NEET UG 2023 G1 Botany Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**720	**Total Questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

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

Section - A

101. 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 for the biological process responsible for moving ions across a cell membrane from a region of lower concentration to a region of higher concentration, which is "against their concentration gradient."

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

- **Active Transport:** This process moves substances against their concentration gradient (from low to high concentration). It requires cellular energy in the form of ATP. This matches the description in the question.

- **Osmosis:** This is the movement of solvent molecules (usually water) across a semipermeable membrane from a region of higher solvent concentration to a region of lower solvent concentration. It is a type of passive transport.

- **Facilitated Diffusion:** This process involves membrane proteins to facilitate the movement of substances across the membrane, but it still occurs down the concentration gradient (from high to low concentration) and does not require metabolic energy.

- **Passive Transport:** This is a general term for the movement of substances across a cell membrane without the use of energy by the cell, following the concentration gradient. Osmosis and facilitated diffusion are types of passive transport.

The key phrase in the question is "against their concentration gradient." Only active transport accomplishes this.

Step 3: Final Answer:
Therefore, the movement and accumulation of ions against their concentration gradient is explained by Active Transport.

Quick Tip

Remember the key distinction: **Active transport** = against the gradient + requires energy (ATP). **Passive transport** = with the gradient + no energy required. This simple rule helps solve most questions on membrane transport.

102. 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 2: Detailed Explanation:
'The Evil Quartet' is a term used to describe the four major causes of biodiversity loss:

1. **Habitat loss and fragmentation:** This is the destruction or division of natural habitats due to activities like deforestation, urbanization, and agriculture. It is widely regarded by ecologists as the single most important cause of extinction. When an organism's habitat is destroyed, it loses its home, food source, and breeding grounds, leading to a population decline and eventual extinction.

2. **Over-exploitation:** This involves harvesting species from the wild at rates faster than natural populations can recover. Examples include overfishing, overhunting, and excessive logging.

3. **Alien species invasions:** When non-native species are introduced into an ecosystem, they can outcompete native species for resources, introduce diseases, or prey on them, leading to their extinction.

4. **Co-extinctions:** This occurs when the extinction of one species causes the extinction of another species that depends on it, such as a parasite and its host or a plant and its specific pollinator.

Among these four, habitat loss and fragmentation affects the largest number of species across all ecosystems globally and is therefore considered the most significant driver of extinction.

Step 3: Final Answer:
The most important cause driving the extinction of species among 'The Evil Quartet' is habitat

loss and fragmentation.

Quick Tip

Remember the acronym **H.O.A.C.** for the Evil Quartet: **H**abitat loss, **O**ver-exploitation, **A**lien species invasion, and **C**o-extinction. Habitat loss is almost always cited as the number one cause.

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103. 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 2: Detailed Explanation:
Expressed Sequence Tags (ESTs) are short subsequences of a cDNA (complementary DNA) sequence. Here's a breakdown of the process and what they represent:

- The first step in gene expression is transcription, where a gene's DNA sequence is copied into a messenger RNA (mRNA) molecule.
- To create ESTs, scientists first isolate all the mRNA from a cell or tissue.
- Then, using the enzyme reverse transcriptase, they create a DNA copy of the mRNA. This is called complementary DNA (cDNA).
- The cDNA molecules are then sequenced from one or both ends to generate short "tags" of a few hundred base pairs. These are the ESTs.

Since ESTs are derived from mRNA, they represent portions of genes that are being actively expressed (transcribed into RNA) in that specific cell or tissue at that specific time. Therefore, ESTs represent all genes that are expressed as RNA. They are a tool to identify transcribed regions of the genome.

Step 3: Final Answer:
Based on the definition, ESTs refer to all genes that are expressed as RNA.

Quick Tip

The key is in the name: "Expressed" Sequence Tags. In molecular biology, gene "expression" primarily refers to the process of transcription (DNA to RNA). So, ESTs are tags for expressed (transcribed) genes.

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104. 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 pleiotropism.

Step 2: Detailed Explanation:
Let's analyze the options in the context of genetics:

- **(A) more than two genes affecting a single character:** This describes polygenic inheritance, not pleiotropy. For example, human skin color is determined by multiple genes.
- **(B) presence of several alleles of a single gene controlling a single crossover:** This description is incorrect. The presence of several alleles for a single gene is called multiple allelism. Crossover is a separate meiotic process.
- **(C) presence of two alleles, each of the two genes controlling a single trait:** This statement is confusing and does not accurately describe a standard genetic phenomenon.
- **(D) a single gene affecting multiple phenotypic expression:** This is the correct definition of pleiotropy. A pleiotropic gene is a single gene that controls or influences multiple, seemingly unrelated phenotypic traits. A classic example is the gene for phenylketonuria (PKU), which can cause mental retardation, reduced hair, and skin pigmentation.

Step 3: Final Answer:
The phenomenon of pleiotropism refers to a single gene affecting multiple phenotypic expressions.

