

NEET UG 2023 H6 Botany Question Paper with Solutions

Time Allowed :3 Hour 20 Minutes	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

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

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

(D) Selaginella and Salvinia

Correct Answer: (D) Selaginella and Salvinia

Solution:

Step 1: Understanding the Question:

The question asks to identify a pair of pteridophytes that are heterosporous. Heterosporous plants produce two distinct types of spores: smaller microspores (male) and larger megaspores (female). This is in contrast to homosporous plants, which produce only one type of spore that develops into a bisexual gametophyte.

Step 2: Detailed Explanation:

Let's analyze the options provided:

- **Psilotum:** It is a homosporous pteridophyte.
- **Equisetum:** It is a homosporous pteridophyte.
- **Lycopodium:** Most species are homosporous, although a few are heterosporous. It is generally considered homosporous in this context.
- **Selaginella:** It is a heterosporous pteridophyte, producing microspores and megaspores.
- **Salvinia:** It is a heterosporous aquatic fern, producing microspores and megaspores.

Now, let's evaluate the pairs:

- (A) Psilotum (homosporous) and Salvinia (heterosporous). Not a valid pair.
(B) Equisetum (homosporous) and Salvinia (heterosporous). Not a valid pair.
(C) Lycopodium (homosporous) and Selaginella (heterosporous). Not a valid pair.
(D) Selaginella (heterosporous) and Salvinia (heterosporous). Both are heterosporous. This is the correct pair.

Step 3: Final Answer:

Based on the analysis, the pair of pteridophytes where both members are heterosporous is Selaginella and Salvinia.

Quick Tip

To answer such questions, it's crucial to memorize the key examples of homosporous and heterosporous pteridophytes. Remember that Selaginella, Salvinia, Marsilea, and Azolla are common examples of heterosporous pteridophytes. Most other common pteridophytes like Psilotum, Lycopodium, Equisetum, and Dryopteris are homosporous.

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

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

Correct Answer: (C) 680 nm

Solution:

Step 1: Understanding the Question:

The question asks for the specific wavelength of light at which the reaction center of Photosystem II (PS II) shows maximum absorption.

Step 2: Detailed Explanation:

Photosynthesis in higher plants involves two photosystems, Photosystem I (PS I) and Photosystem II (PS II).

Each photosystem has a reaction center, which is a specific chlorophyll 'a' molecule that gets excited and donates an electron.

- The reaction center for **Photosystem II (PS II)** is a chlorophyll 'a' molecule that has an absorption peak at **680 nm**. Hence, it is called **P680**.
- The reaction center for **Photosystem I (PS I)** is a chlorophyll 'a' molecule that has an absorption peak at **700 nm**. Hence, it is called **P700**.

The other options are incorrect. 660 nm is within the absorption spectrum of chlorophylls but not the peak of the reaction center. 780 nm is in the far-red region and not the absorption maximum for either reaction center.

Step 3: Final Answer:

The reaction center in PS II has an absorption maximum at 680 nm.

Quick Tip

A simple way to remember this is to associate the number with the photosystem: PS II comes before PS I in the Z-scheme of electron transport, and its absorption maximum (680 nm) is a lower wavelength than PS I's (700 nm). So, II -> 680, I -> 700.

103. 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) C, D, E only
- (B) D, E, A only
- (C) A, B, C only
- (D) B, C, D only

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

Solution:

Step 1: Understanding the Question:

The question requires us to evaluate five statements related to the process of decomposition and the detritus food chain, and then choose the option that lists all the correct statements.

Step 2: Detailed Explanation:

Let's analyze each statement:

- **Statement A: Detritivores perform fragmentation.** This is **correct**. Detritivores, such as earthworms, break down detritus (dead organic matter) into smaller particles. This process is called fragmentation.
- **Statement B: The humus is further degraded by some microbes during mineralization.** This is **correct**. Humus is a dark amorphous substance that is highly resistant to microbial action and decomposes at an extremely slow rate. Eventually, it is degraded by some microbes, and this process, called mineralization, releases inorganic nutrients.
- **Statement C: Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.** This is **correct**. Leaching is the process where water-soluble substances, including inorganic nutrients, are washed down into the lower layers of the soil and can become unavailable to plants.
- **Statement D: The detritus food chain begins with living organisms.** This is **incorrect**. The detritus food chain (DFC) begins with dead organic matter (detritus), not living organisms. The grazing food chain (GFC) begins with living producers.

- **Statement E: Earthworms break down detritus into smaller particles by a process called catabolism.** This is **incorrect**. Earthworms break down detritus by **fragmentation**. Catabolism is the enzymatic breakdown of detritus into simpler inorganic substances by bacteria and fungi.

Therefore, the correct statements are A, B, and C.

Step 3: Final Answer:

The combination of correct statements is A, B, and C, which corresponds to option (C).

Quick Tip

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

104. 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) Monadelphous and Monothealous anthers
- (B) Epiphyllous and Dithealous anthers
- (C) Diadelphous and Dithealous anthers
- (D) Polyadelphous and epipetalous stamens

Correct Answer: (C) Diadelphous and Dithealous anthers

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

Let's analyze the characteristics of stamens in the three families:

- **Family Fabaceae (specifically subfamily Papilionoideae):** The androecium consists of ten stamens. A characteristic feature is the **diadelphous** condition, where the filaments are fused into two bundles, typically in a (9) + 1 arrangement. The anthers are **dithealous** (having two lobes).

- **Family Solanaceae:** The androecium has five stamens. They are **epipetalous**, meaning they are attached to the petals. The stamens are free from one another (notadelphous), and the anthers are dithealous.
- **Family Liliaceae:** The androecium has six stamens, arranged in two whorls of three. They are **epiphyllous** or **epitepalous**, meaning they are attached to the tepals (undifferentiated perianth lobes). The anthers are dithealous.

Now let's evaluate the options:

- (A) Monadelphous condition (filaments fused into one bundle) is found in Malvaceae (e.g., China rose), not Fabaceae. Monothealous anthers are also characteristic of Malvaceae.
- (B) Epiphyllous condition is characteristic of Liliaceae.
- (C) Diadelphous condition is a hallmark of Fabaceae (Papilionoideae). Dithealous anthers are common to all three families, but the combination with the diadelphous condition makes it specific in this context.
- (D) Polyadelphous condition (filaments in more than two bundles) is found in Citrus. Epipetalous condition is found in Solanaceae.

Step 3: Final Answer:

The characteristic specific to Fabaceae among the given choices is the diadelphous condition of the stamens. Therefore, "Diadelphous and Dithealous anthers" is the correct answer.

Quick Tip

Remembering floral formulas helps distinguish plant families. For Papilionoideae (Fabaceae), the androecium is represented as $A_{(9)+1}$, indicating the diadelphous condition. For Solanaceae, it's A_5 with an arc showing the epipetalous condition. For Liliaceae, it's A_{3+3} with an arc showing the epiphyllous condition.

105. Given below are two statements :

Statement I: The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height.

Statement II: Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling.

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

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

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

Solution:

Step 1: Understanding the Question:

The question presents two statements related to the physiological effects of transpiration in plants. We need to determine the correctness of each statement.

Step 2: Detailed Explanation:

- **Analysis of Statement I:** This statement refers to the transpiration pull or cohesion-tension theory of water ascent in plants. The combined forces of cohesion (attraction between water molecules), adhesion (attraction of water molecules to xylem walls), and surface tension create a continuous water column under tension. The pull generated by the evaporation of water from leaves (transpiration) is strong enough to lift this water column to great heights. Tall trees like the redwood can exceed 115 meters in height, and the transpiration pull is the mechanism that supplies water to their tops. Therefore, lifting water over 130 meters is theoretically and practically possible through this mechanism. **Statement I is correct.**
- **Analysis of Statement II:** Transpiration involves the evaporation of water from the leaf surface. Evaporation is a cooling process because it requires energy (latent heat of vaporization), which is drawn from the leaf tissue. This evaporative cooling prevents the leaves from overheating, especially under intense sunlight and high temperatures. A cooling effect of 10 to 15 degrees Celsius is a well-documented phenomenon. **Statement II is correct.**

Step 3: Final Answer:

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

Quick Tip

Think of transpiration as having two major benefits: creating the "pull" for water and mineral transport from roots to leaves, and providing "air conditioning" for the leaves through evaporative cooling. Both aspects are crucial for plant survival.

106. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: Late wood has fewer xylary elements with narrow vessels.

Reason R: Cambium is less active in winters.

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

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

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

Solution:

Step 1: Understanding the Question:

This is an Assertion-Reason question. We need to evaluate the truthfulness of both the Assertion (A) and the Reason (R), and then determine if the Reason correctly explains the Assertion.

Step 2: Detailed Explanation:

- **Analysis of Assertion A:** In temperate regions, trees form annual rings due to seasonal variations in the activity of the vascular cambium.
 - **Spring wood (or early wood)** is formed during spring when the cambium is very active. It is characterized by a larger number of xylary elements that have wider vessels.
 - **Late wood (or autumn wood)** is formed in winter/autumn. It has fewer xylary elements, and the vessels are narrow. This makes the late wood denser and darker.So, the statement "Late wood has fewer xylary elements with narrow vessels" is **true**.
- **Analysis of Reason R:** The activity of the vascular cambium is controlled by physiological and environmental factors, including temperature and photoperiod. In temperate regions, during the winter season, conditions are less favorable for growth, and consequently, the cambium becomes less active. In spring, with favorable conditions, its activity increases. So, the statement "Cambium is less active in winters" is **true**.
- **Analysis of the relationship between A and R:** The reason for the structural difference between early and late wood lies in the cambium's activity. Because the cambium is less active in winter (Reason R), it produces fewer xylary elements, and the vessels that are formed are narrower (Assertion A). Thus, the Reason correctly explains the Assertion.

Step 3: Final Answer:

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

Quick Tip

Remember the direct relationship: High cambial activity (spring) → Wide vessels, more xylem (early wood). Low cambial activity (winter/autumn) → Narrow vessels, less xylem (late wood). This difference creates the distinct annual rings used for dating trees.

107. In the equation $GPP - R = NPP$

GPP is Gross Primary Productivity

NPP is Net Primary Productivity

R here is

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

Correct Answer: (A) Respiratory loss

Solution:

Step 1: Understanding the Question:

The question asks to identify what 'R' represents in the fundamental ecological equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).

Step 2: Detailed Explanation:

- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured by producers (like plants) through photosynthesis and converted into organic substances (biomass). It's the total amount of food or energy produced.
- **Respiration (R):** Producers must use a portion of the energy they capture for their own life processes, such as growth, maintenance, and reproduction. This energy is consumed through cellular respiration. This portion of energy is referred to as **respiratory loss**.
- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass after accounting for the energy they used for their own respiration. It is the energy that remains and is available to the next trophic level (consumers).

Step 3: Key Formula or Approach:

The relationship between these three is given by the equation:

$$NPP = GPP - R$$

Rearranging this, we get $GPP - R = NPP$.

Here, 'R' clearly stands for the energy lost through respiration by the producers.

Step 4: Final Answer:

In the given equation, R represents the respiratory loss.

Quick Tip

Use an analogy to remember this concept:

- **GPP** is like your total salary (gross income).
- **R (Respiratory loss)** is like your essential living expenses and taxes.
- **NPP** is like your savings or disposable income (net income), which is what you can use for other things or what others (consumers) can access.

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

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

Correct Answer: (D) To trap pollen grains

Solution:

Step 1: Understanding the Question:

The question asks for the function of "tassels in the corn cob". It's important to correctly identify the structures mentioned. In a maize (corn) plant, the tassel and the cob are separate structures.

- The **tassel** is the male inflorescence located at the top of the plant. Its function is to produce and disperse pollen grains.
- The **cob** is part of the female inflorescence, which develops into the ear of corn. The long, thread-like structures emerging from the tip of the cob are called **silks**. Each silk is a stigma and style.

