NEET UG 2023 G4 Botany Question Paper with Solutions

Time Allowed :3 Hour 20 Minutes	**Maximum Marks :**720	**Total Questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The Answer Sheet is this Test Booklet. When you are directed to open the Test Booklet, take the Answer Sheet and fill in the particulars in ORIGINAL Copy carefully with blue/black ball pen only.
2. The test is of 3 hours 20 minutes duration and the Test Booklet contains 200 multiple-choice questions (four options with a single correct answer) from Physics, Chemistry, and Biology (Botany and Zoology). 50 questions in each subject are divided into two Sections (A and B) as per details given below:
3. (a) Section A shall consist of 35 (Thirty-five) questions in each subject (Question Nos. 1 to 35, 51 to 85, 101 to 135 and 151 to 185).
4. (b) Section B shall consist of 15 (Fifteen) questions in each subject (Question Nos. 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In Section B, a candidate needs to attempt any 10 (Ten) questions out of 15 (Fifteen) in each subject.
5. Candidates are advised to read all 15 questions in each subject of Section B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, the first ten questions answered by the candidate shall be evaluated.
6. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. The maximum marks are 720.
7. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
8. On completion of the test, the candidate must hand over the Answer Sheet (ORIGINAL and OFFICE Copy) to the Invigilator before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.
9. Use of Electronic/Manual Calculator is prohibited.

Section A

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

(A) copper
(B) manganese

(C) molybdenum
(D) magnesium

Correct Answer: (B) manganese

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific micronutrient that plays a crucial role in the photolysis (splitting) of water during the light-dependent reactions of photosynthesis.

Step 3: Detailed Explanation:
The splitting of water molecules occurs during the light-dependent reactions of photosynthesis, a process known as photolysis.
This reaction takes place in Photosystem II (PS II) and is catalyzed by the Oxygen Evolving Complex (OEC).
The OEC is a metalloenzyme complex that contains a cluster of four manganese ions (Mn) and one calcium ion (Ca^{2+}), which are essential for its catalytic activity.
The overall reaction is:

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

Magnesium (Mg^{2+}) is a central atom of the chlorophyll molecule, but it is not directly involved in water splitting.
Copper and molybdenum are also essential micronutrients but have different roles in plant metabolism.

Step 4: Final Answer:
Therefore, manganese is the correct micronutrient required for the splitting of the water molecule.

Quick Tip

Remember the key roles of important micronutrients in photosynthesis: Manganese (Mn) is for photolysis of water, and Magnesium (Mg) is the central atom in chlorophyll. Don't confuse the two.

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

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

Correct Answer: (C) Alfred Hershey and Martha Chase

Solution:

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

Step 3: Detailed Explanation:

- **Frederick Griffith (1928):** His experiment on Streptococcus pneumoniae demonstrated the "transforming principle" but did not identify what it was.
- **Avery, Macleoid, and McCarthy (1944):** They expanded on Griffith's work and showed that DNA was the transforming principle. However, their findings were not universally accepted by the scientific community at the time.
- **Alfred Hershey and Martha Chase (1952):** They conducted the "blender experiment" using bacteriophages (viruses that infect bacteria). They radioactively labeled the DNA of the phage with ^{32}P and the protein coat with ^{35}S. They found that only the radioactive DNA entered the bacterial cells, providing clear and unequivocal evidence that DNA is the genetic material.
- **Wilkins and Franklin:** Their X-ray diffraction work was crucial for determining the structure of DNA, but did not prove it was the genetic material.

Step 4: Final Answer:
The Hershey-Chase experiment is considered the conclusive proof that DNA is the genetic material.

Quick Tip

Remember the timeline and contribution of each experiment: Griffith discovered transformation, Avery et al. identified the transforming substance as DNA, and Hershey-Chase provided the definitive proof using radioactive tracers.

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

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

Solution:

Step 1: Understanding the Question:
The question presents two statements about vascular tissue arrangement in plants and asks to evaluate their correctness.

Step 3: Detailed Explanation:
Statement I Analysis:
The terms 'endarch' and 'exarch' describe the arrangement of **primary xylem**, not secondary xylem.

- **Endarch:** Protoxylem (the first formed primary xylem) is towards the center (pith), and metaxylem is towards the periphery. This is characteristic of stems.
- **Exarch:** Protoxylem is towards the periphery, and metaxylem is towards the center. This is characteristic of roots.

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

Statement II Analysis:
As explained above, the exarch condition, where the protoxylem is located on the outer side and metaxylem on the inner side, is the defining characteristic of the vascular bundles in the root system of plants. Therefore, Statement II is true.

Step 4: Final Answer:
Statement I is incorrect, and Statement II is true.

Quick Tip

Remember: "Ex" in Exarch is like "Exit" (outward), which helps recall that protoxylem is towards the periphery, a feature of roots. "En" in Endarch is like "Enter" (inward), for protoxylem towards the center, a feature of stems.

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104. Cellulose does not form blue colour with Iodine because

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

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

Solution:

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

Step 3: Detailed Explanation:
The iodine test for starch is based on the ability of the starch molecule to trap iodine molecules within its structure.
Starch consists of two components: amylose and amylopectin. Amylose has a helical secondary structure. The iodine molecules (I_2) fit perfectly inside these helices, forming a charge-transfer complex that appears blue-black.
Cellulose, on the other hand, is a polysaccharide made of β-glucose units linked by β-1,4 glycosidic bonds. This results in a straight, linear chain structure. These chains are arranged in parallel to form fibrils.
Cellulose does not form the complex helical structures found in amylose. Without these helices, there is no space for the iodine molecules to be trapped. Therefore, no blue colour is produced.
Option (B) is incorrect because cellulose is a polysaccharide, not a disaccharide.

Step 4: Final Answer:
Cellulose has a linear structure without complex helices, so it cannot hold iodine molecules to produce the characteristic blue colour.

Quick Tip

Associate the helical structure with the iodine test. Starch (specifically amylose) is helical and turns blue with iodine. Cellulose is linear and does not. This structural difference is key.

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

Correct Answer: (B) Diadelphous and Dithecous anthers

Solution:

Step 1: Understanding the Question:
The question asks to identify a characteristic of stamens that is unique to the family Fabaceae

when compared to Solanaceae and Liliaceae.

Step 3: Detailed Explanation:
Let's analyze the characteristics of stamens in these families:

- **Fabaceae (Pea family):** The stamens are typically ten. A key feature is that they are often **diadelphous**, meaning they are fused into two bundles (commonly in a (9)+1 arrangement, where 9 are fused into a tube and one is free). The anthers are **dithecous** (having two lobes).
- **Solanaceae (Potato family):** Stamens are typically five and **epipetalous** (fused to the petals). Anthers are dithecous.
- **Liliaceae (Lily family):** Stamens are typically six (3+3) and can be **epiphyllous** or epitepalous (fused to the tepals). Anthers are dithecous.

Comparing the options:

- (A) Epiphyllous condition is found in Liliaceae.
- (B) **Diadelphous** condition is characteristic of Fabaceae. Dithecous anthers are common to all three, but the diadelphous arrangement is specific to Fabaceae among the choices.
- (C) Polyadelphous (fused into more than two bundles) is found in families like Rutaceae (Citrus). Epipetalous is found in Solanaceae.
- (D) Monoadelphous (fused into one bundle) is found in Malvaceae (China rose). Monothecous anthers are also found in Malvaceae.

Step 4: Final Answer:
The diadelphous condition of stamens is a specific characteristic of the family Fabaceae that distinguishes it from Solanaceae and Liliaceae.

Quick Tip

Memorize the key floral characteristics for major plant families. For Fabaceae, remember the butterfly-like (papilionaceous) corolla and the diadelphous ((9)+1) stamen arrangement.

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

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

Correct Answer: (B) 680 nm

Solution:

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

Step 3: Detailed Explanation:
In photosynthesis, there are two photosystems, Photosystem I (PS I) and Photosystem II (PS II). Each photosystem consists of a reaction center surrounded by light-harvesting complexes. The reaction center is a special pair of chlorophyll 'a' molecules that can become photo-oxidized.

- The reaction center of **Photosystem II (PS II)** absorbs light most effectively at a wavelength of **680 nm** and is therefore called **P680**.
- The reaction center of **Photosystem I (PS I)** absorbs light most effectively at a wavelength of **700 nm** and is therefore called **P700**.

Step 4: Final Answer:
Based on this information, the reaction centre in PS II has an absorption maximum at 680 nm.

Quick Tip

A simple way to remember is that the photosystems are named in the order of their discovery, not the order they function in the Z-scheme. PS II (P680) comes before PS I (P700) in the electron flow. Remember II comes before I, and 680 comes before 700.