Quick Tip

To remember the difference: **Pleiotropy** = One gene → Many traits. **Polygenic Inheritance** = Many genes → One trait. Think of "pleio" as "plural" effects from one gene.

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105. 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 cells (leaf mesophyll cells) are induced to form an undifferentiated mass of cells (callus). It asks for the name of this phenomenon.

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

- **Senescence:** The process of aging in plant cells, tissues, or organs.
- **Differentiation:** The process by which cells become specialized in structure and function. Leaf mesophyll cells are already differentiated cells specialized for photosynthesis.
- **Dedifferentiation:** The process by which differentiated cells lose their specialization and revert to a meristematic, undifferentiated state, regaining the capacity for cell division. When mesophyll cells form a callus, they are dedifferentiating.
- **Development:** The overall process of growth and differentiation of an organism from a zygote to its mature form.

The process described, where mature, specialized mesophyll cells form an unspecialized, dividing mass of callus, is a classic example of dedifferentiation. Later, this callus can be induced to form roots and shoots in a process called redifferentiation.

Step 3: Final Answer:
The phenomenon of differentiated leaf mesophyll cells forming an undifferentiated callus is called dedifferentiation.

Quick Tip

Remember the sequence in tissue culture: 1. **Differentiation** (forms specialized cells like mesophyll). 2. **Dedifferentiation** (specialized cells revert to unspecialized callus). 3. **Redifferentiation** (callus cells specialize again to form new organs like roots/shoots).

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106. 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 Statements:
We need to evaluate the correctness of two statements regarding xylem arrangement in plants.
Statement I claims that 'endarch' and 'exarch' describe the position of secondary xylem.
Statement II claims that the 'exarch' condition is characteristic of the root system.

Step 2: Detailed Explanation:
Analysis of Statement I:
The terms 'endarch' and 'exarch' refer to the pattern of development of the **primary xylem**, not the secondary xylem.

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

- **Exarch:** Protoxylem is located towards the periphery, and metaxylem is located towards the center. This condition is characteristic of roots.

Since these terms describe primary xylem development, Statement I is incorrect.

Analysis of Statement II:
As defined above, the exarch condition, where protoxylem is on the outside and development proceeds inwards, is indeed the most common and defining feature of the vascular arrangement in the root system of plants. Therefore, Statement II is true.

Step 3: Final Answer:
Statement I is incorrect, and Statement II is true. This corresponds to option (A).

Quick Tip

Remember: **Ex**arch is in roots (**ex**it), where xylem goes from outside in. **En**darch is in stems (**en**ter), where xylem goes from inside out. These terms apply only to **primary** xylem.

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107. 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 Statements:
Assertion A states that the protonema is the first stage of the gametophyte in a moss life cycle.
Reason R states that the protonema develops directly from a spore produced in the capsule.
We need to determine if both statements are true and if R correctly explains A.

Step 2: Detailed Explanation:
Analysis of Assertion A:
The life cycle of a moss (a bryophyte) involves an alternation of generations between a diploid sporophyte and a haploid gametophyte. The dominant phase is the gametophyte. When a haploid spore germinates, it first develops into a filamentous, green, branching structure called the protonema. This is the juvenile, or first, stage of the gametophyte. Later, leafy gametophores (the familiar "moss plant") develop from buds on the protonema. Thus, Assertion A is correct.

Analysis of Reason R:
The sporophyte generation in mosses ends with the capsule (sporangium), which produces haploid spores through meiosis. These spores are released, and upon finding a suitable substrate, they germinate and grow directly into the protonema. Thus, Reason R is also correct.

Connecting A and R:
Reason R explains *how* the protonema stage arises. Because the protonema develops directly from the germinating spore, it is logically the *first* stage of the gametophyte generation. Therefore, R is the correct explanation for A.

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

Quick Tip

Visualize the moss life cycle: Spore → Protonema (first stage of gametophyte) → Leafy gametophore (adult gametophyte) → Gametes → Zygote → Sporophyte (foot, seta, capsule) → Spores. This sequence clarifies the relationship between the spore, protonema, and gametophyte.

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

(A) Telophase I
(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 centromere, which holds sister chromatids together, divides.

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

- **Meiosis I (Reductional Division):** The primary goal is to separate homologous chromosomes.
  - **Metaphase I:** Homologous chromosome pairs (bivalents) align at the metaphase plate. The centromeres do not divide.
  - **Anaphase I:** Homologous chromosomes separate and move to opposite poles. Sister chromatids remain attached at their centromeres.
  - **Telophase I:** Chromosomes arrive at the poles, and the cell divides. Each chromosome still consists of two sister chromatids.
- **Meiosis II (Equational Division):** The goal is to separate sister chromatids. This process is very similar to mitosis.
  - **Metaphase II:** Individual chromosomes (each with two chromatids) align at the metaphase plate.
  - **Anaphase II:** The centromeres of each chromosome finally divide (split), and the sister chromatids are pulled apart to opposite poles. These separated chromatids are now considered individual chromosomes.

