. Match List I with List II:

List I

A. Iron

B. Zinc

C. Boron

D. Molybdenum

List II

I. Synthesis of auxin

II. Component of nitrate reductase

III. Activator of catalase

IV. Cell elongation and differentiation

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 elements in List I with their specific physiological functions in plants from List II.

Step 2: Detailed Explanation:

Let's analyze the function of each mineral element:

- **A. Iron (Fe):** Iron is a crucial component of proteins involved in electron transport, such as cytochromes. It is also an essential activator for the enzyme **catalase**, which breaks down hydrogen peroxide. It is also required for the formation of chlorophyll. So, **A matches with III.**
- **B. Zinc (Zn):** Zinc is required as an activator for various enzymes, most notably carboxylases. It is also essential for the **synthesis of auxin** (specifically Indole-3-acetic acid or IAA). So, **B matches with I.**

- **C. Boron (B):** Boron is required for the uptake and utilization of Ca^{2+} , membrane functioning, pollen germination, **cell elongation, and cell differentiation**. So, **C matches with IV**.
- **D. Molybdenum (Mo):** Molybdenum is a component of several important enzymes in nitrogen metabolism, including nitrogenase (in nitrogen fixation) and **nitrate reductase** (in nitrate assimilation). So, **D matches with II**.

Based on this analysis, the correct matching is: A-III, B-I, C-IV, D-II.

Step 3: Final Answer:

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

Quick Tip

Create flashcards for essential mineral nutrients and their key functions. Focus on unique roles:

- **Zn** → Auxin synthesis.
- **Mo** → Nitrate reductase / Nitrogenase.
- **B** → Pollen germination / Cell differentiation.
- **Fe** → Catalase / Cytochromes.

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 given options related to water pollution and its ecological consequences.

Step 2: Detailed Explanation:

Let's evaluate each statement:

- **(A) Correct:** When sewage containing organic matter is discharged into a water body, decomposer microorganisms (bacteria, fungi) multiply rapidly. They consume a large amount of dissolved oxygen for aerobic decomposition, leading to a sharp drop in oxygen levels. This can cause mass mortality of fish and other aquatic organisms due to hypoxia or anoxia.
- **(B) Incorrect:** Algal blooms are caused by an excess of nutrients (like nitrates and phosphates), a condition known as eutrophication, not directly by excess organic matter. These blooms are detrimental, not beneficial. They block sunlight to submerged plants, and when the algae die, their decomposition by bacteria consumes vast amounts of dissolved oxygen, leading to hypoxic "dead zones" and fish kills. Therefore, they drastically *deteriorate* water quality and are harmful to fisheries.
- **(C) Correct:** Water hyacinth (*Eichhornia crassipes*) is a notorious invasive aquatic weed that thrives in nutrient-rich (eutrophic) water bodies. Its rapid growth covers the water surface, blocking light, reducing oxygen, and disrupting the entire aquatic ecosystem.
- **(D) Correct:** This statement describes the phenomenon of biomagnification (or bioamplification). Certain non-biodegradable toxic substances (like heavy metals and pesticides) from industrial waste accumulate in organisms and their concentration increases at successive trophic levels in the food chain.

Statement (B) makes claims that are the exact opposite of the actual ecological impact of algal blooms.

Step 3: Final Answer:

The incorrect statement is (B). Algal blooms degrade water quality and harm fisheries.

Quick Tip

Remember that "eutrophication" and "algal blooms" are negative terms in ecology. They are associated with nutrient pollution, oxygen depletion, and a decrease in water quality and biodiversity. Any statement claiming they are beneficial is almost certainly incorrect.

38. Match List I with List II:

List I (Interaction) **List II (Species A and B)**

- | | |
|-----------------|-------------------|
| A. Mutualism | I. $+(A), 0(B)$ |
| B. Commensalism | II. $-(A), 0(B)$ |
| C. Amensalism | III. $+(A), -(B)$ |
| D. Parasitism | IV. $+(A), +(B)$ |

Choose the correct answer from the options given below:

- (A) A-IV, B-II, C-I, D-III
(B) A-IV, B-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 the type of population interaction with its symbolic representation, where '+' indicates a benefit, '-' indicates harm, and '0' indicates no significant effect.