Step 2: Detailed Explanation:

The phrasing "tassels in the corn cob" is anatomically incorrect, as tassels are not part of the cob. There seems to be a confusion in the question's terminology. Let's analyze the functions of the actual structures:

- The function of the **tassel** is **to disperse pollen grains** (Option A).

- The function of the **silks on the cob** is to **trap pollen grains** (Option D). Each silk, upon trapping a pollen grain, allows for fertilization of an ovule, which then develops into a kernel (seed).

Given the provided answer key states (D) is correct, it is highly probable that the question intended to ask about the function of the **silks** of the corn cob, but mistakenly used the word "tassels". The function of the silks is indeed to trap airborne pollen grains.

Step 3: Final Answer:

Assuming the question meant to ask about the silks on the corn cob, their function is to trap pollen grains for fertilization. Therefore, option (D) is the intended correct answer despite the inaccurate wording of the question.

Quick Tip

In competitive exams, you may encounter poorly worded or technically incorrect questions. In such cases, try to understand the examiner's intent. For maize, remember: Tassel (top, male) produces pollen; Silk (on the ear/cob, female) traps pollen.

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

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

Correct Answer: (A) Ethylene

Solution:

Step 1: Understanding the Question:

The question asks to identify the plant hormone responsible for promoting the rapid elongation of internodes or petioles in deep water rice plants when they are submerged.

Step 2: Detailed Explanation:

Deep water rice is a variety of rice that grows in flooded conditions. To survive, it must rapidly elongate its internodes to keep its leaves above the water surface for photosynthesis and gas exchange.

- This rapid elongation is triggered by the accumulation of the gaseous hormone **Ethylene** in the submerged parts of the plant.
- Ethylene itself does not directly cause the elongation but increases the sensitivity of the cells to another hormone, **Gibberellic Acid (GA)**.

- It is the Gibberellic Acid that ultimately promotes cell division and elongation, leading to the rapid growth of the internodes.
- However, Ethylene is the primary trigger and promoter of this specific response in submerged plants.
- **2, 4-D** is a synthetic auxin, often used as a herbicide.
- **GA₃** (Gibberellic acid) is involved in the elongation, but Ethylene is the key promoter in this specific scenario.
- **Kinetin** is a cytokinin, which primarily promotes cell division.

Since the question asks which hormone *promotes* this specific adaptation, Ethylene is the most accurate answer as it is the initial signal caused by submergence.

Step 3: Final Answer:

Ethylene promotes internode elongation in deep water rice by increasing the tissue's sensitivity to gibberellins.

Quick Tip

This is a classic example of hormonal synergy and specific environmental response. Remember that for deep water rice, submergence leads to Ethylene accumulation, which then signals for Gibberellin-mediated elongation to escape the water.

110. The phenomenon of pleiotropism refers to

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

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

Solution:

Step 1: Understanding the Question:

The question asks for the definition of pleiotropism (or pleiotropy).

Step 2: Detailed Explanation:

Let's analyze the genetic terms in the options:

- **Pleiotropy:** This is a genetic phenomenon where a single gene influences two or more seemingly unrelated phenotypic traits. For example, in humans, the gene mutation that causes phenylketonuria (PKU) leads to multiple symptoms, including mental retardation,

reduced hair pigmentation, and lighter skin color. This matches option (A).

- **Polygenic Inheritance:** This is when a single character or trait (like height or skin color in humans) is controlled by multiple genes. This matches the description in option (B).
- **Multiple Alleles:** This refers to the situation where a single gene has more than two alleles in a population (e.g., the ABO blood group system). Option (C) incorrectly links this to crossover control.
- Option (D) is confusingly worded but seems to describe two different genes, which is not pleiotropy.

Step 3: Final Answer:

The correct definition of pleiotropism is when a single gene affects multiple phenotypic expressions.

Quick Tip

To avoid confusion, remember the contrast:

- **Pleiotropy:** One gene $\rightarrow$ Many traits.
- **Polygenic Inheritance:** Many genes $\rightarrow$ One trait.

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

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

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

Solution:

Step 1: Understanding the Question:

The question asks for the specific function of RNA polymerase III in eukaryotic transcription. Eukaryotic cells have three main types of RNA polymerases, each responsible for transcribing different classes of genes.

Step 2: Detailed Explanation:

The division of labor among the three eukaryotic RNA polymerases is as follows:

- **RNA Polymerase I:** Located in the nucleolus, it is responsible for transcribing the genes for ribosomal RNAs (rRNAs). Specifically, it transcribes the precursor for the 28S, 18S, and 5.8S rRNAs. This corresponds to option (C).
- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes the genes that code for proteins. This means it synthesizes the precursor of messenger RNA (mRNA), which is called heterogeneous nuclear RNA (hnRNA). It also transcribes most small nuclear RNAs (snRNAs) and microRNAs (miRNAs). This corresponds to option (A).
- **RNA Polymerase III:** Located in the nucleoplasm, it is responsible for transcribing the genes for transfer RNA (tRNA), the 5S rRNA (a component of the large ribosomal subunit), and some small RNAs, including some small nuclear RNAs (snRNAs, like U6 snRNA) and small nucleolar RNAs (snoRNAs). This corresponds to option (D).

Option (B) is incorrect because RNA polymerase III transcribes more than just snRNAs, and RNA polymerase II also transcribes some snRNAs.

Step 3: Final Answer:

Based on the functions of the different RNA polymerases, RNA polymerase III transcribes tRNA, 5S rRNA, and some snRNAs.

Quick Tip

Use the mnemonic "R-M-T" for Polymerases I, II, and III, corresponding to their main products: rRNA, mRNA, and tRNA. Remember the important exception: 5S rRNA is made by Pol III, not Pol I like the other rRNAs.

112. Expressed Sequence Tags (ESTs) refers to

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

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

Solution:

Step 1: Understanding the Question:

The question asks for the definition of Expressed Sequence Tags (ESTs).

Step 2: Detailed Explanation:

ESTs are a tool used in genomics, particularly in the Human Genome Project, to identify gene transcripts.

- The process starts with extracting all the messenger RNA (mRNA) from a cell or tissue. The presence of mRNA indicates that a gene is being "expressed" or transcribed.
- This mRNA is then converted into complementary DNA (cDNA) using the enzyme reverse transcriptase.
- Short, single-pass sequence reads from either the 5' or 3' end of these cDNAs are generated. These short sequences are the Expressed Sequence Tags (ESTs).
- Since ESTs are derived from mRNA, they represent fragments of genes that are being transcribed into RNA in that specific tissue at that time.

Let's evaluate the options based on this understanding:

(A) Incorrect. ESTs only represent expressed genes, not unexpressed ones (which are not transcribed into mRNA).

(B) Incorrect. The method is not selective for "important" genes; it theoretically identifies all genes that are being transcribed.

(C) **Correct.** ESTs are derived from all the mRNA present, so they represent "all genes that are expressed as RNA".

(D) Incorrect. Gene expression first leads to RNA (transcription). Not all RNA is translated into protein (e.g., non-coding RNAs). ESTs are generated from the RNA transcript level, not the protein level.

Step 3: Final Answer:

Expressed Sequence Tags (ESTs) refer to all genes that are expressed as RNA.

Quick Tip

Focus on the term "Expressed" in EST. In molecular biology, gene expression primarily refers to the process of transcription (DNA → RNA). Therefore, ESTs are tags for genes that are being transcribed into RNA.

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

- (A) Avery, Macleod and McCarty
- (B) Wilkins and Franklin
- (C) Frederick Griffith
- (D) Alfred Hershey and Martha Chase

Correct Answer: (D) Alfred Hershey and Martha Chase

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

Let's review the contributions of the scientists listed:

- **Frederick Griffith (1928):** Conducted the transformation experiment with *Streptococcus pneumoniae*. He showed that a "transforming principle" from dead virulent bacteria could make non-virulent bacteria virulent, but he did not identify what this principle was.
- **Avery, Macleod, and McCarty (1944):** They continued Griffith's work and demonstrated through biochemical experiments (using enzymes like proteases, RNases, and DNases) that the transforming principle was DNA. While their evidence was strong, it was not universally accepted by the scientific community at the time, many of whom still believed protein was the more likely candidate for genetic material.
- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using T2 bacteriophage (a virus that infects bacteria). They used radioactive isotopes to label the phage's DNA and protein separately.
 - Phage protein coats were labeled with radioactive sulfur (^{35}S), as proteins contain sulfur but DNA does not.
 - Phage DNA was labeled with radioactive phosphorus (^{32}P), as DNA contains phosphorus but proteins do not.

They found that only the radioactive phosphorus (^{32}P) entered the host bacterial cells, while the radioactive sulfur (^{35}S) remained outside. Since the injected substance directs the production of new viruses, this experiment provided clear, unequivocal proof that DNA is the genetic material.

- **Wilkins and Franklin:** Their work involved X-ray diffraction analysis of DNA, which was crucial for Watson and Crick to deduce the double-helix structure of DNA. Their work was about structure, not the proof of its function as the genetic material.

Step 3: Final Answer:

The Hershey-Chase experiment is considered the conclusive proof that DNA is the genetic material.

Quick Tip

Remember the progression of discovery: Griffith showed transformation exists. Avery et al. identified the transforming substance as DNA. Hershey and Chase confirmed it with a different experimental system (bacteriophages), providing the final, unequivocal proof that convinced the scientific community.

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

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

Correct Answer: (C) Habitat loss and fragmentation

Solution:

Step 1: Understanding the Question:

The question asks to identify the most significant cause of species extinction from the four major causes collectively known as 'The Evil Quartet'.

Step 2: Detailed Explanation:

'The Evil Quartet' is a term used to describe the four main human-caused drivers of biodiversity loss and species extinction. These are:

1. **Habitat loss and fragmentation:** This involves the destruction (e.g., deforestation for agriculture, urbanization) and breaking up of natural habitats into smaller, isolated patches.
2. **Over-exploitation:** This is the harvesting of species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting).
3. **Alien species invasions:** This is the introduction of non-native species to an ecosystem, where they can outcompete native species, introduce diseases, or alter the habitat.
4. **Co-extinctions:** This is the loss of a species as a consequence of the extinction of another species with which it has an obligatory relationship (e.g., a parasite losing its only host).

Among these four, **habitat loss and fragmentation** is globally recognized as the single most important and primary driver of extinction. It affects the largest number of species across all taxa because it removes the fundamental requirements for their survival: food, shelter, and breeding grounds. For example, the massive deforestation of tropical rainforests threatens millions of species. The other causes are also significant but are generally considered secondary to the overarching problem of habitat destruction.

Step 3: Final Answer:

Habitat loss and fragmentation is the most important cause driving the extinction of species.

Quick Tip

While all four components of "The Evil Quartet" are serious threats, always remember that habitat loss is the number one cause. If a species has nowhere to live, it cannot survive, regardless of other pressures.

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

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

Correct Answer: (C) Dobson units

Solution:

Step 1: Understanding the Question:

The question asks for the standard unit of measurement for the total amount of ozone in the atmosphere.

Step 2: Detailed Explanation:

Let's analyze the units provided in the options:

- **Decameter:** A unit of length in the metric system, equal to 10 meters. It is not used for measuring atmospheric gases.
- **Kilobase (kb):** A unit used in molecular biology to measure the length of DNA or RNA molecules, equal to 1000 base pairs. It is irrelevant to atmospheric science.
- **Dobson units (DU):** This is the standard unit for measuring the total column ozone, which is the total amount of ozone in a vertical column of air from the ground to the top of the atmosphere. One Dobson Unit is defined as a layer of ozone that would be 0.01 mm thick at standard temperature (0°C) and pressure (1 atm).
- **Decibels (dB):** A logarithmic unit used to measure sound intensity or the power level of an electrical signal. It has no connection to ozone measurement.

Step 3: Final Answer:

The correct unit for measuring the thickness of the ozone layer is Dobson units.