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

Step 3: Final Answer:
The stage of meiosis that involves the division of the centromere is Anaphase II.

Quick Tip

A key difference to remember: **Anaphase I** separates **homologous chromosomes**. **Anaphase II** separates **sister chromatids**. The separation of chromatids is only possible after the centromere divides.

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109. 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 that has been stained with ethidium bromide (EtBr) and then exposed to ultraviolet (UV) radiation. This is a standard technique in molecular biology.

Step 2: Detailed Explanation:
Ethidium bromide is an intercalating agent commonly used as a fluorescent tag (stain) for nucleic acids, particularly DNA, in molecular biology laboratories. Here's how it works:

1. Ethidium bromide molecules insert themselves (intercalate) between the base pairs of the DNA double helix.

2. When this DNA-EtBr complex is exposed to UV radiation, the EtBr molecule absorbs the UV light and re-emits it at a longer wavelength in the visible spectrum.

3. This re-emitted light is seen as a characteristic bright orange or orange-red fluorescence.

This technique is widely used in agarose gel electrophoresis to visualize DNA bands. Without UV exposure, the stained DNA is not visible.

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

Quick Tip

Remember the combination for DNA visualization: **Agarose Gel + Ethidium Bromide + UV Light = Bright Orange Bands**. This is a fundamental technique in biotechnology and genetics.

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110. 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 substage of Prophase I of meiosis where recombination nodules appear.

Step 2: Detailed Explanation:
Prophase I is the longest phase of meiosis and is divided into five substages:

1. **Leptotene:** Chromosomes start to condense and become visible.

2. **Zygotene:** Synapsis (pairing of homologous chromosomes) begins, forming bivalents. The synaptonemal complex starts to form.

3. **Pachytene:** Synapsis is complete. The paired chromosomes are called bivalents or tetrads. This is the stage where **crossing over** occurs between non-sister chromatids of homologous chromosomes. The sites where crossing over occurs are marked by the appearance of **recombination nodules** on the synaptonemal complex. These nodules contain the enzymes required for genetic recombination.

4. **Diplotene:** The synaptonemal complex dissolves, and the homologous chromosomes start to separate, but they remain attached at the sites of crossing over, called chiasmata.

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

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

Step 3: Final Answer:
The appearance of recombination nodules occurs during the Pachytene substage of prophase I.

Quick Tip

Remember the mnemonic for Prophase I stages: **L**azy **Z**ebra **P**aint **D**ouble **D**ots (**L**eptotene, **Z**ygotene, **P**achytene, **D**iplotene, **D**iakinesis). Crossing over, the main event, happens in the middle stage, Pachytene.

111. 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 (blue-black color), unlike starch.

Step 2: Detailed Explanation:
The iodine test for starch is a well-known chemical test. Starch, specifically the amylose component, gives a characteristic blue-black color with iodine. Let's analyze the structures of starch and cellulose:

- **Starch (Amylose):** It is a polysaccharide made of α-glucose units linked by α-1,4 glycosidic bonds. This type of linkage causes the amylose chain to form a **helical structure**. The interior of this helix is just the right size to trap iodine molecules (specifically, triiodide ions, I_3^-), forming a starch-iodine complex that absorbs light and appears blue-black.

- **Cellulose:** It is also a polysaccharide, but it is made of β-glucose units linked by β-1,4 glycosidic bonds. This linkage results in a **straight, linear chain**, not a helix. These linear chains pack closely together via hydrogen bonds to form strong microfibrils.

Because cellulose has a linear structure and lacks the complex helical coils found in starch, it cannot trap iodine molecules within its structure. Therefore, no color change occurs when iodine is added to cellulose.
Option (B) is incorrect because cellulose is a polysaccharide, not a disaccharide. Option (C) is incorrect because it is not a helical molecule. Option (A) is chemically inaccurate.

Step 3: Final Answer:
Cellulose does not form a blue colour with iodine because it has a linear structure and does not contain the complex helices required to hold iodine molecules.

Quick Tip

Associate the **helical structure of starch (amylose)** with its ability to "hold" or "trap" iodine, leading to the blue-black color. Cellulose is a straight, structural polysaccharide and lacks these helices.

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112. 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 specific to the family Fabaceae and distinguishes it from the families Solanaceae and Liliaceae.

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

- **Family Fabaceae (Leguminosae):** A key feature of the subfamily Papilionoideae (the largest subfamily of Fabaceae) is its androecium (the collective term for stamens). It typically consists of ten stamens that are **diadelphous**, meaning they are fused into two bundles. The common arrangement is (9)+1, where nine stamens are fused to form a tube, and the tenth (posterior) stamen is free. The anthers are **dithecous** (having two lobes).

- **Family Solanaceae (Potato family):** This family typically has five stamens which are **epipetalous** (attached to the petals). The stamens are free from each other (not adelphous), and the anthers are dithecous.