Step 2: Detailed Explanation:

Let's define each interaction and its effect on the two participating species (A and B):

- **A. Mutualism:** An interaction where both species benefit from each other. For example, lichens (algae and fungi). The symbolic representation is $(+, +)$. So, **A matches with IV.**
- **B. Commensalism:** An interaction where one species benefits, and the other is neither harmed nor benefited. For example, an orchid growing on a mango tree. The symbolic representation is $(+, 0)$. So, **B matches with I.**
- **C. Amensalism:** An interaction where one species is harmed, and the other is unaffected. For example, Penicillium secreting penicillin that kills bacteria. The symbolic representation is $(-, 0)$. So, **C matches with II.**
- **D. Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other species (the host), which is harmed. For example, a tapeworm in a human. The symbolic representation is $(+, -)$. So, **D matches with III.**

Based on this analysis, the correct matching is: A-IV, B-I, C-II, D-III.

Step 3: Final Answer:

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

Quick Tip

Memorize the six main types of population interactions using the $(+, -, 0)$ notation:

- Mutualism $(+, +)$
- Competition $(-, -)$
- Predation $(+, -)$
- Parasitism $(+, -)$
- Commensalism $(+, 0)$
- Amensalism $(-, 0)$

39. 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 correct 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:

We need to evaluate the correctness of both the Assertion and the Reason regarding pollination in gymnosperms.

Step 2: Detailed Explanation:

Analysis of Assertion A:

Gymnosperms are a group of plants that produce naked seeds. Their pollination is typically anemophilous, meaning it is mediated by wind. The pollen grains (microspores) are produced in microsporangia (pollen sacs) and are released into the air. Air currents then carry these light, often winged, pollen grains to the female cones containing ovules. Thus, Assertion A is **true**.

Analysis of Reason R:

This statement describes what happens after the pollen is carried by air currents. It contains several inaccuracies:

1. Pollen grains land on the ovule, typically near the micropyle, not directly at the "mouth of the archegonia".
2. The most significant error is the claim that a "pollen tube is not formed". In all living seed plants, including gymnosperms, the pollen grain germinates to form a **pollen tube**. This tube grows through the nucellus tissue towards the archegonium. The male gametes are then discharged from the pollen tube to fertilize the egg. This development of a pollen tube (siphonogamy) is a key feature of gymnosperms and angiosperms.

Because it incorrectly states that a pollen tube is not formed, Reason R is **false**.

Step 3: Final Answer:

Assertion A is a true statement, but Reason R is a false statement. Therefore, the correct

option is (C).

Quick Tip

Remember two key features of gymnosperm reproduction: 1. **Anemophily**: They are wind-pollinated. 2. **Siphonogamy**: They form a pollen tube to deliver male gametes to the egg cell. Any statement contradicting these fundamental points is likely incorrect.

40. Match List I with List II:

List I

- A. Oxidative decarboxylation
- B. Glycolysis
- C. Oxidative phosphorylation
- D. Tricarboxylic acid cycle

List II

- I. Citrate synthase
- II. Pyruvate dehydrogenase
- III. Electron transport system
- IV. EMP pathway

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 asks to match metabolic processes related to cellular respiration (List I) with their corresponding enzyme, system, or alternative name (List II).

Step 2: Detailed Explanation:

Let's match each process:

- **A. Oxidative decarboxylation:** This refers to the link reaction where pyruvate (a 3-carbon molecule) is converted to acetyl-CoA (a 2-carbon molecule), releasing CO₂. This reaction is catalyzed by the large enzyme complex called **Pyruvate dehydrogenase**. So, **A matches with II**.
- **B. Glycolysis:** This is the initial pathway for glucose breakdown. It is also known as the **EMP pathway**, named after its discoverers (Embden, Meyerhof, and Parnas). So, **B matches with IV**.
- **C. Oxidative phosphorylation:** This is the final stage of aerobic respiration where the energy released from the oxidation of NADH and FADH₂ is used to generate a large amount of ATP. This process is carried out by the **Electron transport system (ETS)** located on the inner mitochondrial membrane. So, **C matches with III**.

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

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

Step 3: Final Answer:

The correct combination is A-II, B-IV, C-III, D-I, which is given in option (D).

Quick Tip

For respiration pathways, link key terms:

- Glycolysis $\Leftrightarrow$ EMP pathway
- Link reaction $\Leftrightarrow$ Pyruvate dehydrogenase $\Leftrightarrow$ Oxidative decarboxylation
- Krebs Cycle $\Leftrightarrow$ TCA cycle $\Leftrightarrow$ Citrate synthase
- ATP synthesis $\Leftrightarrow$ ETS $\Leftrightarrow$ Oxidative phosphorylation

41. 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 the factually correct statements from a given list concerning plant anatomy, specifically about bark and related structures.