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

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

Correct Answer: (A) Bright orange colour

Solution:

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

Step 3: Detailed Explanation:
Ethidium bromide (EtBr) is a fluorescent dye that is commonly used as a stain for visualizing nucleic acids (DNA and RNA) in molecular biology laboratories.
EtBr works by intercalating, or inserting itself, between the base pairs of the DNA double helix. When this DNA-EtBr complex is exposed to ultraviolet (UV) light, the EtBr fluoresces. The light emitted is in the orange part of the visible spectrum.
This allows for the visualization of DNA bands in an agarose gel after electrophoresis. The unbound dye does not fluoresce significantly.

Step 4: Final Answer:
Therefore, DNA stained with ethidium bromide appears as bright orange bands under UV radiation.

Quick Tip

Remember the combination: DNA + Ethidium Bromide + UV light = Bright Orange. This is a fundamental visualization technique in gel electrophoresis for DNA.

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108. The phenomenon of pleiotropism refers to

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

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

Solution:

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

Step 3: Detailed Explanation:
Let's analyze the options:

- **Pleiotropy** is the phenomenon where one single gene influences multiple, often unrelated, phenotypic traits. For example, the gene causing phenylketonuria (PKU) in humans affects mental development, skin pigmentation, and hair colour. So, option (D) is the correct definition.
- Option (A) describes **polygenic inheritance**, where a single trait (like height or skin colour) is controlled by multiple genes.

- Options (B) and (C) are incorrect descriptions of genetic principles. Multiple alleles refer to a gene having more than two allelic forms in a population, but they still control a single character.

Step 4: Final Answer:
The correct definition of pleiotropism is a single gene affecting multiple phenotypic expressions.

Quick Tip

To avoid confusion, remember:

- **Pleiotropy:** One gene → Many traits.
- **Polygenic Inheritance:** Many genes → One trait.

The prefix "pleio-" means "more," referring to more effects. "Poly-" means "many," referring to many genes.

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

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

Correct Answer: (C) 1992

Solution:

Step 1: Understanding the Question:
The question asks for the year in which the Earth Summit, formally known as the United Nations Conference on Environment and Development (UNCED), was held in Rio de Janeiro. This summit led to the Convention on Biological Diversity (CBD).

Step 3: Detailed Explanation:
The United Nations Conference on Environment and Development (UNCED), famously known as the **Earth Summit**, was a major international conference held in Rio de Janeiro, Brazil, from June 3 to 14, **1992**.
One of the key agreements adopted at the summit was the **Convention on Biological Diversity (CBD)**. The objectives of the CBD are 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 years listed are significant for other environmental events:

- **2002**: The World Summit on Sustainable Development was held in Johannesburg.

- **1985**: The Vienna Convention for the Protection of the Ozone Layer was adopted.
- **1986**: The Environment Protection Act was enacted in India.

Step 4: Final Answer:
The Earth Summit in Rio de Janeiro was held in 1992.

Quick Tip

Associate "Rio Summit" or "Earth Summit" with the year 1992 and the Convention on Biological Diversity (CBD). This is a landmark event in global environmental policy.

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

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

Correct Answer: (C) DNA

Solution:

Step 1: Understanding the Question:
The question asks what biological macromolecule precipitates out of a solution when chilled ethanol is added during the purification steps of recombinant DNA technology.

Step 3: Detailed Explanation:
The process of isolating DNA from cells involves several steps:
1. **Lysis:** Breaking open the cells to release their contents, including DNA, RNA, proteins, and lipids. 2. **Enzymatic Digestion:** Using enzymes like proteases to break down proteins (like histones) and ribonucleases (RNase) to break down RNA. 3. **Precipitation:** After removing other macromolecules, the DNA needs to be isolated from the aqueous solution. DNA is insoluble in ethanol. Adding chilled ethanol causes the DNA to precipitate out of the solution, as it is dehydrated and aggregates. The precipitated DNA can then be seen as a collection of fine white threads. This process is called ethanol precipitation.
Polysaccharides may also precipitate to some extent, but the primary target and result of this specific step in DNA isolation is the precipitation of DNA.

Step 4: Final Answer:
The addition of chilled ethanol causes the purified DNA to precipitate out of the solution.

Quick Tip

Remember the key principle: DNA is soluble in water (aqueous solution) but insoluble in alcohol (like ethanol). Adding chilled ethanol is the standard final step to concentrate and purify DNA from a lysate.

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

Correct Answer: (D) Alfred Sturtevant

Solution:

Step 1: Understanding the Question:
The question asks to identify the scientist who first used recombination frequency to measure the distance between genes and create a genetic map.

Step 3: Detailed Explanation:

- **Thomas Hunt Morgan:** He performed experiments with Drosophila melanogaster (fruit flies) and discovered concepts like linkage and recombination. He proposed that the frequency of recombination was related to the distance between genes.
- **Alfred Sturtevant:** He was a student of Thomas Hunt Morgan. He took Morgan's idea a step further. In 1913, Sturtevant realized that if the frequency of recombination between two genes is related to their physical distance, then this frequency could be used as a unit of measurement. He used recombination data to construct the very first genetic map of a chromosome. He defined one map unit (or centimorgan, cM) as a 1% recombination frequency.
- **Sutton and Boveri:** They proposed the Chromosomal Theory of Inheritance, which states that genes are located on chromosomes.
- **Henking:** He discovered the X chromosome.

While Morgan laid the groundwork, it was Alfred Sturtevant who first used the concept of recombination frequency to map gene positions.

Step 4: Final Answer:
Alfred Sturtevant was the first to use recombination frequency to create a genetic map.

Quick Tip

Associate the scientists with their key contributions:

- **Morgan:** Linkage and recombination.
- **Sturtevant (Morgan's student):** Genetic mapping using recombination frequency.
- **Sutton & Boveri:** Chromosomal Theory of Inheritance.

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

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

Solution:

Step 1: Understanding the Question:
The question presents an Assertion (A) and a Reason (R) related to the life cycle of a moss. We need to evaluate if both statements are true and if the Reason correctly explains the Assertion.

Step 3: Detailed Explanation:
Assertion A Analysis:
In the life cycle of a moss (a bryophyte), the dominant phase is the gametophyte. The life cycle begins with a haploid spore. When this spore germinates, it develops into a filamentous, creeping, green structure called the protonema. This protonema is the juvenile gametophyte, or the first stage of the gametophyte. From this protonema, buds arise that develop into the mature, leafy gametophyte. So, Assertion A is correct.

Reason R Analysis:
The spores of mosses are produced in a structure called the capsule, which is part of the sporophyte. These haploid spores are released and, under favorable conditions, they germinate to form the protonema. Thus, the protonema develops directly from the spore. So, Reason R is also correct.

Explanation Analysis:
The Assertion states that the protonema is the first stage of the gametophyte. The Reason explains how this protonema is formed—by direct development from a spore produced in the capsule. This explanation is accurate and directly clarifies why the protonema is considered the initial stage of the gametophytic generation. Therefore, R is the correct explanation for A.

Step 4: Final Answer:
Both Assertion A and Reason R are correct, and R provides the correct explanation for A.

Quick Tip

Remember the moss life cycle sequence: Spore (n) → Protonema (n, juvenile gametophyte) → Leafy gametophyte (n, mature) → Gametes (n) → Zygote (2n) → Sporophyte (2n, with capsule) → Spore (n). This flow clarifies the role of the protonema.

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113. Among eukaryotes, replication of DNA takes place in

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

Correct Answer: (C) 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 3: Detailed Explanation:
The eukaryotic cell cycle is divided into two main stages: Interphase and M phase (Mitotic phase).
Interphase is further subdivided into three phases:

- G_1 **phase (Gap 1):** The cell grows and carries out its normal metabolic functions. It prepares for DNA replication.
- **S phase (Synthesis):** This is the phase where DNA replication occurs. The amount of DNA in the cell doubles (from 2C to 4C), but the chromosome number remains the same (each chromosome now consists of two sister chromatids).
- G_2 **phase (Gap 2):** The cell continues to grow and prepares for mitosis. Proteins required for cell division are synthesized.

M phase (Mitosis): This is where the cell divides its nucleus (mitosis) and cytoplasm (cytokinesis) to form two daughter cells.

Step 4: Final Answer:
DNA replication specifically takes place during the S phase of the cell cycle.

Quick Tip

Remember the mnemonic "Go, Sally, Go, Make Children" for the cell cycle phases: G_1, S (Synthesis of DNA), G_2, M (Mitosis), C (Cytokinesis). This helps recall that DNA synthesis happens in the S phase.