- **Family Liliaceae (Lily family):** This family typically has six stamens, arranged in two whorls of three. The stamens are often **epiphyllous** or **epitepalous** (attached to the tepals). The stamens are free, and the anthers are dithecous.

Now let's evaluate the options:

- **(A) Epiphyllous and Dithecous anthers:** Epiphyllous condition is characteristic of Liliaceae. Dithecous anthers are found in all three.

- **(B) Diadelphous and Dithecous anthers:** The diadelphous condition is a hallmark of Fabaceae (specifically Papilionoideae) and is not found in Solanaceae or Liliaceae. Dithecous anthers are common, but the combination is specific.

- **(C) Polyadelphous and epipetalous stamens:** Polyadelphous (fused into many bundles) is seen in families like Malvaceae (e.g., China rose). Epipetalous is seen in Solanaceae. This combination is not characteristic of Fabaceae.

- **(D) Monoadelphous and Monothecous anthers:** Monoadelphous (fused into one bundle) is seen in Malvaceae. Monothecous anthers are also a feature of Malvaceae. Not characteristic of Fabaceae.

Step 3: Final Answer:
The characteristic specific to Fabaceae is the diadelphous condition of the stamens, combined with dithecous anthers.

Quick Tip

For floral formulas, remember these key stamen conditions: **Fabaceae** → Diadelphous (9)+1. **Solanaceae** → Epipetalous. **Liliaceae** → Epiphyllous/Epitepalous. **Malvaceae** → Monoadelphous.

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113. 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 used to measure the thickness of the ozone layer in the atmosphere.

Step 2: Detailed Explanation:
Let's examine the units provided:

- **Kilobase (kb):** A unit of length for DNA or RNA molecules, equal to 1000 base pairs. It is used in molecular biology.

- **Dobson Units (DU):** This is the standard unit of measurement for the total amount of ozone in a column of air from the ground to the top of the atmosphere. One Dobson Unit (1 DU) is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at a temperature of 0 degrees Celsius and a pressure of 1 atmosphere (standard temperature and pressure, STP).

- **Decibels (dB):** A logarithmic unit used to measure sound level or the power level of an electrical signal.

- **Decameter (dam):** A unit of length equal to 10 meters.

From the definitions, it is clear that Dobson units are specifically used to measure the concentration of atmospheric ozone.

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

Quick Tip

Associate the name **Dobson** with the **ozone layer**. G.M.B. Dobson was a British physicist who pioneered research on atmospheric ozone and invented the Dobson spectrophotometer to measure it.

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114. 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 Statements:
Assertion A claims that ATP is consumed at two distinct steps during the process of glycolysis.
Reason R specifies these two steps: the phosphorylation of glucose and the phosphorylation of fructose-6-phosphate. We need to check if both statements are correct and if R correctly explains A.

Step 2: Detailed Explanation:
Glycolysis is the metabolic pathway that converts glucose into pyruvate. The initial phase of glycolysis is known as the "preparatory" or "investment" phase because it consumes ATP to energize the glucose molecule.
Analysis of Assertion A:
In the energy investment phase of glycolysis, two molecules of ATP are indeed consumed per molecule of glucose. So, Assertion A is true.

Analysis of Reason R:
Let's examine the specific steps mentioned:

1. **Step 1:** Glucose is phosphorylated to Glucose-6-phosphate. This reaction is catalyzed by the enzyme hexokinase and requires one molecule of ATP.

$$\text{Glucose} + \text{ATP} \xrightarrow{\text{Hexokinase}} \text{Glucose-6-phosphate} + \text{ADP}$$

2. **Step 3:** Fructose-6-phosphate is phosphorylated to Fructose-1,6-bisphosphate. This reaction is catalyzed by phosphofructokinase-1 and requires a second molecule of ATP.

$$\text{Fructose-6-phosphate} + \text{ATP} \xrightarrow{\text{Phosphofructokinase}} \text{Fructose-1,6-bisphosphate} + \text{ADP}$$

Reason R correctly identifies these two specific steps where ATP is consumed. Therefore, Reason R is also true.

Connecting A and R:
Since Reason R correctly lists the exact two steps where ATP is used, it serves as a perfect explanation for why Assertion A is true.

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

Quick Tip

Remember the net gain of glycolysis: **Invest 2 ATP**, **Gain 4 ATP**, **Net Gain = 2 ATP**. The two invested ATPs are in the reactions catalyzed by hexokinase and phosphofructokinase (PFK). PFK is a key regulatory enzyme of glycolysis.

115. 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 (often written as $NADPH_2$ or NADPH + H^+) required to synthesize one molecule of glucose via the Calvin cycle.

Step 2: Key Formula or Approach:
The Calvin cycle fixes carbon dioxide. To make one molecule of glucose ($C_6H_{12}O_6$), which has 6 carbon atoms, the cycle must "turn" 6 times, fixing one CO_2 molecule per turn. We need to calculate the ATP and NADPH required for these 6 turns.