Step 2: Detailed Explanation:

Let's analyze each statement for its correctness:

- **A. Lenticels are the lens-shaped openings permitting the exchange of gases.** This is **correct**. Lenticels are porous tissues consisting of cells with large intercellular spaces in the periderm of secondarily thickened organs, serving as a pathway for the direct exchange of gases between the internal tissues and the atmosphere.
- **B. Bark formed early in the season is called hard bark.** This is **incorrect**. The bark formed early in the season (spring bark) is called soft bark. The bark formed towards the end of the season (autumn bark) is called hard bark.
- **C. Bark is a technical term that refers to all tissues exterior to vascular cambium.** This is **incorrect**. Bark is a **non-technical** term. The statement would be correct if it said "non-technical".
- **D. Bark refers to periderm and secondary phloem.** This is **correct**. Anatomically, bark is composed of several tissue types. The major components are the secondary phloem and the periderm (which itself includes phellem, phellogen, and phelloderm). This is considered a correct, more precise description of bark's composition.
- **E. Phellogen is single-layered in thickness.** This is **incorrect**. Phellogen, or cork cambium, is a lateral meristem. Like other meristems, it consists of one or more layers of actively dividing cells. It is not strictly single-layered.

Therefore, the only correct statements are A and D.

Step 3: Final Answer:

Based on the analysis, statements A and D are correct. This combination is found in option (B).

Quick Tip

Pay close attention to details in anatomical definitions. Key points to remember are:

- Bark is a **non-technical** term for everything outside the vascular cambium.
- It's mainly composed of **secondary phloem + periderm**.
- **Early/Spring** bark is **soft**; **Late/Autumn** bark is **hard**.

42. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence.

- Insertion of recombinant DNA into the host cell
- Cutting of DNA at specific location by restriction enzyme
- Isolation of desired DNA fragment
- Amplification of gene of interest using PCR

Choose the correct answer from the options given below:

- B, C, D, A
- C, A, B, D
- 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 key steps involved in recombinant DNA technology in the correct chronological order.

Step 2: Detailed Explanation:

Let's outline the logical workflow for creating a recombinant organism:

1. The first step is to get the building blocks. You need to cleave the source DNA (containing your gene of interest) and the vector DNA to create compatible ends. This is done by using restriction enzymes. **Step B: Cutting of DNA at specific location by restriction enzyme.**
2. After cutting the source DNA, it will be in many fragments. You need to separate these fragments and select only the one that contains your gene. This is typically done using gel electrophoresis. **Step C: Isolation of desired DNA fragment.**
3. Often, the amount of the isolated gene fragment is very small. To get enough copies for the subsequent steps (like ligation into many vectors), the fragment is amplified. The most common method for this is the Polymerase Chain Reaction (PCR). **Step D: Amplification of gene of interest using PCR.**
4. Once you have many copies of your gene and the prepared vector, you ligate them together to create the recombinant DNA molecule. The final step is to introduce this recombinant DNA into a suitable host cell (like a bacterium) for it to be replicated and/or expressed. This process is called transformation. **Step A: Insertion of recombinant DNA into the host cell.**

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

Step 3: Final Answer:

The correct chronological order of the steps is B, C, D, A, which corresponds to option (A).

Quick Tip

Think of rDNA technology as a "cut, copy, and paste" process:

1. **Cut (B):** Use restriction enzymes on source and vector DNA.
2. **Isolate (C):** Separate and get your specific piece of DNA.
3. **Copy (D):** Make many copies of your piece using PCR (optional but often necessary).
4. **Paste & Insert (A):** Ligate the piece into the vector and put the final product into a host cell.

43. 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 physical properties of water and a physiological process (List I) with their correct definitions or descriptions (List II). These concepts are important in the context of water transport in plants.