Quick Tip

Associate the name "Dobson" with "Ozone." Gordon Dobson was a British physicist who pioneered research on atmospheric ozone and invented the Dobson spectrophotometer, the instrument used to measure total column ozone from the ground.

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

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

Correct Answer: (A) Anaphase II

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific stage of meiosis where the centromeres, which hold sister chromatids together, divide or split.

Step 2: Detailed Explanation:

Meiosis consists of two successive nuclear divisions, Meiosis I and Meiosis II.

- **Meiosis I (Reductional Division):** The primary event in Meiosis I is the separation of homologous chromosomes.
 - In **Metaphase I**, homologous chromosome pairs (bivalents) align at the metaphase plate.
 - In **Anaphase I**, homologous chromosomes separate and move to opposite poles. The sister chromatids remain attached at their centromeres. **The centromeres do not divide in Anaphase I.**
- **Meiosis II (Equational Division):** The events of Meiosis II are analogous to mitosis. The primary event is the separation of sister chromatids.
 - In **Metaphase II**, individual chromosomes (each still composed 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, they are considered individual chromosomes.

- **Telophase** (I and II) is the final stage where chromosomes arrive at the poles and nuclear envelopes re-form.

Therefore, the division of the centromere occurs during Anaphase II.

Step 3: Final Answer:

The stage of meiosis that involves the division of the centromere is Anaphase II.

Quick Tip

A key distinction to remember:

- **Anaphase I:** Homologous chromosomes separate. Centromeres **do not** divide.
- **Anaphase II:** Sister chromatids separate. Centromeres **do** divide.

Meiosis II is very similar to mitosis. The centromeres also divide during the anaphase of mitosis.

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

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

Correct Answer: (D) Gibberellic Acid

Solution:

Step 1: Understanding the Question:

The question asks which plant hormone (phytohormone) can be used to speed up the transition from the juvenile phase to the mature, reproductive phase in coniferous trees, thereby inducing early seed production.

Step 2: Detailed Explanation:

Many plants, especially woody perennials like conifers, have a long juvenile period during which they are not capable of flowering. This can be a major bottleneck in breeding programs. The roles of the listed hormones are as follows:

- **Zeatin:** This is a type of cytokinin. Cytokinins are primarily involved in promoting cell division, delaying senescence, and overcoming apical dominance. They do not typically hasten maturity.

- **Absciscic Acid (ABA):** This is generally considered a growth-inhibiting hormone. It is involved in inducing dormancy in seeds and buds and mediating stress responses. It would not promote early maturity.
- **Indole-3-butyric Acid (IBA):** This is a type of auxin, primarily used in horticulture to promote the formation of adventitious roots in stem cuttings. It is not used for hastening maturity.
- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including stem elongation (bolting), seed germination, and promoting flowering. A key application of GAs, especially GA₃, in horticulture and forestry is to overcome juvenility. Spraying juvenile conifers with gibberellic acid can induce early flowering and cone (and thus seed) production, significantly shortening the breeding cycle.

Step 3: Final Answer:

Gibberellic Acid is the phytohormone used to hasten maturity and promote early seed production in juvenile conifers.

Quick Tip

Associate Gibberellins (GAs) with "growth and going." They promote seed germination (breaking dormancy), stem elongation (bolting), and the transition to flowering (breaking juvenility). This makes them commercially valuable for various applications, from increasing grape size to speeding up tree breeding.

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

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

Correct Answer: (D) Pachytene

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific substage of Prophase I of meiosis during which recombination nodules are observed.

Step 2: Detailed Explanation:

Prophase I is the longest and most complex phase of meiosis, divided into five substages. Let's examine the key events of each:

- **Leptotene:** Chromosomes begin to condense and become visible.
- **Zygotene:** The pairing of homologous chromosomes, a process called synapsis, begins. The paired chromosomes form a structure called a bivalent or tetrad, held together by the synaptonemal complex.
- **Pachytene:** Synapsis is completed. The bivalents are clearly visible. This is the stage where the crucial event of **crossing over** occurs. Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes. The sites where this exchange takes place are marked by the appearance of proteinaceous structures called **recombination nodules**. These nodules contain the enzymes necessary to cut and rejoin the DNA strands.
- **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate from each other. However, they remain attached at the sites of crossing over. These X-shaped points of attachment are called chiasmata.
- **Diakinesis:** The final stage, where chromosomes are fully condensed, and the terminalization of chiasmata occurs. The nuclear envelope breaks down.

Based on this sequence, recombination nodules, the sites of crossing over, appear during the Pachytene stage.

Step 3: Final Answer:

The appearance of recombination nodules occurs during the Pachytene substage of Prophase I.

Quick Tip

Use a mnemonic to remember the order of Prophase I stages: **Lazy Zebras Push Down Daisies** (Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis). Associate **P**achytene with **P**airing is complete and crossing over (**p**acking together and exchanging parts).

119. Given below are two statements :

Statement I: Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.

Statement II: Exarch condition is the most common feature of the root system.

In the light of the above statements, choose the correct answer from the options

given below:

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

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

Solution:

Step 1: Understanding the Question:

The question requires us to evaluate two statements related to the arrangement of xylem in plants and determine their individual correctness.

Step 2: Detailed Explanation:

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

Since the statement says these terms describe secondary xylem, **Statement I is incorrect.**

- **Analysis of Statement II:** As defined above, the exarch condition (protoxylem on the outside, metaxylem on the inside) is the characteristic arrangement of primary xylem in the vascular bundles of roots in dicots and monocots. Therefore, **Statement II is correct.**

Step 3: Final Answer:

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

Quick Tip

To remember the difference, associate 'Ex' in Exarch with 'exit' or 'exterior,' referring to the protoxylem's position in roots. Associate 'En' in Endarch with 'enter' or 'interior,' referring to the protoxylem's position in stems. These terms always apply to primary tissues.

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

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

Correct Answer: (B) Bright orange colour

Solution:

Step 1: Understanding the Question:

The question asks about the appearance of DNA when it is stained with ethidium bromide and viewed under ultraviolet (UV) light. This is a standard technique in molecular biology.

Step 2: Detailed Explanation:

- **Ethidium bromide (EtBr)** is a fluorescent dye that is commonly used to visualize nucleic acids (DNA or RNA) in techniques like agarose gel electrophoresis.
- EtBr works by **intercalating**, which means it inserts itself between the stacked base pairs of the DNA double helix.
- When the DNA-EtBr complex is exposed to **UV radiation**, the ethidium bromide molecule absorbs the UV light energy and becomes excited. It then releases this energy in the form of visible light, a phenomenon known as fluorescence.
- The emitted light has a longer wavelength than the absorbed UV light and appears as a characteristic **bright orange** or reddish-orange color.

Without the stain, DNA is not visible under UV light. The other colors listed are incorrect for EtBr fluorescence.

Step 3: Final Answer:

DNA stained with ethidium bromide fluoresces bright orange when exposed to UV radiation.

Quick Tip

The image of bright orange bands on a dark background in an agarose gel photo is iconic in molecular biology. Remember this visual: Ethidium Bromide + DNA + UV light = Bright Orange. Also, be aware that EtBr is a potent mutagen and requires careful handling.

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

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

Correct Answer: (A) Alfred Sturtevant

Solution:

Step 1: Understanding the Question:

The question asks to identify the scientist who first proposed the idea of using the frequency of genetic recombination to determine the relative distance and positions of genes on a chromosome, a process known as genetic mapping.

Step 2: Detailed Explanation:

Let's review the contributions of the scientists mentioned:

- **Sutton and Boveri (1902-1903):** They independently proposed the **Chromosomal Theory of Inheritance**, which states that genes are located on chromosomes. They did not create gene maps.
- **Henking (1891):** He was a German biologist who discovered the X chromosome while studying insect spermatogenesis, referring to it as the 'X-body'. His work was in cytogenetics, not gene mapping.
- **Thomas Hunt Morgan (early 1900s):** Working with the fruit fly *Drosophila melanogaster*, he provided the first experimental proof of the Chromosomal Theory of Inheritance. He discovered concepts like linkage (genes on the same chromosome tend to be inherited together) and recombination (crossing over can break this linkage). His work laid the foundation for gene mapping.

- **Alfred Sturtevant (1913):** He was an undergraduate student in T.H. Morgan's lab. He had the brilliant 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*.

Step 3: Final Answer:

Alfred Sturtevant was the first to use recombination frequencies to create a genetic map.

Quick Tip

Remember the lineage: Morgan's lab provided the concepts of linkage and recombination. His student, Sturtevant, took the next step and used the recombination *frequency* data to map the *distance* between genes. Morgan won the Nobel Prize for his work, and Sturtevant's contribution is a classic example of a groundbreaking idea.

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

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

Correct Answer: (A) Tungsten or gold

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific metals used as 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. It is particularly useful for transforming plant cells, which have a rigid cell wall that can be difficult to penetrate.

The process involves:

1. Coating microscopic particles of a heavy metal with the DNA that is to be introduced.
2. These coated microparticles are then accelerated to a very high velocity using a "gun" (powered by compressed gas like helium).
3. The high-velocity microparticles penetrate the cell wall and membrane of the target cells, carrying the foreign DNA with them.

The choice of metal for the microparticles is critical. The particles must be:

- **Dense:** To have enough momentum to penetrate the cell.
- **Biologically inert:** To not cause toxic effects within the cell.

The two metals that are most commonly used because they meet these criteria are **tungsten** and **gold**. Silver, copper, and zinc are generally too reactive or toxic to be suitable for this purpose.

Step 3: Final Answer:

The microparticles used in the gene gun method are made of tungsten or gold.

Quick Tip

Think of the microparticles as tiny, heavy "bullets." Gold (Au) and Tungsten (W) are among the densest elements and are relatively non-reactive, making them perfect for this purpose. Gold is less reactive but more expensive than tungsten.

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

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

Correct Answer: (D) Dedifferentiation

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

Let's define the terms related to cell specialization in plants:

- **Differentiation:** The process by which meristematic (undifferentiated) cells mature and become specialized in structure and function to perform specific roles (e.g., forming xylem, phloem, or mesophyll cells).

- **Dedifferentiation:** The process by which already differentiated, mature cells lose their specialization and revert to an undifferentiated, meristematic state, regaining the capacity for cell division. The formation of a callus from an explant (like leaf mesophyll cells) is the classic example of dedifferentiation.
- **Redifferentiation:** The process by which dedifferentiated cells (like those in a callus) divide and then differentiate again to form new specialized cells, tissues, and eventually whole organs or a plantlet.
- **Development:** A broad term encompassing all changes an organism goes through in its life cycle, including growth, differentiation, and maturation.
- **Senescence:** The process of aging in plants.

In the given scenario, the leaf mesophyll cells are already differentiated. By forming a callus (an unorganized, undifferentiated mass of cells), they are losing their differentiation. This process is correctly termed **dedifferentiation**.

Step 3: Final Answer:

The phenomenon of differentiated leaf mesophyll cells forming an undifferentiated callus is called dedifferentiation.

Quick Tip

Remember the typical sequence in plant tissue culture: 1. **Explant** (differentiated cells) 2. **Dedifferentiation** → **Callus** (undifferentiated cells) 3. **Redifferentiation** → **Plantlet** (differentiated tissues/organs)

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

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

Correct Answer: (C) manganese

Solution:

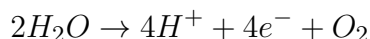
Step 1: Understanding the Question:

The question asks to identify the micronutrient that plays an essential role in the photolysis

(splitting) of water during the light-dependent reactions of photosynthesis.

Step 2: Key Formula or Approach:

The overall reaction for the photolysis of water is:



This reaction takes place within Photosystem II (PS II).

Step 3: Detailed Explanation:

The splitting of water is catalyzed by a specific part of Photosystem II called the **Oxygen-Evolving Complex (OEC)**. For the OEC to function, it requires the presence of certain inorganic cofactors.