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

1. **Reduction Phase:** The conversion of 3-phosphoglycerate (3-PGA) to 1,3-bisphosphoglycerate consumes 1 ATP. The subsequent reduction to glyceraldehyde-3-phosphate (G3P) consumes 1 NADPH. Since two molecules of 3-PGA are formed from one CO_2 fixation, this phase uses **2 ATP** and **2 NADPH** per CO_2.

2. **Regeneration Phase:** The regeneration of the CO_2 acceptor molecule, Ribulose-1,5-bisphosphate (RuBP), from G3P consumes **1 ATP**.

So, for one turn of the Calvin cycle (fixing 1 CO_2):
Total ATP = 2 (from reduction) + 1 (from regeneration) = **3 ATP**
Total NADPH = **2 NADPH**

Now, to synthesize one molecule of glucose ($C_6H_{12}O_6$), the cycle must fix 6 molecules of CO_2.
Total ATP required = (ATP per turn) $\times$ (Number of turns) = $3 \times 6 =$ **18 ATP**
Total NADPH required = (NADPH per turn) $\times$ (Number of turns) = $2 \times 6 =$ **12 NADPH**

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

Quick Tip

For the C3 cycle (Calvin cycle), remember the ratio for fixing one CO_2: **3 ATP** and **2 NADPH**. To make glucose (6 carbons), just multiply both by 6. This gives 18 ATP and 12 NADPH.

---

116. 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 macromolecule is precipitated out of a solution when chilled ethanol is added during the process of DNA purification in recombinant DNA technology.

Step 2: Detailed Explanation:
The isolation of DNA from cells is a crucial first step in many molecular biology procedures, including recombinant DNA technology. The process involves several steps:

1. **Lysis of cells:** Breaking open the cells (e.g., using detergents) to release the cellular contents, including DNA, RNA, proteins, and lipids.

2. **Removal of contaminants:** Using enzymes to degrade unwanted macromolecules. Proteases are used to break down proteins (like histones), and RNases are used to break down RNA.

3. **Precipitation of DNA:** After removing other macromolecules, the DNA remains dissolved in the aqueous solution. DNA is insoluble in ethanol, especially when it is cold and in the presence of salt (e.g., sodium acetate). When chilled ethanol is added to the aqueous solution, the DNA precipitates out of the solution, forming a visible mass of fine white threads. This process is called ethanol precipitation.

Polysaccharides, RNA, and histones would have been removed in earlier steps or would not precipitate in the same manner as DNA under these specific conditions.

Step 3: Final Answer:
The addition of chilled ethanol precipitates DNA from the solution.

Quick Tip

Remember the key principle: DNA is soluble in water but insoluble in alcohol (like ethanol). Adding chilled ethanol causes the DNA to "crash out" of the solution, allowing it to be collected by spooling with a glass rod.

---

117. 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 (phytohormone) can be used to speed up the maturation process in young conifer trees, thereby promoting earlier seed production.

Step 2: Detailed Explanation:
Let's review the functions of the given phytohormones:

- **Abscisic Acid (ABA):** Generally known as a stress hormone, it is involved in dormancy, stomatal closure, and inhibiting growth. It would not hasten maturity.

- **Indole-3-butyric Acid (IBA):** This is an auxin. Auxins are primarily involved in cell elongation, apical dominance, and root initiation. They do not primarily control the transition from juvenile to mature phase.

- **Gibberellic Acid (GA):** Gibberellins have a wide range of effects, including stem elongation (bolting), seed germination, and breaking dormancy. A significant commercial application of GAs is in forestry and horticulture, where spraying them on juvenile conifers can overcome the juvenile phase and induce early flowering and seed production. This shortens the breeding cycle.

- **Zeatin:** This is a type of cytokinin. Cytokinins promote cell division, delay senescence, and overcome apical dominance. They are not the primary hormones used to hasten maturity for seed production.

Based on these functions, gibberellic acid is the hormone used to accelerate the maturation process in juvenile conifers.

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

Quick Tip

Associate Gibberellins (GA) with overcoming juvenility and promoting flowering. A classic example is its use in conifers and also in causing "bolting" (premature flowering) in rosette plants like cabbage.

---

118. 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 provides a fundamental ecological equation relating Gross Primary Productivity (GPP) and Net Primary Productivity (NPP) and asks for the meaning of the term 'R'.

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

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

- **Respiratory Loss (R):** Producers, like all living organisms, must respire to carry out their metabolic activities. Respiration consumes some of the organic matter (and thus

energy) that was produced during photosynthesis. This energy consumed for respiration is known as respiratory loss.

- **Net Primary Productivity (NPP):** This is the rate at which producers create biomass after accounting for the energy they used for their own respiration. It is the energy that is available to the next trophic level (herbivores).

The relationship is therefore:

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

This means that Net Primary Productivity is what remains of the Gross Primary Productivity after the producer has met its own energy needs through respiration. Therefore, 'R' represents the energy lost due to respiration, or Respiratory Loss.