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

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

Correct Answer: (C) To trap pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the function of the tassels found on a corn cob. However, there's a common confusion in the terminology of the question. Tassels are the male flowers at the top of the corn plant that *produce* pollen. The silky threads emerging from the top of the cob are the styles/stigmas of the female flowers. The question likely refers to these silky threads, not the tassels. Let's assume it means the silky threads (silks) on the cob.

Step 3: Detailed Explanation:
Let's clarify the parts of a corn plant (Maize):

- **Tassel:** This is the male inflorescence located at the apex of the plant. Its function is to **produce and disperse pollen grains**.
- **Ear (Cob):** This is the female inflorescence. It consists of multiple female flowers arranged on a central axis.
- **Silks:** The long, silky threads that emerge from the top of the ear are the elongated styles and stigmas of the female flowers. Each silk is connected to a potential kernel (ovule).

Corn is wind-pollinated (anemophilous). The tassels release pollen into the wind, and the long, feathery silks of the cob have a large surface area designed to **trap these airborne pollen grains**. When a pollen grain lands on a silk, it germinates and a pollen tube grows down the

silk to fertilize the ovule, which then develops into a corn kernel.

Based on the options, the question is definitely referring to the corn silks on the cob, not the tassels at the top of the plant. The function of these silks is to trap pollen.

Step 4: Final Answer:
The function of the silks (incorrectly called tassels in the question) on the corn cob is to trap pollen grains for fertilization.

Quick Tip

Be aware of the common confusion between corn tassels and silks. Tassel = Top, Male, Pollen Producer. Silk = on the Ear/Cob, Female, Pollen Catcher. In exams, if the question links "tassels" with the "cob," it's almost certainly referring to the silks and their function in trapping pollen.

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115. In the equation
GPP – R = NPP
GPP is Gross Primary Productivity
NPP is Net Primary Productivity
R here is

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

Correct Answer: (D) Respiratory loss

Solution:

Step 1: Understanding the Question:
The question asks to identify what the term 'R' represents in the ecological equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).

Step 2: Key Formula or Approach:
The fundamental equation for energy flow at the producer level is:

$$NPP = GPP - R$$

Step 3: Detailed Explanation:

- **Gross Primary Productivity (GPP):** This is the total rate at which solar energy is captured and converted into chemical energy (organic matter) by producers (e.g., plants) through photosynthesis. It's the total amount of food produced.

- Producers need to use some of this captured energy for their own life processes, such as growth, maintenance, and reproduction. The main metabolic process that releases this energy is cellular respiration.
- **R (Respiratory Loss):** This term represents the energy consumed by the producers for their own respiration. This energy is lost as heat and is not available to the next trophic level.
- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass that is available to consumers (herbivores). It is the GPP minus the energy lost through respiration (R). It represents the net amount of stored energy.

Step 4: Final Answer:
In the equation GPP – R = NPP, R stands for Respiratory loss.

Quick Tip

Think of it like a salary. GPP is your gross salary (total earnings). R is the tax and deductions (your expenses). NPP is your net salary or take-home pay (what you have left to spend or save).

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

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

Correct Answer: (D) Ethylene

Solution:

Step 1: Understanding the Question:
The question asks to identify the plant hormone responsible for promoting rapid stem (internode) and leaf stalk (petiole) elongation in rice plants that are submerged in deep water.

Step 3: Detailed Explanation:
Deep water rice is a variety of rice that has adapted to grow in flooded conditions. When the plant is submerged, it needs to rapidly elongate its stems to keep its leaves above the water surface for photosynthesis and gas exchange.
This rapid elongation response is primarily mediated by the gaseous plant hormone **ethylene**. When parts of the plant are submerged, the diffusion of ethylene out of the plant is blocked by the water. This leads to an accumulation of ethylene within the plant tissues.
This increased concentration of ethylene stimulates cell division and elongation in the internodes, causing the stem to grow quickly and escape the water. Although Gibberellins (GA_3)

also promote stem elongation (bolting), in the specific case of deep water rice, ethylene is the primary trigger that enhances the sensitivity of the cells to gibberellins, leading to the rapid growth. Therefore, ethylene is the direct promoter of this specific response.

- **2, 4-D** is a synthetic auxin, often used as a herbicide.
- GA_3 (Gibberellic acid) generally promotes stem elongation.
- **Kinetin** is a cytokinin, which promotes cell division.

Step 4: Final Answer:
Ethylene is the hormone that promotes internode elongation in deep water rice plants.

Quick Tip

Associate ethylene with a wide range of stress responses and senescence, including fruit ripening, abscission, and specific adaptations like stem elongation in submerged plants.

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117. Axile placentation is observed in

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

Correct Answer: (A) 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 3: Detailed Explanation:
In **axile placentation**, the ovary is partitioned into two or more chambers (locules) by septa. The placenta, where the ovules are attached, is located in the central axis where the septa meet.
Let's analyze the placentation types in the plants mentioned:

- **China rose (Hibiscus), Petunia, Lemon, Tomato:** All these plants have a syncarpous (fused carpels), multilocular ovary with ovules attached to the central axis. This is the definition of axile placentation.
- **Mustard:** Has parietal placentation.
- **Cucumber:** Has parietal placentation.

- **Primrose, Dianthus:** Have free-central placentation.
- **Beans, Lupin, Pea:** These are members of the Fabaceae family and have marginal placentation.

Now let's check the options:

- (A) **China rose, Petunia, and Lemon** all exhibit axile placentation.
- (B) Contains Mustard and Primrose which do not have axile placentation.
- (C) Contains Beans and Lupin which have marginal placentation.
- (D) Contains Dianthus and Pea which do not have axile placentation.

Step 4: Final Answer:
The group of plants that all show axile placentation is China rose, Petunia, and Lemon.

Quick Tip

A good way to remember examples for axile placentation is to think of fruits you slice and see a central column with seeds attached in segments, like a tomato, lemon, or orange.

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

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

Correct Answer: (C) Pachytene

Solution:

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

Step 3: Detailed Explanation:
Prophase I of meiosis is a long and complex phase divided into five sub-stages:

1. **Leptotene:** Chromosomes condense and become visible.
2. **Zygotene:** Homologous chromosomes pair up in a process called synapsis, forming bivalents. The synaptonemal complex begins to form.

3. **Pachytene:** Synapsis is complete. The paired chromosomes (bivalents) are clearly visible. At this stage, crossing over occurs between non-sister chromatids of homologous chromosomes. The sites of crossing over are marked by the appearance of proteinaceous structures called **recombination nodules**. These nodules contain the enzymes required for recombination.

4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes begin to separate, except at the sites of crossing over. These X-shaped structures are called chiasmata.

5. **Diakinesis:** Chromosomes become fully condensed, and the chiasmata terminalize (move to the ends). The nuclear envelope breaks down.

Step 4: Final Answer:
Recombination nodules, which are the sites of crossing over, appear during the Pachytene substage of Prophase I.

Quick Tip

Use the mnemonic "Lazy Zebra Pounces On Dingoes" to remember the stages of Prophase I: Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis. Associate "Pounces" (Pachytene) with the "pact" or crossing over event, where recombination nodules are found.

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

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

Correct Answer: (B) Dobson units

Solution:

Step 1: Understanding the Question:
The question asks for the unit of measurement used to quantify the thickness or concentration of the ozone layer in the atmosphere.

Step 3: Detailed Explanation:
The concentration of ozone in the stratosphere (the ozone layer) is measured in **Dobson Units (DU)**.
One Dobson Unit is defined as the thickness (in units of 10 µm) that the ozone column would occupy if it were compressed to standard temperature and pressure (0°C and 1 atm).

For example, a column of ozone with a thickness of 300 DU would form a 3 mm thick layer at the Earth's surface under standard conditions.
Let's look at the other options:

- **Kilobase (kb):** A unit of length for DNA or RNA molecules, equal to 1000 base pairs.
- **Decibels (dB):** A logarithmic unit used to measure sound intensity.
- **Decameter (dam):** A unit of length equal to 10 meters.

Step 4: Final Answer:
The thickness of the ozone layer is measured in Dobson units.

Quick Tip

Associate "Ozone" with "Dobson." The name itself is distinctive and specifically linked to measuring the ozone layer. This is a common factual question in environmental science topics.

---

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

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

Solution:

Step 1: Understanding the Question:
The question presents two statements related to the process of transpiration in plants. We need to evaluate the correctness of both statements.

Step 3: Detailed Explanation:
Statement I Analysis:
This statement refers to the cohesion-tension theory of water transport in plants. Transpiration creates a negative pressure potential, or tension, in the xylem. This "transpirational pull" is the main driving force for lifting water from the roots to the top of the plant. The forces of cohesion (attraction between water molecules) and adhesion (attraction of water molecules to

xylem walls) create an unbroken water column. This mechanism is powerful enough to lift water to the tops of the tallest trees, which can exceed 100 meters in height. A lift of over 130 meters is within the theoretical capacity of this mechanism. Therefore, Statement I is correct.