- The central component of the OEC is a cluster of four **Manganese (Mn)** ions. These ions cycle through different oxidation states, which is crucial for accumulating the oxidizing power needed to split water molecules.
- Chloride (Cl^-) and Calcium (Ca^{2+}) ions are also required for the optimal functioning of the OEC.

Let's look at the roles of the other nutrients listed:

- **Magnesium (Mg):** This is a macronutrient, not a micronutrient. Its primary role is being the central atom in the chlorophyll molecule, essential for capturing light energy.
- **Copper (Cu):** A micronutrient that is a component of plastocyanin, an electron carrier protein that links Photosystem II and Photosystem I.
- **Molybdenum (Mo):** A micronutrient primarily involved in nitrogen metabolism as a component of the enzymes nitrate reductase and nitrogenase.

Therefore, manganese is the specific micronutrient required for the splitting of water.

Step 4: Final Answer:

Manganese (Mn) is the essential micronutrient for the photolysis of water during photosynthesis.

Quick Tip

To easily remember the key roles, create simple associations:

- **Mg** for **M**aking chlorophyll.
- **Mn** for splitting **H₂O** (water).
- **Mo** for nitrogen **m**etabolism.

The role of Mn in water splitting is a frequently asked question in competitive exams.

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

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

Correct Answer: (C) insect pollinated plants

Solution:

Step 1: Understanding the Question:

The question provides 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 have co-evolved with their specific pollinators.

Step 2: Detailed Explanation:

Let's analyze the given characteristics and how they function to attract pollinators:

- **Large and Colourful:** These are visual attractants to make the flower conspicuous to pollinators, especially those with good vision, like insects and birds.
- **Fragrant:** Scent is an olfactory attractant, effective for drawing in pollinators from a distance, particularly insects, which often have a highly developed sense of smell.
- **Nectar:** This is a food reward (a sugary liquid) for the pollinator, encouraging them to visit the flower and, in the process, transfer pollen.

Now let's match this set of features with the different types of pollinators:

- **(A) Bat pollinated (Chiropterophily):** Flowers are typically large but dull-colored (white or pale green), open at night, and have a strong, musty, or fermented fruit-like odor. They produce copious nectar. This does not match the 'colourful' and 'fragrant' (in a pleasant way) description.
- **(B) Wind pollinated (Anemophily):** Flowers are small, inconspicuous, lack colour, scent, and nectar. They produce large amounts of light, dry pollen. This is the opposite of the given description.
- **(C) Insect pollinated (Entomophily):** This is the classic syndrome. Flowers are often large, brightly coloured, have a sweet fragrance, and produce nectar to attract a wide variety of insects like bees, butterflies, and moths. This perfectly matches all the given characteristics.
- **(D) Bird pollinated (Ornithophily):** Flowers are typically large and brightly coloured (especially red or orange), produce a large amount of watery nectar, but are usually odorless because birds have a poor sense of smell. This does not match the 'fragrant' characteristic.

Step 3: Final Answer:

The combination of large, colourful, fragrant flowers with nectar is characteristic of insect pollinated plants.

Quick Tip

To solve pollination syndrome questions, think logically about the senses and needs of the pollinator.

- **Wind:** No need for attraction. Flowers are simple.
- **Insects:** Good vision (colour) and smell (fragrance). Need food (nectar).
- **Birds:** Excellent vision (bright colours), poor smell (no fragrance needed). High metabolism (lots of nectar).
- **Bats:** Nocturnal, so vision is less important (dull colour), but smell is key (strong odor).

126. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: The first stage of gametophyte in the life cycle of moss is protonema stage.

Reason R: Protonema develops directly from spores produced in capsule.

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

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

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

Solution:

Step 1: Understanding the Question:

This is an Assertion-Reason question concerning the life cycle of mosses (Bryophytes). We must assess the validity of both statements and determine if the reason correctly explains the assertion.

Step 2: Detailed Explanation:

- **Analysis of Assertion A:** The life cycle of a moss includes a dominant gametophyte stage. This gametophyte develops in two distinct phases. When a haploid spore germinates, it first grows into a creeping, green, branched, and frequently filamentous stage called the **protonema**. This is the juvenile gametophyte. Later, a leafy, upright stage, known as the leafy gametophore, develops from a bud on the protonema. Therefore, the statement that the first stage of the gametophyte is the protonema is **true**.

- **Analysis of Reason R:** In the moss life cycle, the diploid sporophyte develops a structure called the capsule. Inside the capsule, meiosis occurs to produce haploid spores. These spores are then dispersed, and upon finding a suitable moist substrate, they germinate and develop directly into the protonema. Therefore, the statement that the protonema develops directly from spores produced in the capsule is also **true**.
- **Analysis of the relationship between A and R:** The reason provides the developmental origin of the protonema. The fact that the protonema develops directly from the germinating spore (Reason R) is precisely why it is considered the first stage of the gametophyte's development (Assertion A). Thus, the reason correctly and logically explains the assertion.

Step 3: Final Answer:

Both Assertion A and Reason R are correct, and Reason R is the correct explanation for Assertion A.

Quick Tip

Remember the developmental sequence of the moss gametophyte: Spore → Germination → Protonema (first/juvenile stage) → Bud → Leafy gametophore (second/adult stage). This sequence clearly shows that the protonema is the first stage and that it originates from the spore.

127. Cellulose does not form blue colour with Iodine because

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

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

Solution:

Step 1: Understanding the Question:

The question asks for the reason why cellulose does not give a positive iodine test (blue-black colour), unlike starch.

Step 2: Detailed Explanation:

The iodine test is specific for the presence of starch. Starch, particularly the amylose component, has a helical secondary structure. When iodine solution is added, the iodine molecules

(specifically, triiodide ions, I_3^-) get trapped inside these helical coils. This complex of starch-iodine absorbs light, resulting in a characteristic blue-black colour.

Cellulose, on the other hand, is a polysaccharide composed of β -glucose units linked by β -1,4 glycosidic bonds. This structure results in straight, linear chains that do not form helices. These linear chains are arranged parallel to each other and are held together by hydrogen bonds, forming strong microfibrils.

Because cellulose lacks the helical structure necessary to trap iodine molecules, no colour change occurs when iodine is added.

Let's analyze the other options:

(B) Cellulose is a very stable polymer and does not break down upon reaction with iodine.

(C) Cellulose is a polysaccharide, not a disaccharide. A disaccharide is made of two sugar units (e.g., sucrose).

(D) Cellulose is a linear molecule, not a helical one. Starch (amylose) is the helical molecule.

Step 3: Final Answer:

The correct reason is that cellulose does not have the complex helical structure required to hold iodine molecules. Therefore, option (A) is the correct answer.

Quick Tip

Remember the structural difference: Starch (amylose) is a **helical** polymer of α -glucose, which traps iodine. Cellulose is a **linear** polymer of β -glucose, which cannot trap iodine. This structural difference is key to many of their properties.

128. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: ATP is used at two steps in glycolysis.

Reason R : First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1,6-diphosphate.

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

(A) A is true but R is false.

(B) A is false but R is true.

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

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

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

Solution:

Step 1: Understanding the Question:

The question presents an assertion and a reason related to the energy investment phase of

glycolysis. We need to evaluate the truthfulness of both statements and determine if the reason correctly explains the assertion.

Step 2: Detailed Explanation:

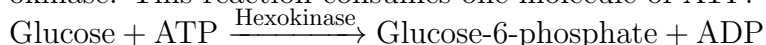
Analyzing Assertion A: "ATP is used at two steps in glycolysis."

Glycolysis is a 10-step process that breaks down glucose. The first phase is the "preparatory" or "energy investment" phase, where the cell puts in energy to get the process started. In this phase, ATP is indeed consumed at two distinct steps. So, Assertion A is **true**.

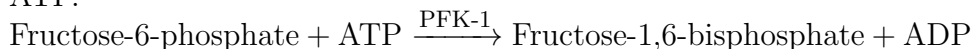
Analyzing Reason R: "First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1,6-diphosphate."

Let's examine the specific steps:

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



Step 3 of Glycolysis: Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate by the enzyme phosphofructokinase-1 (PFK-1). This reaction consumes a second molecule of ATP.



The reason correctly identifies the exact two steps where ATP is consumed. So, Reason R is also **true**.

Step 3: Correlating Assertion and Reason:

Since Reason R precisely describes the two steps where ATP is used, it serves as the correct and complete explanation for Assertion A.

Step 4: Final Answer:

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

Quick Tip

For Assertion-Reason questions, follow a systematic approach: 1. Check if Assertion (A) is true or false. 2. Check if Reason (R) is true or false. 3. If both are true, check if R is the correct explanation for A by asking "Why is A true?" If the answer is R, then it's the correct explanation.

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

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

Correct Answer: (D) 1992

Solution:

Step 1: Understanding the Question:

The question asks for the year in which the historic "Earth Summit," where the Convention on Biological Diversity was introduced, took place in Rio de Janeiro.

Step 2: Detailed Explanation:

This is a fact-based question from the topic of environmental issues and conservation.

The United Nations Conference on Environment and Development (UNCED), popularly known as the "Earth Summit," was held in Rio de Janeiro, Brazil.

This landmark event took place from June 3 to June 14, **1992**.

One of the key outcomes of this summit was the opening for signature of the Convention on Biological Diversity (CBD), a multilateral treaty with objectives including the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

The other options are incorrect:

- 2002: The World Summit on Sustainable Development was held in Johannesburg.
- 1986 and 1985 are not associated with the Earth Summit.

Step 3: Final Answer:

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

Quick Tip

For environmental science topics, create a timeline of major international conferences and agreements. Key events to remember include the Stockholm Conference (1972), the Rio Earth Summit (1992), the Kyoto Protocol (1997), and the Paris Agreement (2015).

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

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

Correct Answer: (B) Active Transport

Solution:

Step 1: Understanding the Question:

The question describes the transport of ions across a cell membrane. The key phrase is "against their concentration gradient," which means moving from a region of lower concentration to a region of higher concentration.

Step 2: Detailed Explanation:

Let's analyze the types of transport listed in the options:

(A) Passive Transport: This is the movement of substances across a membrane **down** the concentration gradient (from high to low concentration). It does not require metabolic energy. Simple diffusion is a form of passive transport.

(C) Osmosis: This is a specific type of passive transport referring to the movement of water molecules across a semi-permeable membrane from a region of high water potential to a region of low water potential.

(D) Facilitated Diffusion: This is also a type of passive transport where substances move **down** the concentration gradient, but with the help of membrane proteins (channel or carrier proteins). It does not require metabolic energy.

(B) Active Transport: This is the movement of substances **against** their concentration gradient. This process is like pumping something uphill; it requires energy, which is typically supplied by ATP hydrolysis. It also requires specific carrier proteins in the membrane.

Since the question specifies movement "against their concentration gradient," this requires an input of energy and is the defining characteristic of active transport.

Step 3: Final Answer:

The movement of ions against a concentration gradient is explained by Active Transport. Therefore, option (B) is the correct answer.

Quick Tip

Remember the key difference: **Passive** processes (diffusion, osmosis, facilitated diffusion) are "downhill" (with the gradient) and require no energy. **Active** transport is "uphill" (against the gradient) and requires energy (ATP).

131. Axile placentation is observed in

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

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

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

In **axile placentation**, the placenta is axial, and the ovules are attached to it in a multilocular ovary (an ovary with multiple chambers or locules). This is characteristic of plants with a syncarpous (fused carpels) ovary. Common examples include China rose (Hibiscus), tomato, lemon, and Petunia.

Let's analyze the options based on their placentation types:

(A) Tomato, Dianthus and Pea:

- Tomato: Axile placentation.
- Dianthus: Free-central placentation.
- Pea: Marginal placentation.

This option is incorrect.