Step 3: Final Answer:
In the equation GPP - R = NPP, R represents Respiratory loss.

Quick Tip

Think of it like a salary. GPP is your **Gross** salary (total earnings). 'R' (Respiration) is like your taxes and living **expenses**. NPP is your **Net** salary (what's left to save or spend on others).

---

119. 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 2: Detailed Explanation:
Let's define different types of placentation and identify the examples:

- **Axile Placentation:** The ovary is partitioned by septa into two or more chambers (locules). The ovules are attached to the central axis where the septa meet. This is found in plants with syncarpous (fused carpels), multilocular ovaries. Examples include **China rose** (Malvaceae), **Tomato**, **Lemon** (Rutaceae), and **Petunia** (Solanaceae).

- **Parietal Placentation:** The ovules develop on the inner wall of the ovary or on peripheral parts. The ovary is one-chambered but can become two-chambered due to the formation of a false septum (replum). Examples include **Mustard** and Argemone.

- **Free-central Placentation:** The ovules are borne on a central axis, and there are no septa dividing the ovary into chambers. Examples include **Dianthus** and **Primrose**.

- **Marginal Placentation:** The placenta forms a ridge along the ventral suture of the ovary, and the ovules are borne on this ridge in two rows. This is characteristic of the Fabaceae family. Examples include **Pea**, **Beans**, and **Lupin**.

- **Basal Placentation:** The placenta develops at the base of the ovary, and a single ovule is attached to it. Examples include Sunflower and Marigold.

Now let's analyze the options:

- **(A) China rose, Petunia and Lemon:** All three exhibit axile placentation.

- **(B) Mustard, Cucumber and Primrose:** Mustard and Cucumber have parietal placentation, while Primrose has free-central placentation.

- **(C) China rose, Beans and Lupin:** China rose has axile placentation, while Beans and Lupin have marginal placentation.

- **(D) Tomato, Dianthus and Pea:** Tomato has axile placentation, Dianthus has free-central placentation, and Pea has marginal placentation.

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

Quick Tip

Remember key examples for each placentation type. **Axile**: Tomato, Lemon, China rose (think of a sliced lemon or tomato). **Marginal**: Pea pod. **Parietal**: Mustard. **Free-central**: Dianthus, Primrose.

120. 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 scientists who provided the first "unequivocal" or unambiguous proof that DNA, and not protein, is the genetic material.

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

- **Frederick Griffith (1928):** Conducted the "transforming principle" experiment with *Streptococcus pneumoniae*. He showed that some substance from heat-killed virulent bacteria could transform non-virulent bacteria into virulent ones. However, he did not identify what this substance was.

- **Avery, Macleod, and McCarthy (1944):** They expanded on Griffith's work. Through a series of experiments using enzymes to destroy different macromolecules (proteases for proteins, RNases for RNA, DNases for DNA), they demonstrated that the transforming substance was DNA. While their work was strong evidence, it was not universally accepted by the scientific community at the time, some of whom still favored the protein hypothesis.

- **Alfred Hershey and Martha Chase (1952):** They conducted the famous "blender experiment" using bacteriophages (viruses that infect bacteria). They used radioactive isotopes to label the phage's DNA and protein separately.
  - They labeled the protein coat with radioactive sulfur (^{35}S), as sulfur is present in proteins but not DNA.
  - They labeled the DNA core with radioactive phosphorus (^{32}P), as phosphorus is present in DNA but not proteins.

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

- **Wilkins and Franklin:** They used X-ray diffraction to study the structure of DNA. Their work was critical for Watson and Crick to deduce the double-helix structure of DNA, but it did not prove that DNA was the genetic material.

Step 3: Final Answer:
The unequivocal proof that DNA is the genetic material was first proposed by Alfred Hershey and Martha Chase.

Quick Tip

Remember the timeline and contribution: **Griffith** found the "transforming principle." **Avery, et al.** identified it as DNA. **Hershey and Chase** provided the definitive, "unequivocal" proof using radioactive bacteriophages.

---

121. 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: (D) To disperse pollen grains

Solution:

Step 1: Understanding the Question:
The question asks for the primary biological function of the tassel in a corn plant (maize).

Step 2: Detailed Explanation:
Corn (Zea mays) is a monoecious plant, meaning it has separate male and female flowers on the same plant.

- The **tassel**, located at the top of the plant, is the male inflorescence (a cluster of male flowers). Its function is to produce pollen grains.

- The **corn cob** (or ear), located at the axil of a leaf, is the female inflorescence. It is covered with long, sticky strands called silks, which are the stigmas and styles of the female flowers.

- Pollination in corn is anemophilous (wind-pollinated). The tassels release a large quantity of light pollen grains into the wind.

- The silks on the corn cob are designed to trap these airborne pollen grains to facilitate fertilization.

Therefore, the function of the tassel is to produce and disperse pollen grains. Option (C) describes the function of the silks, not the tassels.