Statement II Analysis:
Transpiration is the evaporation of water from the plant's surface, primarily from the leaves. Evaporation is a cooling process because it requires energy (latent heat of vaporization) to change water from a liquid to a gaseous state. This energy is taken from the leaf, thereby lowering its temperature. This evaporative cooling can prevent leaves from overheating in direct sunlight, and the cooling effect can indeed be in the range of 10 to 15 degrees Celsius. Therefore, Statement II is also correct.

Step 4: Final Answer:
Both statements accurately describe important aspects of transpiration. Statement I describes its role in water transport, and Statement II describes its role in thermoregulation. Thus, both statements are correct.

Quick Tip

Remember the two main functions of transpiration: 1. **Transport:** Creates the "pull" to lift water and minerals from roots to leaves. 2. **Cooling:** Prevents leaf damage from high temperatures through evaporative cooling.

---

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

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

Correct Answer: (D) Anaphase II

Solution:

Step 1: Understanding the Question:
The question asks to identify the specific stage of meiosis where the centromeres, which hold the sister chromatids together, divide.

Step 3: Detailed Explanation:
Let's review the key events in the stages of meiosis:
Meiosis I (Reductional Division):

- **Prophase I, Metaphase I, Anaphase I, Telophase I:** The main event of Anaphase I is the separation of **homologous chromosomes**. The sister chromatids remain attached at their centromeres. The centromeres **do not** divide in Meiosis I.

Meiosis II (Equational Division): This phase is very similar to mitosis.

- **Prophase II, Metaphase II:** Chromosomes, each composed of two sister chromatids, align at the metaphase plate.
- **Anaphase II:** This is the critical stage where the centromeres finally divide. The sister chromatids separate and are now considered individual chromosomes. They move towards opposite poles of the cell.
- **Telophase II:** The separated chromosomes arrive at the poles, and nuclear envelopes reform, resulting in four haploid cells.

Step 4: Final Answer:
The division of the centromere and separation of sister chromatids occurs during Anaphase II of meiosis.

Quick Tip

Remember the key difference between Anaphase I and Anaphase II:

- **Anaphase I:** Separation of **homologous chromosomes**. Centromeres do not split.
- **Anaphase II:** Separation of **sister chromatids**. Centromeres split. (Similar to mitotic Anaphase).

---

122. Identify the correct statements :
A. Detrivores perform fragmentation.
B. The humus is further degraded by some microbes during mineralization.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
D. The detritus food chain begins with living organisms.
E. Earthworms break down detritus into smaller particles by a process called catabolism.
Choose the correct answer from the options given below :

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

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

Solution:

Step 1: Understanding the Question:
The question asks to identify the correct statements regarding the process of decomposition.

Decomposition involves several steps: fragmentation, leaching, catabolism, humification, and mineralization.

Step 3: Detailed Explanation:
Let's analyze each statement:

- **A. Detrivores perform fragmentation.** This is correct. Detritivores, like earthworms, break down detritus (dead organic matter) into smaller particles. This process is called fragmentation.
- **B. The humus is further degraded by some microbes during mineralization.** This is correct. Humus is a dark amorphous substance that is highly resistant to microbial action. It is degraded very slowly, and this process, called mineralization, releases inorganic nutrients.
- **C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.** This is correct. Leaching is the process by which water-soluble nutrients percolate through the soil horizons and can be precipitated as unavailable salts.
- **D. The detritus food chain begins with living organisms.** This is incorrect. The detritus food chain (DFC) begins with dead organic matter (detritus). The grazing food chain (GFC) begins with living producers.
- **E. Earthworms break down detritus into smaller particles by a process called catabolism.** This is incorrect. The physical breakdown of detritus by earthworms is fragmentation. Catabolism refers to the enzymatic degradation of detritus into simpler inorganic substances by bacteria and fungi.

Thus, statements A, B, and C are correct.

Step 4: Final Answer:
The correct option includes statements A, B, and C only.

Quick Tip

Remember the sequence of decomposition: Fragmentation (by detritivores) → Leaching (water-soluble nutrients move down) → Catabolism (bacterial/fungal enzymes) → Humification (forms humus) → Mineralization (releases inorganic nutrients).

---

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

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

(D) Synergids, Zygote and Primary endosperm nucleus

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

Solution:

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

Step 3: Detailed Explanation:
Let's determine the ploidy of the structures in a fertilized embryo sac:

- **Haploid (n) structures:** After fertilization, the synergids and antipodal cells degenerate, but they were haploid. Let's assume the question refers to their ploidy level just after fertilization starts. Synergids are haploid (n), and antipodals are haploid (n).
- **Diploid (2n) structure:** The zygote is formed by the fusion of one male gamete (n) with the egg cell (n). Thus, the zygote is diploid (2n).
- **Triploid (3n) structure:** The Primary Endosperm Nucleus (PEN) is formed by the fusion of the second male gamete (n) with the two polar nuclei (n + n). This process is called triple fusion, resulting in a triploid (3n) nucleus, which develops into the endosperm.

Now let's check the sequence in the options:

- (A) Synergids (n), antipodals (n), Polar nuclei (n+n, not yet 3n). Incorrect sequence.
- (B) Synergids (n), Primary endosperm nucleus (3n), zygote (2n). The ploidy sequence is n, 3n, 2n. Incorrect.
- (C) Antipodals (n), synergids (n), primary endosperm nucleus (3n). The ploidy sequence starts with two haploid structures. Incorrect.
- (D) **Synergids (n), Zygote (2n), and Primary endosperm nucleus (3n).** The ploidy sequence is n, 2n, 3n. This is the correct sequential order.

Step 4: Final Answer:
The correct sequence of haploid, diploid, and triploid structures is Synergids, Zygote, and Primary endosperm nucleus.

Quick Tip

Remember the key events of double fertilization:

1. Syngamy: Male gamete (n) + Egg (n) $\rightarrow$ Zygote (2n).
2. Triple Fusion: Male gamete (n) + 2 Polar Nuclei (n+n) $\rightarrow$ PEN (3n).

This helps recall the ploidy of the resulting structures.

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

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

Correct Answer: (B) Habitat loss and fragmentation

Solution:

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

Step 3: Detailed Explanation:
'The Evil Quartet' is a term used to describe the four major causes of biodiversity loss:

1. **Habitat loss and fragmentation:** This is the destruction or division of natural habitats due to activities like deforestation, urbanization, and agriculture. It affects the largest number of species by removing the places they live and find food, making it the single most important cause of extinction.
2. **Over-exploitation:** This refers to harvesting species from the wild at rates faster than natural populations can recover (e.g., overfishing, overhunting).
3. **Alien species invasions:** When non-native species are introduced into an ecosystem, they can outcompete, prey upon, or introduce diseases to native species, leading to their decline.
4. **Co-extinctions:** This occurs when the extinction of one species causes the extinction of another species that depended on it (e.g., a specific pollinator for a plant).

While all four are significant threats, scientific consensus holds that habitat loss and fragmentation is the leading driver of species extinction worldwide.

Step 4: Final Answer:
Habitat loss and fragmentation is considered the most important cause driving species extinction.

Quick Tip

Remember that destroying an organism's home is the most direct and widespread way to threaten its survival. That's why habitat loss is consistently ranked as the number one threat to biodiversity.

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

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

Correct Answer: (C) Dedifferentiation

Solution:

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

Step 3: Detailed Explanation:
Let's define the terms:

- **Differentiation:** The process by which a less specialized cell becomes a more specialized cell type. For example, a meristematic cell differentiating into a mesophyll cell.
- **Dedifferentiation:** The process by which mature, differentiated, non-dividing cells revert to a meristematic (undifferentiated) state and regain the ability to divide. This is exactly what happens when permanent mesophyll cells form a callus.
- **Redifferentiation:** The process by which dedifferentiated cells (like callus cells) divide and then differentiate again to form new, specialized cells, tissues, or organs.
- **Senescence:** The process of aging in plants.

The phenomenon described in the question, where specialized mesophyll cells form an undifferentiated callus, is a classic example of dedifferentiation.

Step 4: Final Answer:
The formation of callus from leaf mesophyll cells is called dedifferentiation.

Quick Tip

Remember the cycle in tissue culture:

1. Start with a differentiated cell (explant).
2. It undergoes **dedifferentiation** to form a callus.
3. The callus undergoes **redifferentiation** to form a new plantlet.