Step 2: Detailed Explanation:

Let's define each term in List I and find its match in List II:

- **A. Cohesion:** This is the property of like molecules sticking to each other. In the context of water, it is the **mutual attraction among water molecules** due to hydrogen bonding. This property is crucial for maintaining the continuous water column in the xylem. So, **A matches with II.**
- **B. Adhesion:** This is the property of different molecules sticking to each other. In plants, it is the **attraction of water molecules towards polar surfaces**, such as the surfaces of the tracheary elements (xylem vessels and tracheids). This helps to counteract gravity. So, **B matches with IV.**
- **C. Surface tension:** This is a consequence of cohesion. Water molecules at the surface are more attracted to each other (cohesion) than to the air above. This results in a force that minimizes the surface area. It can be described as water molecules having **more attraction in the liquid phase** than in the gas phase at the interface. So, **C matches with I.**
- **D. Guttation:** This is the exudation of water droplets from the tips or margins of leaves, typically through special pores called hydathodes. It is essentially **water loss in the liquid phase**, which occurs when root pressure is high and transpiration is low. So, **D matches with III.**

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

Step 3: Final Answer:

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

Quick Tip

Remember the 'C' and 'A' in cohesion and adhesion:

- **Cohesion** → Attraction between **co**-workers (similar molecules, i.e., water-water).
- **Adhesion** → Attraction to **additional** things (different molecules, i.e., water-xylem wall).

Distinguish guttation (liquid water loss) from transpiration (vapor water loss).

44. Which of the following statements are correct about Klinefelter's Syndrome?

A. This disorder was first described by Langdon Down (1866).

B. Such an individual has overall masculine development. However, the feminine development is also expressed.

C. The affected individual is short statured.

D. Physical, psychomotor and mental development is retarded.

E. Such individuals are sterile.

Choose the correct answer from the options given below:

(A) A and 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 a given list of characteristics.

Step 2: Detailed Explanation:

Let's evaluate each statement about Klinefelter's Syndrome (47, XXY):

- **A. This disorder was first described by Langdon Down (1866).** This is **incorrect**. Langdon Down first described Down's Syndrome (Trisomy 21). Klinefelter's Syndrome was first described by Harry Klinefelter in 1942.
- **B. Such an individual has overall masculine development. However, the feminine development is also expressed.** This is **correct**. Individuals are phenotypically male due to the Y chromosome. However, the presence of an extra X chromosome leads

to the development of some feminine characteristics, a condition called gynecomastia (development of breasts).

- **C. The affected individual is short statured.** This is **incorrect**. Individuals with Klinefelter's Syndrome are often taller than average, with disproportionately long limbs. Short stature is characteristic of Turner's Syndrome (45, XO).
- **D. Physical, psychomotor and mental development is retarded.** This is **incorrect**. While some individuals may have learning difficulties, severe mental retardation is not a typical feature. The symptoms can be very mild in some cases. Severe mental retardation is more associated with Down's Syndrome.
- **E. Such individuals are sterile.** This is **correct**. The testes are underdeveloped, and individuals are sterile due to azoospermia (absence of sperm).

Therefore, the correct statements are B and E.

Step 3: Final Answer:

The correct combination of statements is B and E, which is given in option (C).

Quick Tip

To differentiate chromosomal disorders, focus on the key features:

- **Klinefelter's (XXY):** Tall, sterile male with feminine features (gynecomastia).
- **Turner's (XO):** Short, sterile female with underdeveloped secondary sexual characters.
- **Down's (Trisomy 21):** Short stature, mental retardation, characteristic facial features.

45. 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 total number of different proteins that make up a ribosome. The question does not specify prokaryotic or eukaryotic, but typically in this context, it

refers to the eukaryotic ribosome.

Step 2: Detailed Explanation:

Ribosomes are complex structures composed of ribosomal RNA (rRNA) and ribosomal proteins.

- **Prokaryotic Ribosome (70S):**

- Large subunit (50S): contains ~ 31 -34 proteins.
- Small subunit (30S): contains ~ 21 proteins.
- Total: ~ 52 -55 proteins.

- **Eukaryotic Ribosome (80S):**

- Large subunit (60S): contains ~ 49 proteins.
- Small subunit (40S): contains ~ 33 proteins.
- Total: ~ 82 proteins.

Looking at the options, the number 80 is the closest approximation to the total number of proteins in a eukaryotic ribosome.

- (A) 80: Close to the eukaryotic total (~ 82).
- (B) 60: Corresponds to the large subunit of a eukaryotic ribosome (60S), but Svedberg unit is not the number of proteins.
- (C) 40: Corresponds to the small subunit of a eukaryotic ribosome (40S).
- (D) 20: No direct correspondence, but close to the number of proteins in a prokaryotic small subunit.

The question asks for the total number of different proteins, and 80 is the most appropriate answer representing the eukaryotic ribosome.

Step 3: Final Answer:

A eukaryotic ribosome is composed of approximately 80 different proteins. Therefore, option (A) is the correct answer.