Step 3: Final Answer:
Based on the biological roles of the structures in a corn plant, the correct function of the tassel is to disperse pollen grains.

Quick Tip

In questions about plant reproduction, clearly distinguish between male and female parts and their specific roles. For corn, remember: Tassel = Male = Top = Disperses Pollen; Cob/Silk = Female = Side = Traps Pollen.

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122. 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 micronutrient essential for the photolysis (splitting) of water during the light-dependent reactions of photosynthesis.

Step 2: Detailed Explanation:
The splitting of water molecules (H_2O) occurs during the light-dependent reactions of photosynthesis. This process releases electrons (e^-), protons (H^+), and oxygen (O_2).
The chemical reaction is: $2H_2O \rightarrow 4H^+ + O_2 + 4e^-$.
This reaction takes place in the oxygen-evolving complex (OEC) associated with Photosystem II (PS II).
The mineral element that plays a crucial role as a cofactor in the OEC is **Manganese (Mn)**. It is essential for the catalytic activity of the enzyme complex that splits water. Chloride ions (Cl^-) are also involved.

- **Copper (Cu)** is a component of plastocyanin, an electron carrier.
- **Molybdenum (Mo)** is a component of nitrate reductase and nitrogenase.
- **Magnesium (Mg)** is a central atom in the chlorophyll molecule.

Step 3: Final Answer:
Manganese (Mn) is the specific micronutrient required for the splitting of the water molecule in photosynthesis.

Quick Tip

Memorize the specific roles of key micronutrients in plants. Create a chart listing the nutrient and its primary function(s), for example: Mn → Photolysis of water; Mg → Chlorophyll center; Mo → Nitrogen fixation; Zn → Auxin synthesis.

---

123. 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 physiological process of transpiration in plants and asks to evaluate their correctness.

Step 2: Detailed Explanation:
Analysis of Statement I:
This statement refers to the cohesion-tension theory of water transport in plants. Transpiration creates a negative pressure potential or tension (a "pull") in the xylem. Due to the cohesive forces between water molecules and adhesive forces between water and xylem walls, this pull

is transmitted down the entire water column from the leaves to the roots. This mechanism is powerful enough to lift water to the tops of the tallest trees, some of which exceed 100 meters (e.g., Sequoia). A height of 130 meters is within the theoretical limit of this force. Thus, Statement I is correct.

Analysis of Statement II:
Transpiration is the process of water evaporating from the surfaces of leaves. Evaporation is a cooling process because the water molecules with the highest kinetic energy (i.e., the "hottest" ones) are the ones that escape as vapor, leaving the remaining liquid water and the leaf surface cooler. This evaporative cooling can prevent leaves from overheating in direct sunlight, lowering the surface temperature by as much as 10 to 15 degrees Celsius. Thus, Statement II is also correct.

Step 3: Final Answer:
Since both statements accurately describe key aspects of transpiration, the correct option is that both Statement I and Statement II are correct.

Quick Tip

Remember the dual role of transpiration: it's a necessary "cost" for pulling water and minerals up the plant (transpirational pull), and it also serves the vital function of cooling the leaves to prevent heat damage.

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124. 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 2: Detailed Explanation:
The eukaryotic cell cycle is divided into two main stages: Interphase and M phase (Mitotic phase).
Interphase is the period of growth and preparation for cell division and is further subdivided into three phases:

- **G_1 phase (Gap 1):** This is the initial growth phase where the cell grows in size and synthesizes proteins and mRNA. No DNA replication occurs.

- **S phase (Synthesis phase):** This is the phase during which the cell's DNA is replicated. At the end of the S phase, each chromosome consists of two sister chromatids. The amount of DNA in the cell doubles.

- **G_2 phase (Gap 2):** The cell continues to grow and produce proteins and organelles needed for mitosis. The cell checks the replicated DNA for errors before entering mitosis.

M phase (Mitosis phase): This is the phase of nuclear division (mitosis) and cytoplasmic division (cytokinesis).

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

Quick Tip

Use the mnemonic "Go Sally Go! Make Children!" to remember the order of the cell cycle phases: G_1, S (Synthesis of DNA), G_2, M (Mitosis), C (Cytokinesis). This helps to correctly place DNA replication in the S phase.

---

125. 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 2: Detailed Explanation:
The gene gun method, also known as biolistics or microparticle bombardment, is a technique for delivering foreign DNA (transgenes) into cells.
The process involves:

1. Coating microscopic particles of a heavy metal with the desired DNA.
2. These coated microparticles are then accelerated to a very high velocity using a "gene gun".
3. The high-velocity particles penetrate the cell wall and cell membrane of the target cells, carrying the DNA with them into the cell's interior.

The metals used for these microparticles must be dense (to have enough momentum) and biologically inert (to not harm the cells). **Gold (Au)** and **Tungsten (W)** are the most commonly used metals for this purpose due to these properties. Silver, copper, and zinc are generally too reactive or toxic to the cells to be used effectively.