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

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

Correct Answer: (D) Tungsten or gold

Solution:

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

Step 3: Detailed Explanation:
The gene gun method, also known as biolistic particle delivery system, is a technique for introducing foreign DNA into cells.
The method involves coating microscopic particles of a heavy metal with the DNA of interest. These DNA-coated microprojectiles are then accelerated to high velocity and fired into the target cells or tissues.
The particles must be dense enough to penetrate the cell walls and membranes but also be biologically inert to not harm the cells.
The metals of choice for these microparticles are **gold (Au)** or **tungsten (W)** due to their high density and chemical inertness.

Step 4: Final Answer:
Microparticles of tungsten or gold are used in the gene gun method.

Quick Tip

Associate the "gene gun" with valuable projectiles. Gold and Tungsten are heavy, dense metals, making them suitable "bullets" for this technique. This is a common fact-based question in biotechnology.

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

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

(D) bat pollinated plants

Correct Answer: (B) insect pollinated plants

Solution:

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

Step 3: Detailed Explanation:
These characteristics are adaptations to attract animal pollinators. Let's analyze the options:

- **Wind pollinated plants (anemophily):** Flowers are typically small, inconspicuous, not colourful, and lack fragrance and nectar, as they do not need to attract pollinators.
- **Insect pollinated plants (entomophily):** Flowers have evolved to attract insects. Large size and bright colours provide visual cues, fragrance provides an olfactory cue, and nectar serves as a food reward. The combination of all these traits is characteristic of insect pollination.
- **Bird pollinated plants (ornithophily):** Flowers are often large and brightly coloured (especially red or orange), with abundant nectar, but they are typically odorless because birds have a poor sense of smell.
- **Bat pollinated plants (chiropterophily):** Flowers are usually large, pale or white, open at night, and emit a strong, musky or fruity odor. They also produce copious nectar.

The combination of being large, colourful, **fragrant**, and having nectar is the classic suite of traits for flowers pollinated by insects like bees and butterflies.

Step 4: Final Answer:
The described floral characteristics are adaptations for insect pollination.

Quick Tip

Remember that different pollinators perceive different cues. Insects see colour and smell fragrance. Birds see colour but don't smell well. Bats are nocturnal and rely on strong smells and pale colours visible at night.

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128. Expressed Sequence Tags (ESTs) refers to

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

(D) All genes whether expressed or unexpressed.

Correct Answer: (B) 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 3: Detailed Explanation:
Expressed Sequence Tags (ESTs) are a tool used in genomics to identify gene transcripts. The process involves:

1. Isolating all the messenger RNA (mRNA) from a cell or tissue.
2. Using the enzyme reverse transcriptase to create complementary DNA (cDNA) from the mRNA templates.
3. Sequencing short fragments (tags) from one or both ends of these cDNAs.

Since the process starts with mRNA, which is the product of gene transcription (expression), ESTs represent parts of genes that are being expressed as RNA in that specific cellular context. Therefore, the collection of ESTs from a sample represents "all genes that are expressed as RNA".

- Option (A) is too restrictive; ESTs identify all expressed genes, not just "important" ones.
- Option (C) is incorrect because ESTs are derived from RNA transcripts. Not all RNAs are translated into proteins.
- Option (D) is incorrect because ESTs are by definition derived from expressed genes only.

Step 4: Final Answer:
ESTs refer to all genes that are expressed as RNA.

Quick Tip

Break down the name: "Expressed" means it comes from transcribed genes (mRNA). "Sequence Tag" means it's a short piece of sequence used to identify a longer transcript. This helps recall that ESTs are markers for genes expressed as RNA.

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

(A) Active Transport
(B) Osmosis

(C) Facilitated Diffusion
(D) Passive Transport

Correct Answer: (A) Active Transport

Solution:

Step 1: Understanding the Question:
The question asks to identify the transport mechanism that allows ions to move and accumulate against a concentration gradient (i.e., from a region of lower concentration to a region of higher concentration).

Step 3: Detailed Explanation:
Let's analyze the transport mechanisms:

- **Passive Transport:** This is the movement of substances **down** the concentration gradient (from high to low concentration) and does not require energy. Simple diffusion and facilitated diffusion are types of passive transport.
- **Facilitated Diffusion:** A type of passive transport where substances move down the concentration gradient with the help of membrane proteins (channels or carriers). No energy is expended.
- **Osmosis:** The specific movement of water across a selectively permeable membrane from a region of high water potential to low water potential. It is a type of passive transport.
- **Active Transport:** This is the movement of substances **against** the concentration gradient. This process is "uphill" and requires the cell to expend metabolic energy (usually from ATP). It is carried out by specific membrane proteins called pumps.

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

Step 4: Final Answer:
The movement of ions against a concentration gradient is explained by Active Transport.

Quick Tip

Think of concentration gradients like a hill. Passive transport is like rolling a ball downhill (no energy needed). Active transport is like pushing a ball uphill (energy is required). "Against the gradient" means "uphill."

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

Correct Answer: (B) 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 consumption of ATP during the process of glycolysis. We need to evaluate their truthfulness and the relationship between them.

Step 3: Detailed Explanation:
Assertion A Analysis:
Glycolysis is a 10-step process. In the initial "preparatory" or "investment" phase, energy is consumed.

- **Step 1:** Glucose is phosphorylated to glucose-6-phosphate. This reaction consumes one molecule of ATP.
- **Step 3:** Fructose-6-phosphate is phosphorylated to fructose-1,6-bisphosphate. This reaction consumes a second molecule of ATP.

No other steps in glycolysis consume ATP. Therefore, the statement "ATP is used at two steps in glycolysis" is correct. Assertion A is true.

Reason R Analysis:
The reason states the specific steps where ATP is used: "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." As detailed above, these are precisely the two ATP-consuming steps. Therefore, Reason R is also true.

Explanation Analysis:
Reason R provides the exact details that validate Assertion A. It explains *which* two steps use ATP, thus serving as a direct and correct explanation for the assertion.

Step 4: Final Answer:
Both Assertion A and Reason R are true, and R is the correct explanation of A.

Quick Tip

Remember glycolysis as having an "investment phase" and a "payoff phase." In the investment phase, you spend 2 ATP (at steps 1 and 3). In the payoff phase, you generate 4 ATP and 2 NADH. The net gain is 2 ATP and 2 NADH.

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

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

Correct Answer: (C) Gibberellic Acid

Solution:

Step 1: Understanding the Question:
The question asks which plant hormone can be used to speed up the transition from the juvenile to the mature phase in conifers, thereby promoting earlier seed production.

Step 3: Detailed Explanation:
Let's review the functions of the listed phytohormones:

- **Abscisic Acid (ABA):** Generally acts as a growth inhibitor. It promotes dormancy and stomatal closure during stress. It does not hasten maturity.
- **Indole-3-butyric Acid (IBA):** An auxin that primarily promotes root initiation in stem cuttings.
- **Gibberellic Acid (GA):** Gibberellins have many roles, including promoting stem elongation (bolting), seed germination, and flowering. A significant commercial application is spraying juvenile conifers with GAs to overcome the juvenile phase and induce early flowering and seed production. This shortens the breeding cycle.
- **Zeatin:** A type of cytokinin that promotes cell division, delays senescence, and overcomes apical dominance. It does not have a primary role in hastening maturity.

The specific effect of promoting early maturity in juvenile conifers is a well-known function of gibberellins.

Step 4: Final Answer:
Spraying with Gibberellic Acid helps in hastening the maturity period of juvenile conifers.

Quick Tip

Associate Gibberellins (GA) with "growing up" and "growing tall" in plants. They cause bolting (stem elongation before flowering) and help plants mature faster, especially in conifers.

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

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

Correct Answer: (C) Selaginella and Salvinia

Solution:

Step 1: Understanding the Question:
The question asks to identify a pair of pteridophytes that are both heterosporous. Heterosporous plants produce two distinct types of spores: smaller microspores (which develop into male gametophytes) and larger megaspores (which develop into female gametophytes).

Step 3: Detailed Explanation:
Let's classify the given pteridophytes as either homosporous (producing one type of spore) or heterosporous:

- **Equisetum:** Homosporous.
- **Lycopodium:** Homosporous.
- **Psilotum:** Homosporous.
- **Selaginella:** Heterosporous.
- **Salvinia:** Heterosporous.

Other examples of heterosporous pteridophytes include *Azolla*, *Marsilea*, and *Isoetes*.

Now let's evaluate the options:

- (A) Equisetum (homosporous) and Salvinia (heterosporous). Not a pair of heterosporous plants.
- (B) Lycopodium (homosporous) and Selaginella (heterosporous). Not a pair of heterosporous plants.
- (C) **Selaginella (heterosporous) and Salvinia (heterosporous).** This is a correct pair of heterosporous pteridophytes.

- (D) Psilotum (homosporous) and Salvinia (heterosporous). Not a pair of heterosporous plants.