Quick Tip

For ribosome composition, remember the subunit Svedberg units ($70S = 50S + 30S$ for prokaryotes; $80S = 60S + 40S$ for eukaryotes). The total number of proteins is a factual detail to memorize: around 55 for prokaryotes and around 80 for eukaryotes. The number 80 in the options clearly points towards the eukaryotic ribosome.

46. 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:

This question requires matching the phases of the eukaryotic cell cycle (List I) with their correct descriptions or key events (List II).

Step 2: Detailed Explanation:

Let's describe each phase in List I and find its match in List II.

- **A. M Phase:** This is the Mitosis phase, where the cell nucleus divides. Mitosis is known as an **Equational division** because the daughter cells receive the same number of chromosomes as the parent cell. So, **A matches with IV**.
- **B. G₂ 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 the **proteins** needed for mitosis are synthesized. For example, tubulin protein for spindle fibers is synthesized here. So, **B matches with I**.
- **C. Quiescent stage (G₀):** This is a non-dividing stage where cells have exited the cell cycle. Cells in this stage are metabolically active but are in an **inactive phase** with respect to proliferation. They do not divide unless called upon to do so. So, **C matches with II**.
- **D. G₁ Phase:** This is the first gap phase. It is the **interval between the completion of mitosis and the initiation of DNA replication** (S phase). The cell grows and prepares for DNA synthesis during this phase. So, **D matches with III**.

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

Step 3: Final Answer:

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

Quick Tip

Draw out the cell cycle diagram ($G_1 \rightarrow S \rightarrow G_2 \rightarrow M$, with G_0 as an exit from G_1). Label the key events for each phase:

- **G₁:** Growth, interval before S.
- **S:** DNA Synthesis.
- **G₂:** Growth, protein synthesis for M.
- **M:** Mitosis (Equational division).
- **G₀:** Quiescent/Inactive (non-dividing).

47. 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 required for the process of chemiosmosis, which is the mechanism for ATP synthesis in both photosynthesis and cellular respiration.

Step 2: Detailed Explanation:

The Chemiosmotic Hypothesis, proposed by Peter Mitchell, explains how ATP is synthesized. The process requires four key components:

1. **A Membrane:** A selectively permeable membrane is required to establish and maintain a concentration gradient. This is the inner mitochondrial membrane in respiration and the thylakoid membrane in photosynthesis.
2. **A Proton Pump:** A mechanism is needed to pump protons (H^+ ions) across the membrane from a region of low concentration to a region of high concentration. This work is done by protein complexes in the electron transport chain (ETC), which use the energy from electron flow to pump protons.
3. **A Proton Gradient:** The action of the proton pump creates a proton motive force, which is a combination of a concentration gradient (difference in H^+ concentration) and an electrical potential across the membrane. This stored potential energy is referred to as the proton gradient.
4. **ATP Synthase:** This is a large enzyme complex embedded in the membrane. It has a channel that allows protons to flow back across the membrane down their electrochemical

gradient. The energy released by this passive flow of protons is harnessed by the enzyme to synthesize ATP from ADP and inorganic phosphate.

Evaluating the options:

- (A) Lists all four essential components correctly.
- (B) Incorrectly lists NADP synthase instead of ATP synthase.
- (C) Incorrectly lists an "electron gradient" instead of a proton gradient.
- (D) Has two errors: "electron gradient" and "NADP synthase".

Step 3: Final Answer:

The essential components for chemiosmosis are a membrane, a proton pump, a proton gradient, and ATP synthase. Therefore, option (A) is correct.

Quick Tip

Remember the four key players of chemiosmosis: 1. The **Field** (Membrane) 2. The **Pump** (Proton Pump / ETC) 3. The **Power Source** (Proton Gradient) 4. The **Generator** (ATP Synthase) All four are absolutely necessary for the process to work.

48. Malonate 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:

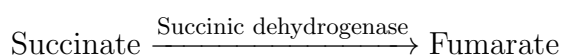
Step 1: Understanding the Question:

The question asks to identify the enzyme that is inhibited by malonate, leading to the inhibition of bacterial growth. This points to a specific type of enzyme inhibition.

Step 2: Detailed Explanation:

Malonate is a classic example of a **competitive inhibitor**. To understand its action, we need to look at its structure and the reaction it inhibits.

- **Target Reaction:** In the Krebs cycle (Tricarboxylic acid cycle), the enzyme **succinic dehydrogenase** catalyzes the oxidation of succinate to fumarate.