(B) China rose, Petunia and Lemon:

- China rose (Hibiscus): Axile placentation.
- Petunia: Axile placentation.
- Lemon: Axile placentation.

This option contains only plants with axile placentation.

(C) Mustard, Cucumber and Primrose:

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

This option is incorrect.

(D) China rose, Beans and Lupin:

- China rose: Axile placentation.
- Beans (like Pea): Marginal placentation.
- Lupin: Marginal placentation.

This option is incorrect.

Step 3: Final Answer:

The group of plants that all show axile placentation is China rose, Petunia, and Lemon. Therefore, option (B) is the correct answer.

Quick Tip

Use mnemonics to remember examples for placentation types. For Axile: "Axile in China's Tomato Lemon Petunias" (China rose, Tomato, Lemon, Petunia). For Marginal: "Pea Bean Grams on the Margin" (Pea, Bean, Gram).

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

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

Correct Answer: (D) DNA

Solution:

Step 1: Understanding the Question:

The question asks which molecule is precipitated out when chilled ethanol is added during the purification step in recombinant DNA technology. This refers to the process of isolating DNA from a cell lysate.

Step 2: Detailed Explanation:

The process of isolating DNA involves several steps:

1. **Lysis:** Breaking open the cells (e.g., bacterial, plant, or animal cells) to release their contents, including DNA. This is done using detergents.
2. **Removal of contaminants:** The cell lysate contains DNA, RNA, proteins (like histones), lipids, and polysaccharides. Enzymes like proteases (to digest proteins) and ribonucleases (to digest RNA) are added to remove these contaminants.
3. **Precipitation of DNA:** After removing other macromolecules, the goal is to isolate the DNA from the aqueous solution. DNA is a polar molecule and is soluble in water, but it is insoluble in ethanol. When chilled ethanol is added to the aqueous solution containing DNA, the DNA precipitates out of the solution. The low temperature reduces the solubility further. The precipitated DNA can be seen as fine white threads, which can be spooled out from the solution. This technique is called **ethanol precipitation**. Other molecules like RNA (if not fully digested), sugars (polysaccharides), and remaining proteins are generally more soluble in the ethanol-water mixture and stay in the solution.

Step 3: Final Answer:

The addition of chilled ethanol specifically causes the precipitation of DNA. Therefore, option (D) is the correct answer.

Quick Tip

A key principle in biotechnology is that DNA is soluble in water but insoluble in alcohol (like ethanol or isopropanol). This property is exploited universally for concentrating and purifying DNA from aqueous solutions.

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

- (A) G₁ phase
- (B) G₂ phase
- (C) M phase
- (D) S phase

Correct Answer: (D) S phase

Solution:

Step 1: Understanding the Question:

The question asks to identify the specific phase of the eukaryotic cell cycle during which DNA replication occurs.

Step 2: Detailed Explanation:

The eukaryotic cell cycle is divided into two main stages: Interphase and M phase (Mitotic phase).

Interphase is the period of growth and preparation for cell division. It is further subdivided into three phases:

- **G₁ phase (Gap 1):** This is the first growth phase where the cell grows in size and synthesizes proteins and RNA. The cell is metabolically active.
- **S phase (Synthesis phase):** This is the phase where DNA replication occurs. At the end of the S phase, each chromosome consists of two sister chromatids, and the amount of DNA in the cell has doubled (from 2C to 4C), but the chromosome number (ploidy) remains the same.
- **G₂ phase (Gap 2):** This is the second growth phase where the cell continues to grow and synthesizes proteins and organelles in preparation for mitosis.

M phase (Mitotic phase) is the stage of actual cell division, which includes mitosis (nuclear division) and cytokinesis (cytoplasmic division).

Therefore, the replication of DNA specifically takes place during the S phase of interphase.

Step 3: Final Answer:

DNA replication in eukaryotes occurs during the S phase. Hence, option (D) is the correct answer.

Quick Tip

Associate the letters of the cell cycle phases with their key events: **G** for Growth (G₁ and G₂), **S** for Synthesis of DNA, and **M** for Mitosis. This simple association can help you quickly recall the function of each phase.

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

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

Correct Answer: (D) 18 ATP and 12 NADPH₂

Solution:

Step 1: Understanding the Question:

The question asks for the total number of ATP and NADPH₂ molecules required to synthesize one molecule of glucose ($C_6H_{12}O_6$) through the Calvin cycle. (Note: NADPH₂ is an older notation for NADPH + H⁺).

Step 2: Key Formula or Approach:

To synthesize one molecule of glucose, which is a 6-carbon sugar, the Calvin cycle must fix 6 molecules of carbon dioxide (CO_2). We need to calculate the energy requirements for these 6 turns of the cycle.

Step 3: Detailed Explanation:

The Calvin cycle has three main stages: Carboxylation, Reduction, and Regeneration. Let's analyze the energy usage per molecule of CO_2 fixed (i.e., per one turn of the cycle):

1. **Carboxylation:** Fixation of one CO_2 molecule onto Ribulose-1,5-bisphosphate (RuBP). This step does not require ATP or NADPH.
2. **Reduction:** The resulting 3-PGA molecules are converted into Glyceraldehyde-3-phosphate (G3P). This stage consumes: - 2 molecules of ATP - 2 molecules of NADPH
3. **Regeneration:** The RuBP molecule is regenerated from G3P to continue the cycle. This stage consumes: - 1 molecule of ATP

Total for one turn (1 CO_2 fixed):

- ATP required = 2 (from Reduction) + 1 (from Regeneration) = **3 ATP**
- NADPH required = 2 (from Reduction) = **2 NADPH**

To synthesize one molecule of glucose ($C_6H_{12}O_6$), we need to fix 6 molecules of CO_2 . Therefore, the cycle must run 6 times.

Total for six turns (for 1 Glucose molecule):

- Total ATP = (ATP per turn) $\times$ 6 = 3 ATP $\times$ 6 = **18 ATP**
- Total NADPH = (NADPH per turn) $\times$ 6 = 2 NADPH $\times$ 6 = **12 NADPH**

Step 4: Final Answer:

The synthesis of one molecule of glucose requires 18 ATP and 12 NADPH₂. Therefore, option (D) is the correct answer.

Quick Tip

Memorize the stoichiometry for a single turn of the Calvin cycle: $1\text{ CO}_2 + 3\text{ ATP} + 2\text{ NADPH} \rightarrow (1/6)\text{ Glucose}$. To get the requirement for a full glucose molecule, simply multiply everything by 6.

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

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

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

Solution:

Step 1: Understanding the Question:

The question asks to identify a sequence of structures from a fertilized embryo sac that are haploid (n), diploid (2n), and triploid (3n), in that specific order.

Step 2: Detailed Explanation:

Let's first determine the ploidy level of the various structures within a mature, fertilized embryo sac in an angiosperm. This involves understanding the process of double fertilization.

- **Haploid (n) structures:** The mature female gametophyte (embryo sac) contains several haploid cells before fertilization: the egg cell, two synergids, and three antipodal cells. After fertilization, the synergids and antipodals degenerate, but they are initially haploid. The male gametes are also haploid.

- **Diploid (2n) structure:** One male gamete (n) fuses with the egg cell (n) in a process called syngamy. This results in the formation of a diploid **Zygote** (2n), which develops into the embryo.

- **Triploid (3n) structure:** The second male gamete (n) fuses with the two polar nuclei (n + n) located in the central cell. This process, called triple fusion, results in the formation of the **Primary Endosperm Nucleus (PEN)** (3n), which develops into the endosperm, a nutritive tissue.

Now let's check the options for the required sequence: Haploid (n) → Diploid (2n) → Triploid (3n).

(A) Synergids, Zygote and Primary endosperm nucleus:

- Synergids: Haploid (n)
- Zygote: Diploid (2n)
- Primary endosperm nucleus (PEN): Triploid (3n)

This sequence (n, 2n, 3n) matches the question's requirement.

(B) Synergids, antipodals and Polar nuclei:

- Synergids: Haploid (n)
- Antipodals: Haploid (n)
- Polar nuclei: (n + n)

This sequence is incorrect.

(C) Synergids, Primary endosperm nucleus and zygote:

- Synergids: Haploid (n)
- Primary endosperm nucleus: Triploid (3n)
- Zygote: Diploid (2n)

The sequence (n, 3n, 2n) is incorrect.

(D) Antipodals, synergids, and primary endosperm nucleus:

- Antipodals: Haploid (n)
- Synergids: Haploid (n)
- Primary endosperm nucleus: Triploid (3n)

This sequence is incorrect.

Step 3: Final Answer:

The correct sequence representing haploid, diploid, and triploid structures is Synergids, Zygote, and Primary endosperm nucleus. Therefore, option (A) is the correct answer.

Quick Tip

Double fertilization is a unique feature of angiosperms. Remember the two key fusions:

1. **Syngamy:** Male gamete (n) + Egg (n) → Zygote (2n).
2. **Triple Fusion:** Male gamete (n) + Central Cell (2 polar nuclei, n+n) → PEN (3n).

136. Match List I with List II:

List I (Interaction)

- A. Mutualism
- B. Commensalism
- C. Amensalism
- D. Parasitism

List II (Species A and B)

- I. +(A), O(B)
- II. -(A), O(B)
- III. +(A), -(B)
- IV. +(A), +(B)

Choose the correct answer from the options given below :

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

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

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

Solution:

Step 1: Understanding the Question:

The question requires matching different types of population interactions (List I) with their corresponding effects on the two interacting species, A and B (List II). The symbols represent: '+' for a beneficial effect, '-' for a detrimental effect, and 'O' for no effect.

Step 2: Detailed Explanation:

Let's analyze each interaction type from List I and match it with the correct representation from List II.

- **A. Mutualism:** This is an interaction where both species benefit from each other. Therefore, the effect is positive for both Species A and Species B. This corresponds to $+(A)$, $+(B)$, which is option **IV**.
- **B. Commensalism:** In this interaction, one species benefits while the other is neither harmed nor benefited (unaffected). This corresponds to $+(A)$, $O(B)$, which is option **I**.
- **C. Amensalism:** This is an interaction where one species is harmed, and the other is unaffected. This corresponds to $-(A)$, $O(B)$, which is option **II**.
- **D. Parasitism:** In this interaction, one species (the parasite) benefits at the expense of the other (the host), which is harmed. This corresponds to $+(A)$, $-(B)$, which is option **III**. (Assuming species A is the parasite and B is the host).

Step 3: Matching the pairs:

Based on the analysis above:

A matches with IV.

B matches with I.

C matches with II.

D matches with III.

This combination is **A-IV, B-I, C-II, D-III**.

Step 4: Final Answer:

The correct set of matches is A-IV, B-I, C-II, D-III, which is given in option (4).

Quick Tip

To easily remember these interactions, create a simple chart with columns for Species A, Species B, and the Interaction type. Use '+', '-', and 'O' symbols. This visual aid helps in quickly recalling the effects during an exam. For example:

- Mutualism: (+, +)
- Commensalism: (+, O)
- Amensalism: (-, O)
- Parasitism/Predation: (+, -)
- Competition: (-, -)

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

Correct Answer: (1) A-III, B-I, C-IV, D-II

Solution:

Step 1: Understanding the Question:

The question asks to match the micronutrients in List I with their specific physiological roles or functions in plants listed in List II.

Step 2: Detailed Explanation:

Let's analyze the function of each micronutrient:

- **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. Therefore, Iron matches with **III. Activator of catalase.**

- **B. Zinc (Zn):** Zinc is required for the synthesis of auxins, specifically for the synthesis of tryptophan, which is a precursor to auxin. It also activates various enzymes, like carboxylases. Therefore, Zinc matches with **I. Synthesis of auxin.**
- **C. Boron (B):** Boron is essential for Ca^{2+} uptake and utilisation, membrane functioning, pollen germination, and cell elongation and differentiation. Therefore, Boron matches with **IV. Cell elongation and differentiation.**
- **D. Molybdenum (Mo):** Molybdenum is a component of several enzymes, including nitrate reductase and nitrogenase, both of which are critical for nitrogen metabolism in plants. Therefore, Molybdenum matches with **II. Component of nitrate reductase.**

Step 3: Matching the pairs:

Based on the functions:

A matches with III.