Step 4: Final Answer:
Both Selaginella and Salvinia are heterosporous pteridophytes.

Quick Tip

Most pteridophytes are homosporous. Remember the key exceptions that are heterosporous: *Selaginella*, *Salvinia*, *Azolla*, and *Marsilea*. The "S" genera (*Selaginella*, *Salvinia*) are the most common examples in exams.

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

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

Solution:

Step 1: Understanding the Question:
The question provides an Assertion (A) about the characteristics of late wood and a Reason (R) about the activity of cambium in winter. We need to determine if they are true and if R explains A.

Step 3: Detailed Explanation:
Assertion A Analysis:
In temperate regions, the vascular cambium's activity changes with the seasons, leading to the formation of annual rings.

- **Spring wood (early wood):** Formed during spring when the cambium is very active. It consists of a large number of xylary elements with wider vessels.
- **Autumn wood (late wood):** Formed during autumn/winter when the cambium is less active. It has fewer xylary elements, and the vessels are narrow and thick-walled. This wood is denser.

So, the statement "Late wood has fewer xylary elements with narrow vessels" is correct. Assertion A is true.

Reason R Analysis:
The activity of the vascular cambium is regulated by physiological and environmental factors. During the unfavorable conditions of winter (low temperature, short daylight), the cambium becomes less active or dormant. Therefore, the statement "Cambium is less active in winters" is correct. Reason R is true.

Explanation Analysis:
The reduced activity of the cambium in winter (Reason R) is the direct cause of the structural features of late wood described in Assertion A (fewer elements, narrow vessels). Because the cambium is less active, it produces fewer cells, and the cells that are produced do not expand as much, resulting in narrow lumens. Thus, R is the correct explanation for A.

Step 4: Final Answer:
Both Assertion A and Reason R are true, and R is the correct explanation of A.

Quick Tip

Think of it like this: Spring = favorable conditions, high activity, big/wide cells (spring wood). Winter = unfavorable conditions, low activity, small/narrow cells (late wood). The difference between these two creates the annual ring.

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

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

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

Solution:

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

Step 3: Detailed Explanation:
In eukaryotic nuclei, transcription is carried out by three distinct RNA polymerases, each with a specific set of genes to transcribe:

- **RNA Polymerase I:** Located in the nucleolus, it transcribes the genes for the large ribosomal RNAs (rRNAs): 28S, 18S, and 5.8S rRNA.
- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes the precursor of messenger RNA (called pre-mRNA or hnRNA) and most small nuclear RNAs (snRNAs).
- **RNA Polymerase III:** Located in the nucleoplasm, it transcribes the genes for transfer RNA (tRNA), the 5S ribosomal RNA (a small component of the large ribosomal subunit), and some small nuclear RNAs (e.g., U6 snRNA).

Based on this division of labor:

- Option (A) is incorrect.
- Option (B) describes the function of RNA Polymerase I.
- Option (C) correctly lists the main transcripts produced by RNA Polymerase III.
- Option (D) describes the function of RNA Polymerase II.

Step 4: Final Answer:
The role of RNA polymerase III is the transcription of tRNA, 5S rRNA, and some snRNAs.

Quick Tip

Use the mnemonic "1, 2, 3 - R, M, T". RNA Pol **I** makes **r**RNA. RNA Pol **II** makes **m**RNA. RNA Pol **III** makes **t**RNA (and other small RNAs like 5S rRNA).

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks for the total number of ATP and NADPH molecules required by the Calvin cycle to synthesize one molecule of glucose ($C_6H_{12}O_6$). (Note: $NADPH_2$ is an older notation for NADPH + H^+, and is equivalent to NADPH in this context).

Step 2: Key Formula or Approach:
The synthesis of one glucose molecule requires 6 turns of the Calvin cycle, as each turn fixes one

molecule of CO_2. We need to calculate the ATP and NADPH cost per turn and then multiply by 6.

Step 3: Detailed Explanation:
Let's analyze the energy requirements for one turn of the Calvin cycle (fixing 1 CO_2):

1. **Reduction Phase:** Two molecules of 3-PGA are converted to two molecules of glyceraldehyde-3-phosphate (G3P). This step requires 2 ATP and 2 NADPH.
2. **Regeneration Phase:** For every 3 turns of the cycle, 5 molecules of G3P are used to regenerate 3 molecules of RuBP. This process requires 3 ATP. Per turn, this averages to 1 ATP.

So, the total cost for one turn of the Calvin cycle is:

- ATP: 2 (from reduction) + 1 (from regeneration) = 3 ATP
- NADPH: 2 (from reduction) = 2 NADPH

To synthesize one molecule of glucose (C_6), the cycle must turn 6 times.

- Total ATP required = 6 turns $\times$ 3 ATP/turn = **18 ATP**
- Total NADPH required = 6 turns $\times$ 2 NADPH/turn = **12 NADPH**

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

Quick Tip

Remember the numbers 3 and 2 for the Calvin cycle. For every 1 CO_2 fixed, you need **3 ATP** and **2 NADPH**. To make glucose (C_6), multiply everything by 6.

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136. Match List I with List II :

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

Choose the correct answer from the options given below :

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

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

Solution:

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

Step 3: Detailed Explanation:
Let's match each micronutrient with its role:

- **A. Iron (Fe):** Iron is a crucial component of proteins involved in electron transport, such as cytochromes and ferredoxin. It is also required for chlorophyll formation and is an essential activator for the enzyme catalase. Thus, **A matches with III**.
- **B. Zinc (Zn):** Zinc is required for the synthesis of the plant hormone auxin (as it activates enzymes involved in tryptophan synthesis, a precursor to auxin). It is also an activator of various other enzymes like carboxylases. Thus, **B matches with I**.
- **C. Boron (B):** Boron is required for the uptake and utilization of Ca^{2+}, membrane functioning, pollen germination, cell elongation, and cell differentiation. Thus, **C matches with IV**.
- **D. Molybdenum (Mo):** Molybdenum is a component of several enzymes, most notably nitrate reductase and nitrogenase, both of which are critical for nitrogen metabolism. Thus, **D matches with II**.

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

Step 4: Final Answer:
Looking at the options, option (D) provides the correct combination: A-III, B-I, C-IV, D-II.

Quick Tip

For mineral nutrition matching questions, memorize at least one key, unique function for each element. For example: Zinc → Auxin synthesis; Molybdenum → Nitrate reductase; Boron → Pollen germination; Iron → Catalase/Chlorophyll synthesis.

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

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

Correct Answer: (B) 80

Solution:

Step 1: Understanding the Question:
The question asks for the approximate number of different proteins that make up a ribosome. The question does not specify prokaryotic or eukaryotic, but typically in a general context, it refers to eukaryotes, and we should check which answer fits best.

Step 3: Detailed Explanation:
Ribosomes are complex macromolecular machines composed of ribosomal RNA (rRNA) and ribosomal proteins.

- **Prokaryotic Ribosomes (70S):** The 30S subunit has about 21 proteins, and the 50S subunit has about 34 proteins, making a total of approximately 55 proteins.
- **Eukaryotic Ribosomes (80S):** The 40S subunit has about 33 proteins, and the 60S subunit has about 49 proteins, making a total of approximately 82 proteins.

Looking at the given options:

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

The value 80 is the closest approximation to the number of proteins found in a eukaryotic ribosome (82). The other options are significantly different from the protein counts in either prokaryotic or eukaryotic ribosomes.

Step 4: Final Answer:
A ribosome (eukaryotic) consists of approximately 80 different proteins.

Quick Tip

Remember the general composition of ribosomes. Eukaryotic ribosomes are larger (80S) and more complex than prokaryotic ones (70S). The number 80 in the option is a strong hint towards the 80S eukaryotic ribosome.

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138. Match List I with List II : Choose the correct answer from the options given

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

below :

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

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

Solution:

Step 1: Understanding the Question:
This question requires matching metabolic processes from List I with their associated enzymes, pathways, or locations from List II.

Step 3: Detailed Explanation:
Let's match each process:

- **A. Oxidative decarboxylation:** This refers to the link reaction where pyruvate is converted to Acetyl-CoA. This reaction is catalyzed by the pyruvate dehydrogenase complex. Thus, **A matches with II**.
- **B. Glycolysis:** This is the initial pathway for glucose breakdown. It is also known as the Embden-Meyerhof-Parnas (EMP) pathway. Thus, **B matches with IV**.
- **C. Oxidative phosphorylation:** This is the final stage of cellular respiration where the energy from NADH and $FADH_2$ is used to produce ATP. This process occurs via the Electron Transport System (ETS) located on the inner mitochondrial membrane. Thus, **C matches with III**.
- **D. Tricarboxylic acid cycle (TCA cycle):** Also known as the Krebs cycle or citric acid cycle. The cycle begins when acetyl-CoA combines with oxaloacetate to form citrate, a reaction catalyzed by the enzyme citrate synthase. Therefore, this enzyme is fundamentally linked to the cycle. Thus, **D matches with I**.