- **Inhibitor: Malonate** has a molecular structure that is very similar to the enzyme's actual substrate, succinate.
- **Mechanism of Inhibition:** Because of this structural similarity, malonate can bind to the active site of the succinic dehydrogenase enzyme. However, it cannot be converted into a product. By occupying the active site, malonate "competes" with the real substrate (succinate) and prevents it from binding. This inhibition blocks the Krebs cycle, which is a central metabolic pathway for energy production in aerobic bacteria.

Inhibiting succinic dehydrogenase disrupts cellular respiration, thereby stopping ATP production and inhibiting the growth of the pathogenic bacteria. The other enzymes listed are involved in different metabolic pathways and are not the target of malonate.

Step 3: Final Answer:

Malonate is a competitive inhibitor of the enzyme succinic dehydrogenase. Therefore, option (A) is the correct answer.

Quick Tip

The pair **Malonate** and **Succinic dehydrogenase** is a textbook example of competitive inhibition. Remember the "look-alike" principle: malonate looks like succinate, so it fits into the same enzyme's active site and blocks it. This is a frequently tested concept in biochemistry.

49. 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 question presents two statements about the morphology of a flower. Assertion A defines a flower as a modified shoot, and Reason R provides details of this modification. We need to

evaluate if both are true and if R correctly explains A.

Step 2: Detailed Explanation:

Analysis of Assertion A:

The statement that a flower is a highly modified and condensed reproductive shoot is a fundamental concept in plant morphology. During the transition to flowering, the vegetative shoot apical meristem (SAM) transforms into an inflorescence or floral meristem. This floral meristem then gives rise to the parts of a flower. So, Assertion A is **true**.

Analysis of Reason R:

This statement explains the modification process in more detail. In a normal vegetative shoot, nodes (where leaves arise) are separated by elongated internodes. In the formation of a flower, the apical meristem stops producing leaves and the axis stops elongating. The **internodes become highly condensed and do not elongate**, bringing the nodes very close together. From these successive condensed nodes, the modified leaves, which are the floral appendages (sepals, petals, stamens, and carpels), arise laterally in whorls. This description accurately explains how a shoot is modified to become a flower. So, Reason R is **true**.

Relationship between A and R:

Reason R provides the specific details (condensation of internodes, production of floral appendages instead of leaves) that explain *how* a shoot is modified to become a flower. It is the perfect explanation for the definition given in Assertion A.

Step 3: Final Answer:

Both Assertion A and Reason R are true, and Reason R is the correct explanation of Assertion A. Therefore, option (A) is the correct choice.

Quick Tip

Remember the homology between a shoot and a flower:

- **Stem** → **Thalamus** (condensed axis)
- **Leaves** → **Floral appendages** (sepals, petals, stamens, carpels)

The key modification is the extreme condensation of the internodes.

50. 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 incorrect but Statement II is true.

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

Solution:

Step 1: Understanding the Question:

The question presents two statements related to ecological competition. We need to evaluate the correctness of each statement.

Step 2: Detailed Explanation:

Analysis of Statement I:

This statement provides a definition of Gause's 'Competitive Exclusion Principle'. The principle, based on G.F. Gause's experiments with *Paramecium*, posits that when two species are competing for the exact same limiting resources, one species will have a slight advantage over the other, leading to the eventual elimination of the competitively inferior species from that habitat. The statement accurately describes this principle. Thus, Statement I is **correct**.

Analysis of Statement II:

This statement makes a generalization about the impact of competition on carnivores versus herbivores. Competition for resources (food, space) is a powerful force at all trophic levels. However, it is generally considered that competition among **herbivores** is more intense. This is because herbivores often compete for a limited number of plant species, and their populations can be very dense. Carnivores, being at a higher trophic level, are often limited by prey availability (a bottom-up control) more than by direct competition with other carnivores, although competition certainly occurs (e.g., between lions and hyenas). There is no general ecological rule stating that carnivores are *more* adversely affected by competition than herbivores. In fact, the opposite is often argued. Thus, Statement II is **false**.

Step 3: Final Answer:

Statement I is a correct definition of the competitive exclusion principle, while Statement II is an incorrect ecological generalization. Therefore, the correct option is (C).

Quick Tip

Remember Gause's principle: "Complete competitors cannot coexist." For Statement II, avoid making broad generalizations unless they are well-established ecological principles. The intensity of competition depends on resource limitation and niche overlap, which can be high at any trophic level, but is often considered particularly strong among herbivores.