B matches with I.

C matches with IV.

D matches with II.

This combination is **A-III, B-I, C-IV, D-II.**

Step 4: Final Answer:

The correct set of matches is A-III, B-I, C-IV, D-II, which corresponds to option (1).

Quick Tip

Create flashcards for essential micronutrients and their key functions. Focus on unique roles, such as Mo in nitrogen metabolism (nitrate reductase, nitrogenase) and Zn in auxin synthesis, as these are frequently asked in exams.

138. Identify the correct statements :

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

Choose the correct answer from the options given below :

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

(D) A and D only

Correct Answer: (4) A and D only

Solution:

Step 1: Understanding the Question:

The question requires us to evaluate five statements related to plant anatomy, specifically about bark and associated structures, and identify which of them are correct.

Step 2: Detailed Explanation:

Let's analyze each statement:

- **Statement A: Lenticels are the lens-shaped openings permitting the exchange of gases.** This is **correct**. Lenticels are porous tissues consisting of cells with large inter-cellular spaces in the periderm of secondarily thickened organs, such as stems and roots of woody plants. They function as pores for direct gas exchange between the internal tissues and the atmosphere.
- **Statement B: Bark formed early in the season is called hard bark.** This is **incorrect**. Bark formed early in the season (spring) is known as 'early' or 'soft' bark. Bark formed towards the end of the season (autumn) is called 'late' or 'hard' bark.
- **Statement C: Bark is a technical term that refers to all tissues exterior to vascular cambium.** This statement is misleading. While "bark" in a broad, non-technical sense refers to all tissues outside the vascular cambium, it is not a strictly technical term. More precise technical terms are periderm, phloem, etc. Statement D provides a more accepted definition.
- **Statement D: Bark refers to periderm and secondary phloem.** This is a commonly accepted and more precise definition of bark in botany. It includes all tissues lying outside the vascular cambium. The bark is composed of the periderm (phellem, phellogen, phelloderm) and the secondary phloem. This statement is considered **correct**.
- **Statement E: Phellogen is single-layered in thickness.** This is **incorrect**. Phellogen, also known as cork cambium, is a meristematic tissue. It is typically a couple of layers thick, not a single layer, as it divides to produce cork (phellem) on the outside and secondary cortex (phelloderm) on the inside.

Step 3: Identifying the correct statements:

From the analysis, only statements A and D are correct.

Step 4: Final Answer:

The option that includes only the correct statements (A and D) is option (4).

Quick Tip

In plant anatomy, distinguish between technical and non-technical terms. 'Bark' is a good example. While it generally means 'everything outside the wood (xylem)', its precise composition (periderm + secondary phloem) is important for exams. Remember that all cambium tissues (vascular cambium, phellogen) are meristematic and thus consist of multiple layers of dividing cells.

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

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

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

Solution:**Step 1: Understanding the Question:**

The question asks for the essential components required for the process of chemiosmosis. Chemiosmosis is the mechanism by which ATP is produced during cellular respiration and photosynthesis.

Step 2: Detailed Explanation:

The chemiosmotic theory, proposed by Peter Mitchell, explains the coupling of electron transport to ATP synthesis. The process requires four key components:

1. **A Membrane:** A selectively permeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is necessary to establish and maintain a concentration gradient of protons. It separates a region of high proton concentration from a region of low proton concentration.
2. **A Proton Pump:** This component uses energy, typically from the flow of electrons through an electron transport chain, to actively transport protons (H^+ ions) across the membrane from one side to the other. This action creates the proton gradient.
3. **A Proton Gradient:** The pumping of protons results in a higher concentration of H^+ on one side of the membrane. This gradient of protons, also known as the proton-motive

force, is a form of stored potential energy.

4. **ATP Synthase:** This is a large enzyme complex embedded in the membrane. It provides a channel through which protons can flow back down their concentration gradient. The kinetic energy from this proton flow is used by ATP synthase to catalyze the synthesis of ATP from ADP and inorganic phosphate (Pi).

Step 3: Evaluating the Options:

- (1) proton pump, electron gradient, ATP synthase: This is incomplete as it misses the essential membrane, and it mentions an "electron gradient" instead of the crucial "proton gradient".
- (2) proton pump, electron gradient, NADP synthase: Incorrect. NADP synthase is involved in producing NADPH in photosynthesis, not ATP synthesis via chemiosmosis, and it misses the membrane and proton gradient.
- (3) membrane, proton pump, proton gradient, ATP synthase: This option correctly lists all four essential components for chemiosmosis.
- (4) membrane, proton pump, proton gradient, NADP synthase: Incorrect. It replaces the essential ATP synthase with NADP synthase.

Step 4: Final Answer:

The correct combination of components required for chemiosmosis is given in option (3).

Quick Tip

Think of chemiosmosis like a hydroelectric dam. The **membrane** is the dam. The **proton pump** is the pump that moves water up to the reservoir. The **proton gradient** is the stored water at a high level. The **ATP synthase** is the turbine that generates electricity (ATP) as the water flows down. This analogy helps remember all four key components.

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

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

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:

The question asks to arrange the given steps of recombinant DNA technology in the correct chronological order.

Step 2: Detailed Explanation of the Steps:

The process of creating a recombinant DNA molecule and introducing it into a host organism generally follows a specific sequence:

1. **C. Isolation of desired DNA fragment:** The first step is to obtain the gene of interest. This involves isolating the DNA from the source organism and then separating the desired gene from the rest of the DNA.
2. **B. Cutting of DNA at specific location by restriction enzyme:** Once the DNA (both the gene of interest and the vector DNA, like a plasmid) is isolated, it must be cut. Restriction enzymes are used to cut the DNA at specific recognition sites. The same enzyme is used for both the gene and the vector to create compatible 'sticky ends'.
3. **D. Amplification of gene of interest using PCR:** To get a sufficient quantity of the gene of interest for the subsequent steps, it is amplified using the Polymerase Chain Reaction (PCR). This step generates millions of copies of the specific DNA fragment. While PCR can be done at different stages, it is most commonly performed after isolating the gene and before ligating it into a vector. After cutting, the gene is ligated into the cut vector.
4. **A. Insertion of recombinant DNA into the host cell:** After the gene of interest is ligated into the vector (forming recombinant DNA), this new molecule is introduced into a suitable host cell (like a bacterium) through a process called transformation. The host cell will then replicate, making many copies of the recombinant DNA.

Step 3: Determining the Correct Sequence:

Based on the standard protocol for recombinant DNA technology, the logical order of the given steps is:

Isolation (C) → Cutting (B) → Amplification (D) → Insertion (A).

Therefore, the correct sequence is C, B, D, A.

Step 4: Final Answer:

The correct sequence of steps is C, B, D, A, which corresponds to option (1).

Quick Tip

Remember the acronym **I-C-A-I**: Isolation, Cutting, Amplification (and Ligation), Insertion. This simple mnemonic can help you recall the correct order of the main steps in recombinant DNA technology during an exam.

141. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

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

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

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

Solution:

Step 1: Understanding the Question:

This question consists of two statements, an Assertion (A) and a Reason (R). We need to evaluate the truthfulness of both statements and determine if the Reason correctly explains the Assertion.

Step 2: Evaluating Assertion A:

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

This statement is **true**. Gymnosperms, such as conifers (pines), cycads, and Ginkgo, predominantly rely on wind pollination (anemophily). The pollen grains, which are produced in the microsporangia (pollen sacs), are lightweight and often winged, facilitating their dispersal by air currents over long distances.

Step 3: Evaluating Reason R:

Reason R: Air currents carry the pollen grains to the mouth of the archegonia

where the male gametes are discharged and pollen tube is not formed.

This statement is **false**. Let's break it down:

- "Air currents carry the pollen grains to the mouth of the archegonia": The pollen lands on the ovule, typically near the micropyle, not directly at the mouth of the archegonia which is located deep inside the ovule.
- "where the male gametes are discharged and pollen tube is not formed": This is the key error. A defining feature of seed plants, including gymnosperms, is siphonogamy, which is the formation of a pollen tube. After landing on the nucellus of the ovule, the pollen grain germinates and forms a pollen tube. This tube grows through the nucellus tissue and carries the non-motile male gametes to the archegonium for fertilization. The pollen tube is essential for fertilization.

Since the statement claims a pollen tube is not formed, the Reason (R) is definitively false.

Step 4: Final Answer:

Assertion (A) is true, and Reason (R) is false. This corresponds to option (1).

Quick Tip

Remember that the development of the pollen tube (siphonogamy) is a major evolutionary advancement in seed plants (gymnosperms and angiosperms). It eliminated the need for water for fertilization, allowing these plants to colonize terrestrial environments more effectively. Any statement claiming its absence in gymnosperms is incorrect.

136. Match List I with List II:

List I (Interaction)

- A. Mutualism
- B. Commensalism
- C. Amensalism
- D. Parasitism

List II (Species A and B)

- I. +(A), O(B)
- II. -(A), O(B)
- III. +(A), -(B)
- IV. +(A), +(B)

Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:

The question asks to match the type of ecological interaction (List I) with its correct representation in terms of benefit (+), harm (-), or no effect (0) on the interacting species (List II).

Step 2: Detailed Explanation:

Let's analyze each type of interaction:

A. Mutualism: This is an interaction where both species A and species B benefit from the association. The correct representation is (+, +). This corresponds to **IV. +(A), +(B)**.

B. Commensalism: In this interaction, one species (A) benefits, while the other species (B) is neither harmed nor benefited (unaffected). The correct representation is (+, 0). This corresponds to **I. +(A), O(B)**.

C. Amensalism: This is an interaction where one species (A) is harmed, and the other species (B) is unaffected. The correct representation is (-, 0). This corresponds to **II. -(A), O(B)**.

D. Parasitism: In this interaction, one species (the parasite, A) benefits at the expense of the other species (the host, B), which is harmed. The correct representation is (+, -). This corresponds to **III. +(A), -(B)**.

Step 3: Matching the Lists:

Based on the analysis above:

- A matches with IV.
- B matches with I.
- C matches with II.
- D matches with III.

Step 4: Final Answer:

The correct combination is A-IV, B-I, C-II, D-III. This matches option (4).

Quick Tip

For population interaction questions, always remember the symbols: '+' for benefit, '-' for harm, and '0' for neutral (no effect). Create a quick table of all interactions (Mutualism, Commensalism, Amensalism, Parasitism, Predation, Competition) with their symbolic representations for easy revision.

137. 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-I, C-IV, D-II

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

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

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

Correct Answer: (1) A-III, B-I, C-IV, D-II

Solution:

Step 1: Understanding the Question:

The question requires matching the micronutrients in List I with their specific functions in plants from List II.

Step 2: Detailed Explanation:

Let's analyze the function of each micronutrient:

A. Iron (Fe): Iron is an important constituent of proteins involved in the transfer of electrons like ferredoxin and cytochromes. It is reversibly oxidised from Fe^{2+} to Fe^{3+} during electron transfer. It activates the catalase enzyme and is essential for the formation of chlorophyll. Thus, Iron is an **Activator of catalase**. This matches **III**.

B. Zinc (Zn): Zinc is required for the activity of various enzymes, especially carboxylases. It is also needed for the **synthesis of auxin**. This matches **I**.

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

D. Molybdenum (Mo): Molybdenum is a component of several enzymes, including nitrogenase and **nitrate reductase**, both of which participate in nitrogen metabolism. This matches **II**.

Step 3: Matching the Lists:

- A matches with III.
- B matches with I.
- C matches with IV.
- D matches with II.

Step 4: Final Answer:

The correct combination is A-III, B-I, C-IV, D-II. This corresponds to option (1).