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

Step 4: Final Answer:
Looking at the options, option (A) provides the correct combination: A-II, B-IV, C-III, D-I.

Quick Tip

Create a mental flowchart for cellular respiration: Glycolysis (EMP pathway) → Pyruvate → Oxidative Decarboxylation (by Pyruvate Dehydrogenase) → Acetyl-CoA → TCA Cycle (starts with Citrate Synthase) → Electron Transport System (for Oxidative Phosphorylation). This flow helps to link the terms correctly.

139. Match List I with List II : Choose the correct answer from the options given

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

below :

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching different types of population interactions (List I) with their symbolic representations (List II), where '+' denotes benefit, '-' denotes harm, and '0' denotes no significant effect.

Step 3: Detailed Explanation:
Let's analyze each interaction:

- **A. Mutualism:** An interaction where both species benefit from each other. The representation is (+, +). Thus, **A matches with IV**.
- **B. Commensalism:** An interaction where one species benefits, and the other is neither harmed nor benefited (unaffected). The representation is (+, 0). Thus, **B matches with I**.
- **C. Amensalism:** An interaction where one species is harmed, and the other is unaffected. The representation is (-, 0). Thus, **C matches with II**.
- **D. Parasitism:** An interaction where one species (the parasite) benefits at the expense of the other species (the host), which is harmed. The representation is (+, -). Thus, **D matches with III**.

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

Step 4: Final Answer:
Comparing our matches with the given options, option (C) correctly represents the relationships: A-IV, B-I, C-II, D-III.

Quick Tip

Create a simple table to memorize these interactions. Key pairs to remember are Mutualism (+,+) vs. Competition (-,-) and Commensalism (+,0) vs. Amensalism (-,0).

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

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

Solution:

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

Step 3: Detailed Explanation:
Statement I Analysis:
This statement provides the definition of Gause's 'Competitive Exclusion Principle'. The principle indeed states that when two species compete for the exact same limited resources, one species will be more efficient and will eventually outcompete and eliminate the other. This statement is a correct definition of the principle. Thus, Statement I is correct.

Statement II Analysis:
This statement makes a broad generalization that carnivores are more affected by competition than herbivores. Competition is a powerful evolutionary force at all trophic levels. Herbivores often face intense interspecific and intraspecific competition for limited plant resources. Carnivores also face intense competition for prey and territory. There is no universally accepted ecological rule that states that competition is inherently more adverse for carnivores than for herbivores. The intensity of competition depends on various factors like resource availability, niche overlap, and population density, not just the trophic level. Therefore, this generalization is considered incorrect. Thus, Statement II is false.

Step 4: Final Answer:
Statement I is correct, and Statement II is false.

Quick Tip

Remember Gause's principle with the phrase "complete competitors cannot coexist." For broad ecological statements, be cautious. Generalizations like "always" or "more than" are often incorrect because ecosystems are complex and context-dependent.

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

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

Correct Answer: (C) A and D only

Solution:

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

Step 3: Detailed Explanation:
Let's evaluate each statement:

- **A. Lenticels are the lens-shaped openings permitting the exchange of gases.** This is correct. Lenticels are pores in the periderm of woody plants that allow for gas exchange between the internal tissues and the atmosphere.
- **B. Bark formed early in the season is called hard bark.** This is incorrect. Bark formed early in the season (spring) is called 'early' or 'soft' bark, while that formed late in the season is 'late' or 'hard' bark.
- **C. Bark is a technical term that refers to all tissues exterior to vascular cambium.** This is a broad, non-technical definition of bark. While correct in a general sense, there is a more precise definition.

- **D. Bark refers to periderm and secondary phloem.** This is the more precise, technical definition. Bark includes the secondary phloem (inner bark) and the periderm (outer bark). This statement is correct.
- **E. Phellogen is single-layered in thickness.** This is incorrect. Phellogen, or cork cambium, is a meristematic tissue and is typically a few cell layers thick, not just a single layer.

The definitively correct statements are A and D. Statement C is a less precise definition but not entirely wrong, however, D is the better technical definition. Given the options, the combination of the two most accurate statements must be chosen.

Step 4: Final Answer:
Statements A and D are correct. Therefore, the correct option is (C).

Quick Tip

Remember that "bark" is a common word with a specific biological meaning. Technically, it's everything outside the vascular cambium. More specifically, it's composed of periderm and secondary phloem.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to arrange the given steps of creating recombinant DNA in the correct chronological order.

Step 3: Detailed Explanation:
The process of recombinant DNA technology involves a series of sequential steps:

1. The process begins with identifying and isolating the gene of interest. This corresponds to **C. Isolation of desired DNA fragment**.
2. Once the source DNA is isolated, restriction enzymes are used to cut out the specific gene of interest. This is **B. Cutting of DNA at specific location by restriction enzyme**.
3. To get a sufficient quantity of the gene for further steps, it is amplified using the Polymerase Chain Reaction (PCR). This is **D. Amplification of gene of interest using PCR**. (This step is often done after isolating the gene, before or after ligation into a vector).
4. The amplified gene of interest is then ligated into a vector to create recombinant DNA (this step is not listed, but is implied before A).
5. Finally, the recombinant DNA (vector + gene) is introduced into a suitable host cell for cloning or expression. This is **A. Insertion of recombinant DNA into the host cell**.

The logical sequence of the given steps is C $\rightarrow$ B $\rightarrow$ D $\rightarrow$ A.

Step 4: Final Answer:
The correct sequence is C, B, D, A, which corresponds to option (D).

Quick Tip

Think of the process like a recipe: First, you get your special ingredient (C: Isolate gene). Then you prepare it (B: Cut with enzymes). Then you make more of it if needed (D: Amplify with PCR). Finally, you add it to the main dish (A: Insert into host).

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

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

Solution:

Step 1: Understanding the Question:
The question provides an Assertion and a Reason related to pollination in gymnosperms. We need to evaluate their correctness and the relationship between them.

Step 3: Detailed Explanation:
Assertion A Analysis:
This statement describes the mode of pollination in gymnosperms. Gymnosperms are typically wind-pollinated (anemophilous). The pollen grains, which develop in the microsporangium, are lightweight and produced in large quantities to be dispersed by air currents. This statement is correct. So, Assertion A is true.

Reason R Analysis:
This statement describes the events after pollination. It has two parts. First, "Air currents carry the pollen grains to the mouth of the archegonia". The pollen grain lands on the micropyle of the ovule, not directly on the archegonium which is deep inside the ovule. Second, and more importantly, it claims "...pollen tube is not formed". This is incorrect. In most gymnosperms (like Pinus), the pollen grain germinates on the ovule to form a pollen tube, which grows towards the archegonium to deliver the male gametes. This process is called siphonogamy. Therefore, the statement that the pollen tube is not formed is false. So, Reason R is false.

Step 4: Final Answer:
Assertion A is true, but Reason R is false.

Quick Tip

Remember that the development of the pollen tube (siphonogamy) is a key evolutionary advancement seen in both gymnosperms and angiosperms, which allows for fertilization without the need for external water.

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

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

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

Solution:

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

Step 3: Detailed Explanation:
Let's analyze each statement:

- **(A)** This statement correctly describes the phenomenon of **biomagnification**, where the concentration of non-biodegradable toxic substances increases at each successive trophic level in a food chain.
- **(B)** This statement correctly describes the consequences of high organic pollution. Decomposer microorganisms consume dissolved oxygen to break down organic waste, increasing the Biological Oxygen Demand (BOD). This depletion of oxygen can lead to hypoxia or anoxia, causing mass death of fish and other aquatic organisms.
- **(C)** This statement is **incorrect**. Algal blooms are caused by nutrient enrichment (eutrophication), often from sewage and agricultural runoff. They severely **degrade water quality** by blocking sunlight, producing toxins, and causing severe oxygen depletion when they die and decompose. This leads to the death of fish and does not promote fisheries; it destroys them.
- **(D)** This statement is correct. Water hyacinth (*Eichhornia crassipes*) is a notorious invasive weed that thrives in nutrient-rich (eutrophic) waters. Its rapid growth covers the water surface, blocking light and oxygen, which disrupts the aquatic ecosystem.

Step 4: Final Answer:
The incorrect statement is (C), as algal blooms are detrimental to water quality and aquatic life.

Quick Tip

Associate "algal bloom" and "eutrophication" with negative consequences: oxygen depletion, fish kills, and poor water quality. Any statement claiming they are beneficial is almost certainly incorrect.