Quick Tip

Mineral nutrition is a memory-intensive topic. Create flashcards or a summary table for all essential macro- and micronutrients, listing their key functions and deficiency symptoms. Pay special attention to the elements that act as enzyme activators.

138. Identify the correct statements :

- A. Lenticels are the lens-shaped openings permitting the exchange of gases.**
- B. Bark formed early in the season is called hard bark.**
- C. Bark is a technical term that refers to all tissues exterior to vascular cambium.**
- D. Bark refers to periderm and secondary phloem.**
- E. Phellogen is single-layered in thickness.**

Choose the correct answer from the options given below :

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

Correct Answer: (4) A and D only

Solution:

Step 1: Understanding the Question:

The question asks to identify which of the given statements about plant anatomy are correct.

Step 2: Detailed Explanation:

Let's evaluate each statement:

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

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

C. Bark is a technical term that refers to all tissues exterior to vascular cambium. This statement is **incorrect**. Bark is a non-technical term. In botany, more precise terms like periderm, phloem, etc., are used.

D. Bark refers to periderm and secondary phloem. This statement is **correct**. The term bark collectively includes all tissues outside the vascular cambium, which are the periderm (cork, cork cambium, secondary cortex) and the secondary phloem.

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

Step 3: Final Answer:

Based on the analysis, only statements A and D are correct. Therefore, the correct option is (4).

Quick Tip

In plant anatomy, pay close attention to the definitions of terms like bark, periderm, stele, etc. Note whether a term is technical or non-technical, as this can be a key point in 'identify the correct/incorrect statement' questions.

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

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

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

Solution:

Step 1: Understanding the Question:

The question asks 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:

Chemiosmosis requires four key components:

- 1. Membrane:** A selectively permeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is necessary to establish and maintain a concentration gradient.
- 2. Proton Pump:** An energy-releasing process, such as the electron transport chain, powers pumps that actively transport protons (H^+ ions) across the membrane from a region of low concentration to a region of high concentration.
- 3. Proton Gradient:** The accumulation of protons on one side of the membrane creates a proton motive force, which is a form of potential energy. This is also called a proton gradient or electrochemical gradient.
- 4. ATP Synthase:** This is a membrane-bound enzyme complex that allows protons to flow back across the membrane down their concentration gradient. The energy released from this flow is used by ATP synthase to phosphorylate ADP, forming ATP.

Step 3: Analyzing the Options:

- Option (1) is incomplete as it misses the essential membrane and mentions an electron gradient instead of the direct driving force, the proton gradient.
- Option (2) incorrectly lists NADP synthase, which is involved in producing NADPH, not ATP via chemiosmosis.
- Option (3) correctly lists all four essential components: the membrane, the proton pump, the proton gradient, and ATP synthase.

- Option (4) incorrectly lists NADP synthase instead of ATP synthase.

Step 4: Final Answer:

The combination that accurately lists all the requirements for chemiosmosis is given in option (3).

Quick Tip

To remember the components of chemiosmosis, visualize the process. Picture the membrane as a dam, the proton pump as building up water (protons) behind the dam, the proton gradient as the stored water's potential energy, and ATP synthase as the turbine through which water flows to generate electricity (ATP).

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

- A. Insertion of recombinant DNA into the host cell.
 - B. Cutting of DNA at specific location by restriction enzyme.
 - C. Isolation of desired DNA fragment.
 - D. Amplification of gene of interest using PCR.
- Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:

The question asks to arrange the given steps of recombinant DNA (rDNA) technology in the correct chronological order.

Step 2: Detailed Explanation:

Let's analyze the logical flow of creating a recombinant organism:

The overall goal is to take a gene of interest from one organism and put it into another.

C. Isolation of desired DNA fragment: The very first step is to obtain the gene you want to work with. This involves isolating the DNA and then the specific gene fragment. So, C is the starting point.

B. Cutting of DNA at specific location by restriction enzyme: Once you have the gene of interest and a vector (like a plasmid), you need to cut both with the same restriction enzyme to create compatible (sticky) ends. This prepares them for ligation. This step logically follows

the isolation of the gene.

D. Amplification of gene of interest using PCR: Polymerase Chain Reaction (PCR) is used to make multiple copies of the desired gene. This ensures that there is enough of the gene fragment to be ligated into the vectors. This step is usually performed after isolating the gene and before ligation and insertion. So it comes after B.

A. Insertion of recombinant DNA into the host cell: After the gene of interest is ligated into the vector (an implied step after B and D), the resulting recombinant DNA is introduced into a host cell (like a bacterium) in a process called transformation. This is the final step among the given options.

Step 3: Arranging the Sequence:

Based on this logic, the correct sequence is:

1. **C** (Isolation of desired DNA fragment)
2. **B** (Cutting of DNA)
3. **D** (Amplification using PCR)
4. **A** (Insertion into host cell)

This corresponds to the sequence C, B, D, A.

Step 4: Final Answer:

The correct sequence is C, B, D, A, which matches option (1).

Quick Tip

Remember the acronym R-I-C-L-I-C-E for the steps of Recombinant DNA technology: Restriction digestion (Cutting), Isolation, C-DNA formation (optional), Ligation, Insertion, Culturing, and Extraction of the product. This can help you quickly arrange the steps in order.

141. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

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

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

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

Solution:

Step 1: Understanding the Question:

The question presents an Assertion (A) and a Reason (R) related to the reproductive process in gymnosperms. We need to evaluate the truthfulness of both statements and determine if R is the correct explanation for A.

Step 2: Evaluating Assertion A:

Assertion A: In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

This statement is **true**. Gymnosperms are predominantly anemophilous, meaning they are wind-pollinated. The pollen grains, which develop in the microsporangium (pollen sac), are light and produced in large quantities to facilitate dispersal by wind.

Step 3: Evaluating Reason R:

Reason R: Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

This statement is **false**. While air currents do carry the pollen grains, they carry them to the opening of the ovules (micropyle), not directly to the archegonia. After landing on the nucellus, the pollen grain germinates and forms a **pollen tube**. This pollen tube grows towards the archegonium and carries the male gametes to the egg cell for fertilization. The formation of a pollen tube is a characteristic feature of all seed plants (spermatophytes), including gymnosperms. The statement explicitly says "pollen tube is not formed," which is incorrect.

Step 4: Final Answer:

Since Assertion A is true and Reason R is false, the correct option is (1).

Quick Tip

Remember the term "siphonogamy" which refers to fertilization involving a pollen tube. Both gymnosperms and angiosperms exhibit siphonogamy. A key difference is that in gymnosperms, the pollen lands directly on the ovule (direct pollination), whereas in angiosperms, it lands on the stigma.

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

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

Correct Answer: (3) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:

The question asks to identify the enzyme whose activity is inhibited by malonate, leading to the inhibition of bacterial growth. This question relates to the concept of enzyme inhibition.

Step 2: Key Formula or Approach:

The principle at play here is **competitive inhibition**. In competitive inhibition, an inhibitor molecule that is structurally similar to the substrate molecule binds to the active site of the enzyme, preventing the actual substrate from binding.

Inhibitor (I) + Enzyme (E) $\rightleftharpoons$ EI complex (inactive)

Substrate (S) + Enzyme (E) $\rightleftharpoons$ ES complex $\rightarrow$ E + Product (P)

Step 3: Detailed Explanation:

- Malonate (or melonate) is a structural analogue of succinate.
- Succinate is the substrate for the enzyme **succinic dehydrogenase**, which catalyzes the oxidation of succinate to fumarate in the Krebs cycle (Tricarboxylic acid cycle).
- Because of its structural similarity, malonate competes with succinate for the active site of the succinic dehydrogenase enzyme.
- When malonate binds to the enzyme, it forms an enzyme-inhibitor complex and blocks the enzyme's activity. This prevents the conversion of succinate to fumarate.
- The Krebs cycle is a central metabolic pathway for energy production (ATP). By inhibiting a key enzyme in this cycle, malonate effectively stops aerobic respiration, thus inhibiting the growth and replication of pathogenic bacteria that rely on this pathway.

The other enzymes listed are incorrect:

- **Lipase:** Digests fats (lipids).
- **Dinitrogenase:** Involved in nitrogen fixation.
- **Amylase:** Digests starch.

Step 4: Final Answer:

Malonate is a classic competitive inhibitor of succinic dehydrogenase. Therefore, it inhibits bacterial growth by blocking this enzyme's activity. Option (3) is the correct answer.

Quick Tip

Remember the classic examples of enzyme inhibition, as they are frequently tested. Malonate inhibiting succinic dehydrogenase is the most common example of competitive inhibition. Understanding the structural similarity between the inhibitor (malonate) and the substrate (succinate) is key to solving such questions.

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

- A. This disorder was first described by Langdon Down (1866).
- B. Such an individual has overall masculine development. However, the feminine development is also expressed.
- C. The affected individual is short statured.
- D. Physical, psychomotor and mental development is retarded.
- E. Such individuals are sterile.

Choose the correct answer from the options given below :

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

Correct Answer: (1) B and E only

Solution:

Step 1: Understanding the Question:

The question asks to identify the correct statements describing Klinefelter's Syndrome from a given list. Klinefelter's Syndrome is a genetic disorder caused by the presence of an extra X chromosome in males (karyotype 47, XXY).

Step 2: Detailed Explanation:

Let's analyze each statement:

- **Statement A:** This disorder was first described by Langdon Down (1866).
This is **incorrect**. Langdon Down described Down's Syndrome. Klinefelter's Syndrome was first described by Dr. Harry Klinefelter in 1942.
- **Statement B:** Such an individual has overall masculine development. However, the feminine development is also expressed.
This is **correct**. Individuals with Klinefelter's Syndrome are phenotypically male (due to the Y chromosome), but the extra X chromosome leads to the development of some feminine characteristics, such as gynecomastia (enlarged breasts), sparse body hair, and a more rounded body shape.

- **Statement C:** The affected individual is short statured.
This is **incorrect**. Individuals with this syndrome are typically taller than average, often with disproportionately long legs and arms. Short stature is characteristic of Turner's Syndrome (45, XO).
- **Statement D:** Physical, psychomotor and mental development is retarded.
This is **incorrect**. While some individuals may have learning disabilities or delayed speech and language development, their overall intelligence is usually within the normal range. The term "retarded" is inaccurate and outdated.
- **Statement E:** Such individuals are sterile.
This is **correct**. The presence of an extra X chromosome interferes with testicular development, leading to smaller-than-normal testes (testicular atrophy) and inadequate production of testosterone and sperm (azoospermia), resulting in sterility.

Step 3: Identifying the correct statements:

Based on the analysis, statements B and E are the only correct descriptions of Klinefelter's Syndrome.

Step 4: Final Answer:

The correct option is the one that includes only statements B and E, which is option (1).

Quick Tip

For genetic disorders, create a comparison table for syndromes like Klinefelter's (XXY, tall male, sterile, gynecomastia), Turner's (XO, short female, sterile, webbed neck), and Down's (Trisomy 21, characteristic facial features, short stature). This helps in quickly distinguishing their features during exams.

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

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

Solution:

Step 1: Understanding the Question:

The question requires matching metabolic processes from List I with their associated enzyme, pathway name, or system from List II. These processes are all part of cellular respiration.

Step 2: Detailed Explanation:

Let's analyze each item in List I and find its correct match in List II.

- **A. Oxidative decarboxylation:** This refers to the link reaction that connects glycolysis to the Krebs cycle. In this step, pyruvate is converted into acetyl-CoA. The large enzyme complex that catalyzes this reaction is the **Pyruvate dehydrogenase complex**. Therefore, A matches with **II**.
- **B. Glycolysis:** This is the initial pathway for glucose breakdown. It is also known by the names of the scientists who elucidated it: Gustav Embden, Otto Meyerhof, and Jakub Karol Parnas. Hence, it is called the **EMP pathway**. Therefore, B matches with **IV**.
- **C. Oxidative phosphorylation:** This is the final stage of aerobic respiration where ATP is synthesized. It utilizes the energy released from the oxidation of NADH and FADH₂ as electrons are passed along a series of protein complexes embedded in the inner mitochondrial membrane. This series of complexes is known as the **Electron transport system (ETS)**. Therefore, C matches with **III**.
- **D. Tricarboxylic acid (TCA) cycle:** This is also known as the Krebs cycle or citric acid cycle. The cycle begins when acetyl-CoA combines with oxaloacetate to form citrate. This first reaction is catalyzed by the enzyme **Citrate synthase**. This enzyme is a key regulatory point of the cycle. Therefore, D matches with **I**.

Step 3: Matching the pairs:

The correct pairings are:

- A → II
- B → IV
- C → III
- D → I

This corresponds to the sequence A-II, B-IV, C-III, D-I.

Step 4: Final Answer:

The correct option that reflects these matches is (2).

Quick Tip

For cellular respiration, focus on the alternative names of pathways (Glycolysis = EMP pathway; Krebs cycle = TCA cycle/Citric acid cycle) and the key enzymes or starting/ending products of each stage. Drawing a flowchart of the entire process can be a very effective study tool.

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

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

Correct Answer: (4) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.

Solution:

Step 1: Understanding the Question:

The question asks to identify the incorrect statement among the given options related to water pollution and its ecological effects.

Step 2: Detailed Explanation:

Let's evaluate each statement:

- **(1) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body.** This is **correct**. Eutrophic water bodies are rich in nutrients, which promotes the excessive growth of invasive aquatic plants like water hyacinth. This growth can block sunlight, deplete oxygen, and disrupt the aquatic ecosystem.
- **(2) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels.** This is **correct**. This phenomenon is called **biomagnification** or bioamplification. Persistent toxins like DDT or mercury

accumulate in organisms and their concentration increases as they move up the food chain.

- **(3) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms.** This is **correct**. Sewage adds a large amount of organic matter to water. Aerobic decomposer bacteria consume dissolved oxygen to break down this matter. The measure of this oxygen consumption is Biochemical Oxygen Demand (BOD). High BOD leads to oxygen depletion (hypoxia), which can cause mass death of fish and other aquatic organisms.
- **(4) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.** This is **incorrect**. Algal blooms are a result of eutrophication (nutrient enrichment, primarily nitrates and phosphates). They drastically **deteriorate** water quality. They block sunlight to submerged plants and, upon death, the decomposition of the massive algal biomass by bacteria consumes large amounts of dissolved oxygen, leading to hypoxic conditions that are lethal to fish. Therefore, algal blooms harm, not promote, fisheries.

Step 3: Final Answer:

Statement (4) makes a claim that is the opposite of what actually happens. Algal blooms are detrimental to water quality and aquatic life. Thus, it is the incorrect statement.

Quick Tip

Remember the negative consequences of eutrophication. The sequence is: Nutrient enrichment → Algal Bloom → Death of algae → Decomposition by bacteria → Severe depletion of dissolved oxygen → Death of fish and other aquatic animals. This chain of events is crucial for understanding questions on water pollution.

146. Match List I with List II:

List I

- A. M Phase
- B. G₂ Phase
- C. Quiescent stage
- D. G₁ Phase

List II

- I. Proteins are synthesized
- II. Inactive phase
- III. Interval between mitosis and initiation of DNA replication
- IV. Equational division

Choose the correct answer from the options given below :

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

Correct Answer: (1) A-IV, B-I, C-II, D-III

Solution:

Step 1: Understanding the Question:

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

Step 2: Detailed Explanation:

Let's analyze each phase from List I and match it with its description from List II.

- **A. M Phase:** This is the mitotic phase, where the cell divides. Mitosis is known as **equational division** because the chromosome number in the parent and daughter cells remains the same. Therefore, A matches with **IV**.
- **B. G₂ Phase:** This is the second gap or growth phase. During G₂, the cell prepares for mitosis. This preparation includes the synthesis of proteins, such as tubulin, which is required for the formation of spindle fibers. Therefore, B matches with **I**. (Note: Protein synthesis occurs throughout interphase, but it is a key activity in G₂).
- **C. Quiescent stage (G₀):** This is a phase where cells exit the cell cycle and stop dividing. While metabolically active, they are in a non-proliferative state. It is often referred to as an **inactive phase** in the context of the cell division cycle. Therefore, C matches with **II**.
- **D. G₁ Phase:** This is the first gap or growth phase. It is the **interval between the end of mitosis (M phase) and the start of the S phase (initiation of DNA replication)**. The cell grows and carries out its normal metabolic functions during this phase. Therefore, D matches with **III**.

Step 3: Matching the pairs:

The correct pairings are:

A → IV

B → I

C → II

D → III

This corresponds to the sequence A-IV, B-I, C-II, D-III.

Step 4: Final Answer:

The option that correctly lists these matches is (1).

Quick Tip

To master the cell cycle, draw the cycle diagram and label the key events in each phase:

- **G₁**: Cell growth, longest phase.
- **S**: DNA Synthesis/Replication.
- **G₂**: Preparation for mitosis (protein synthesis).
- **M**: Mitosis (Equational division).
- **G₀**: Exit from cycle, quiescent stage.

This visual aid reinforces the sequence and purpose of each stage.

147. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

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

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

Correct Answer: (3) Both A and R are true and R is the correct explanation of A.

Solution:

Step 1: Understanding the Question:

The question presents an Assertion (A) and a Reason (R) about the morphological nature of a flower. We need to assess if both statements are true and if the Reason correctly explains the Assertion.

Step 2: Evaluating Assertion A:

Assertion A: A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

This statement is **true**. This is the standard botanical definition of a flower. A vegetative

shoot apical meristem has indeterminate growth, producing leaves and elongating the stem. When a plant transitions to flowering, this meristem transforms into a floral meristem, which has determinate growth and produces the parts of a flower.

Step 3: Evaluating Reason R:

Reason R: Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

This statement is also **true**. It describes the specific modifications that occur when a shoot becomes a flower. The axis of the shoot (the receptacle of the flower) stops elongating, so the internodes become highly condensed. The nodes, which are very close together, then give rise to modified leaves, which are the floral appendages (sepals, petals, stamens, and carpels), arranged in whorls.

Step 4: Evaluating if R explains A:

The Reason (R) provides the detailed mechanism of how a shoot is modified to become a flower. It explains *what* "modified shoot" means in the context of the Assertion (A). The condensation of internodes and the production of floral appendages instead of regular leaves are the key modifications. Therefore, the Reason correctly explains the Assertion.

Step 5: Final Answer:

Both Assertion A and Reason R are true, and Reason R is the correct explanation for Assertion A. This corresponds to option (3).

Quick Tip

The concept that a flower is a modified shoot is fundamental to plant morphology. Remember the homologies:

- Stem → Receptacle/Thalamus
- Nodes → Points of attachment of floral whorls
- Internodes → Condensed
- Leaves → Floral appendages (sepals, petals, stamens, carpels)

This understanding helps interpret the structure of any flower.

148. Match List I with List II :

List I

- A. Cohesion
- B. Adhesion
- C. Surface tension
- D. Guttation

List II

- I. More attraction in liquid phase

II. Mutual attraction among water molecules

III. Water loss in liquid phase

IV. Attraction towards polar surfaces

Choose the correct answer from the options given below :

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

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

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

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

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

Solution:

Step 1: Understanding the Question:

The question requires matching terms related to the physical properties of water (List I) with their correct definitions or descriptions (List II). These properties are crucial for water transport in plants.

Step 2: Detailed Explanation:

Let's analyze each term in List I and find its correct match in List II.

- **A. Cohesion:** This property refers to the attraction between molecules of the same substance. For water, it is the **mutual attraction among water molecules** due to hydrogen bonds. This matches with **II**.
- **B. Adhesion:** This is the attraction of molecules of one substance to molecules of a different substance. In plants, it is the attraction of water molecules to the walls of the xylem vessels, which are **polar surfaces**. This matches with **IV**.
- **C. Surface tension:** This is a property of liquids that arises from the cohesion of its molecules. Water molecules at the surface are more strongly attracted to each other (in the liquid) than to the molecules in the air above. This results in **more attraction in the liquid phase** compared to the gas phase, creating a "film" on the surface. This matches with **I**.
- **D. Guttation:** This is the process of exudation of water drops from the pores (hydathodes) at the leaf margins. It represents **water loss in the liquid phase**, as opposed to transpiration which is water loss as vapor. This matches with **III**.

Step 3: Matching the pairs:

The correct pairings are:

A → II

B → IV

$C \rightarrow I$

$D \rightarrow III$

This corresponds to the sequence A-II, B-IV, C-I, D-III.

Step 4: Final Answer:

The option that correctly lists these matches is (3).

Quick Tip

To remember the difference between cohesion and adhesion, think: **Co-** means "together" (like co-worker), so cohesion is water molecules sticking together. **Ad-** means "to" (like adhere to), so adhesion is water sticking to another surface.

149. Given below are two statements :

Statement I: Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually.

Statement II: In general, carnivores are more adversely affected by competition than herbivores.

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

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

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

Solution:

Step 1: Understanding the Question:

The question asks us to evaluate two statements related to ecological competition and determine their correctness.

Step 2: Evaluating Statement I:

Statement I describes Gause's 'Competitive Exclusion Principle'. The principle indeed states that when two species compete for the exact same limited resources, one species will be better adapted and will eventually outcompete and eliminate the other. The statement is a correct definition of this principle. Therefore, **Statement I is correct.**

Step 3: Evaluating Statement II:

Statement II makes a generalization that carnivores are more adversely affected by competition than herbivores. This is a broad statement and is not universally true. Competition can

be a very strong limiting factor for both groups. For example, herbivores can face intense competition for limited plant resources, especially in environments with low primary productivity. Similarly, different herbivore species may compete for the same food plants. While competition among carnivores for prey is often intense, it is not a strict rule that they are *more* adversely affected than herbivores. In ecology, such generalizations are often considered incorrect because exceptions are common. Therefore, **Statement II is false**.

Step 4: Final Answer:

Since Statement I is correct and Statement II is false, the correct option is (1).

Quick Tip

Be cautious with broad generalizations in biology, such as "always," "never," or comparing entire trophic levels (like carnivores vs. herbivores). These statements are often false because biological systems are complex and have many exceptions. Focus on precise definitions, like Gause's Principle, which are more reliable.

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

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

Correct Answer: (3) 80

Solution:

Step 1: Understanding the Question:

The question asks for the number of different proteins found in a ribosome. Ribosomes are complex cellular machines responsible for protein synthesis and are composed of ribosomal RNA (rRNA) and ribosomal proteins.

Step 2: Detailed Explanation:

The composition of ribosomes differs between prokaryotes and eukaryotes.

- **Prokaryotic (70S) Ribosome:** It consists of a 50S large subunit and a 30S small subunit. In total, it contains about 55 different proteins.
- **Eukaryotic (80S) Ribosome:** It consists of a 60S large subunit and a 40S small subunit. In total, it contains approximately 80-83 different proteins.

The question does not specify the organism type. However, looking at the options:

- (1) 40
- (2) 20
- (3) 80
- (4) 60

The value 80 is a very close approximation for the number of proteins in a eukaryotic ribosome. The value 60 is close to the number in a prokaryotic ribosome (55). In the context of general biology questions at this level, if a specific cell type isn't mentioned, "around 80" is the accepted number for eukaryotic ribosomes. Given that 80 is an explicit option, it is the intended answer, referring to the eukaryotic ribosome.

Step 3: Final Answer:

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

Quick Tip

When a biology question asks about a cellular feature without specifying prokaryote vs. eukaryote, and the options match one type much better than the other, choose the best fit. For ribosomes, remember the approximate protein counts: 55 for prokaryotes and 80 for eukaryotes.