---

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

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

Correct Answer: (D) B and E only

Solution:

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

Step 3: Detailed Explanation:
Let's evaluate each statement regarding Klinefelter's Syndrome (genotype 47, XXY):

- **A. This disorder was first described by Langdon Down (1866).** This is incorrect. Langdon Down described Down's Syndrome. Klinefelter's Syndrome was described by Dr. Harry Klinefelter in 1942.
- **B. Such an individual has overall masculine development. However, the feminine development is also expressed.** This is correct. The presence of the Y chromosome leads to male development, but the extra X chromosome leads to the expression of some feminine characteristics, such as the development of breasts (gynaecomastia).
- **C. The affected individual is short statured.** This is incorrect. Individuals with Klinefelter's Syndrome are often taller than average. Short stature is characteristic of Turner's Syndrome (45, X0).
- **D. Physical, psychomotor and mental development is retarded.** This is incorrect. While some learning difficulties may be present, severe mental retardation is not a typical feature of Klinefelter's Syndrome. This description is more characteristic of Down's Syndrome.
- **E. Such individuals are sterile.** This is correct. The extra X chromosome impairs the development of the testes, leading to low testosterone production and infertility.

The correct statements are B and E.

Step 4: Final Answer:
The combination of correct statements is B and E, which is given in option (D).

Quick Tip

To remember the key features of chromosomal disorders:

- **Klinefelter's (XXY):** A tall, sterile male with some female characteristics (gynaecomastia).
- **Turner's (XO):** A short, sterile female with underdeveloped secondary sexual characteristics.
- **Down's (Trisomy 21):** Short stature, characteristic facial features, and retarded development.

---

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

Correct Answer: (B) 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) defining a flower and a Reason (R) describing the morphological changes involved. We need to evaluate if both are true and if the reason explains the assertion.

Step 3: Detailed Explanation:
Assertion A Analysis:
The statement "A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem" is the accepted botanical definition of a flower. The vegetative shoot apex transforms into a reproductive apex that produces floral parts instead of leaves. So, Assertion A is true.

Reason R Analysis:
The statement "Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves" explains the process of modification. The floral

axis (thalamus) is a condensed stem where internodes do not elongate. The floral parts (sepals, petals, stamens, carpels) are homologous to leaves and arise from these condensed nodes. So, Reason R is also true.

Explanation Analysis:
The reason (R) provides the specific details of how a shoot is modified to become a flower—the condensation of internodes and the modification of leaves into floral appendages. This directly explains why a flower is considered a modified shoot (A). Therefore, R is the correct explanation for A.

Step 4: Final Answer:
Both Assertion A and Reason R are true, and R is the correct explanation of A.

Quick Tip

Remember the evidence for a flower being a modified shoot: the thalamus is a condensed stem, and floral parts like sepals and petals are structurally similar to leaves. This homology is a core concept in plant morphology.

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147. Match List I with List II : Choose the correct answer from the options given below :

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

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

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

Solution:

Step 1: Understanding the Question:
The question requires matching the phases of the cell cycle (List I) with their corresponding descriptions or key events (List II).

Step 3: Detailed Explanation:
Let's match each phase with its description:

- **A. M Phase:** This is the mitotic phase where the cell divides. Mitosis is known as equational division because the chromosome number in the daughter cells is the same as in the parent cell. Thus, **A matches with IV**.
- **B. G_2 Phase:** This is the second gap phase, occurring after DNA synthesis (S phase) and before mitosis (M phase). During G_2, the cell prepares for division, which includes the synthesis of proteins like tubulin required for the spindle apparatus. Thus, **B matches with I**.
- **C. Quiescent stage (G_0):** This is a non-dividing state where cells exit the cell cycle. Cells in G_0 are metabolically active but do not proliferate. It can be considered an inactive phase with respect to cell division. Thus, **C matches with II**.
- **D. G_1 Phase:** This is the first gap phase, which is the interval between the end of mitosis (M phase) and the beginning of DNA synthesis (S phase). Thus, **D matches with III**.

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

Step 4: Final Answer:
Comparing our matches with the given options, option (D) correctly represents the relationships: A-IV, B-I, C-II, D-III.

Quick Tip

Visualize the cell cycle as a clock: M $\rightarrow$ G_1 $\rightarrow$ S $\rightarrow$ G_2 $\rightarrow$ M. G_1 is the gap before S (Synthesis). G_2 is the gap after S. M is the division itself. G_0 is an exit ramp from G_1.

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

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

Correct Answer: (B) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks for the specific enzyme that is inhibited by malonate (spelled as "Melonate" in the question), leading to the inhibition of bacterial growth.

Step 3: Detailed Explanation:
Malonate is a classic example of a competitive inhibitor in biochemistry. Its molecular structure

is very similar to that of succinate, the natural substrate for the enzyme succinic dehydrogenase.
Succinic dehydrogenase is a key enzyme in the Krebs cycle (citric acid cycle), where it catalyzes the oxidation of succinate to fumarate.
Because of its structural similarity, malonate binds to the active site of succinic dehydrogenase but cannot be acted upon by the enzyme. This binding blocks the real substrate, succinate, from accessing the active site.
By inhibiting this crucial step in the Krebs cycle, malonate disrupts aerobic respiration and ATP production, thereby inhibiting the growth and proliferation of organisms like pathogenic bacteria that rely on this pathway.

Step 4: Final Answer:
Malonate inhibits the enzyme succinic dehydrogenase.

Quick Tip

Remember the concept of competitive inhibition: "A similar-looking molecule competes for the same spot." Malonate looks like succinate, so it competes for the active site of succinic dehydrogenase. This is a frequently cited example.

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

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

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

Solution:

Step 1: Understanding the Question:
The question asks to identify the essential components required for the process of chemiosmosis, which is the mechanism for ATP synthesis in both photosynthesis and cellular respiration.

Step 3: Detailed Explanation:
According to Peter Mitchell's chemiosmotic theory, ATP synthesis is coupled to the movement of protons across a membrane. The essential requirements are:

1. **A membrane:** An intact, impermeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is necessary to separate two aqueous compartments and maintain a proton gradient.

2. **A proton pump:** This is typically the electron transport chain (ETC), which uses the energy from electron flow to actively pump protons (H^+) from one side of the membrane to the other.
3. **A proton gradient:** The pumping of protons creates an electrochemical potential difference across the membrane, also known as the proton motive force. This gradient is a form of stored energy.
4. **ATP synthase:** This is a large enzyme complex embedded in the membrane. It has a channel that allows protons to flow back across the membrane down their concentration gradient. This flow of protons drives the catalytic site of the enzyme to synthesize ATP from ADP and inorganic phosphate (Pi).

Option (B) includes all four of these essential components. The other options are incorrect because they either miss a component (like the membrane) or name the wrong enzyme (NADP synthase instead of ATP synthase) or gradient (electron gradient instead of proton gradient).

Step 4: Final Answer:
The combination required for chemiosmosis is a membrane, a proton pump, a proton gradient, and ATP synthase.

Quick Tip

Think of chemiosmosis like a hydroelectric dam. The **membrane** is the dam. The **proton pump** is the machinery that pumps water up to the reservoir. The **proton gradient** is the stored water in the reservoir. The **ATP synthase** is the turbine that generates energy (ATP) as the water flows back down.

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150. Match List I with List II : Choose the correct answer from the options given below :

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

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

Correct Answer: (B) 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 and plant water relations (List I) with their correct definitions (List II).

Step 3: Detailed Explanation:
Let's match each term:

- **A. Cohesion:** Refers to the attraction between molecules of the same substance. For water, it is the strong mutual attraction between water molecules due to hydrogen bonds. Thus, **A matches with II**.
- **B. Adhesion:** Refers to the attraction between molecules of different substances. In plants, it is the attraction of water molecules to polar surfaces like the lignocellulosic walls of xylem vessels. Thus, **B matches with IV**.
- **C. Surface tension:** A property of liquids that allows them to resist an external force, due to the cohesive nature of its molecules. Water molecules are more attracted to each other in the liquid phase than to water in the gas phase. This leads to high surface tension. Thus, **C matches with I**.
- **D. Guttation:** The process of water exudation in liquid form (as droplets) from the hydathodes at the tips or margins of leaves. This is literally water loss in the liquid phase. Thus, **D matches with III**.

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

Step 4: Final Answer:
Comparing our matches with the given options, option (B) correctly represents the relationships: A-II, B-IV, C-I, D-III.

Quick Tip

Remember the "co-" in cohesion means "together" (like molecules sticking together). The "ad-" in adhesion means "to" (like molecules sticking to a surface). Differentiate guttation (liquid water loss) from transpiration (water vapor loss).