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

Quick Tip

For biotechnology techniques, remember the key materials used. For the gene gun, think of "precious" or "heavy" metals like gold and tungsten, which act as "bullets" to carry the DNA into the cell.

---

126. 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 maximum absorption.

Step 2: Detailed Explanation:
In the light-dependent reactions of 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 (LHC) or antennae molecules. The reaction center is a special pair of chlorophyll 'a' molecules.

- The reaction center of **Photosystem II (PS II)** is called **P680** because it absorbs light with a maximum wavelength of **680 nm**.

- The reaction center of **Photosystem I (PS I)** is called **P700** because it absorbs light with a maximum wavelength of **700 nm**.

The other given wavelengths are not specific to the reaction centers of PS I or PS II.

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

Quick Tip

Remember the numbering of photosystems is based on their order of discovery, not their order of function in the Z-scheme. PS II (P680) functions before PS I (P700). Remember "II comes before I" in the alphabet, but 680 comes before 700 numerically. This might help avoid confusion.

---

127. 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 the frequency of genetic recombination to measure the distance between genes and create a genetic map.

Step 2: Detailed Explanation:

- **Thomas Hunt Morgan** and his group, working with *Drosophila melanogaster*, established the concepts of linkage and recombination. They showed that genes are located on chromosomes and that some genes tend to be inherited together (linkage).

- **Alfred Sturtevant**, a student of Thomas Hunt Morgan, took this concept a step further. In 1913, he proposed that the frequency of recombination (crossing over) between two linked genes is proportional to the physical distance between them on the chromosome.

- He used recombination frequencies to construct the first-ever genetic map of a chromosome (the X chromosome of Drosophila). The unit of genetic distance was later named the map unit or centimorgan (cM) in honor of Morgan.

- **Sutton and Boveri** independently proposed the Chromosomal Theory of Inheritance.

- **Henking** discovered the X body (later identified as the X chromosome).

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

Quick Tip

Associate scientists with their key contributions. Morgan → Linkage/Recombination concept. Sturtevant (Morgan's student) → Gene Mapping using recombination frequency. Sutton Boveri → Chromosomal Theory of Inheritance. This helps in quickly answering history-of-science questions in genetics.

---

128. 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 of the Earth Summit held in Rio de Janeiro, where the Convention on Biological Diversity (CBD) was established.

Step 2: Detailed Explanation:
The United Nations Conference on Environment and Development (UNCED), popularly known as the **Earth Summit**, was held in **Rio de Janeiro, Brazil**, in June **1992**.
This summit was a major global event that brought together world leaders to discuss issues of environmental protection and sustainable development.
One of the key outcomes of the Earth Summit was the signing of the **Convention on Biological Diversity (CBD)**, an international treaty with three main goals:

1. The conservation of biological diversity.
2. The sustainable use of its components.
3. The fair and equitable sharing of benefits arising out of the utilization of genetic resources.

The other years mentioned are incorrect. The World Summit on Sustainable Development was held in Johannesburg in 2002.

Step 3: Final Answer:
The Earth Summit in Rio de Janeiro took place in the year 1992.

Quick Tip

Remember key environmental summits and their years:

- **1972:** Stockholm Conference (first major conference on international environmental issues).
- **1987:** Montreal Protocol (on ozone-depleting substances).
- **1992:** Rio Earth Summit (CBD, Climate Change Convention).
- **1997:** Kyoto Protocol (greenhouse gas emissions).

---

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

(A) 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 among the given five options related to

the process of decomposition and the detritus food chain.

Step 2: Detailed Explanation:
Let's analyze each statement:
A. Detritivores perform fragmentation. This is **correct**. Detritivores, such as earthworms, break down large pieces of dead organic matter (detritus) into smaller particles. This process is called fragmentation.

B. The humus is further degraded by some microbes during mineralization. This is **correct**. Humus is a dark, amorphous substance that is highly resistant to microbial action and decomposes at an extremely slow rate. Over time, it is slowly degraded by microbes, 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 where water-soluble substances, including inorganic nutrients, are washed down through the soil profile. They can then become unavailable to plants if they move beyond the root zone or get 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), such as dead plants, animals, and their waste products. The grazing food chain (GFC) begins with living organisms (producers).

E. Earthworms break down detritus into smaller particles by a process called catabolism. This is **incorrect**. Earthworms break down detritus by **fragmentation**. Catabolism is the enzymatic breakdown of complex organic molecules into simpler inorganic substances, a process carried out by bacteria and fungi. While earthworms do digest some material, their primary role in breakdown is fragmentation.

Step 3: Final Answer:
Statements A, B, and C are correct. Statements D and E are incorrect. Therefore, the correct option is (B).

Quick Tip

Decomposition has three main steps:

1. **Fragmentation:** Physical breakdown by detritivores (e.g., earthworms).
2. **Leaching:** Soluble nutrients wash away.
3. **Catabolism:** Chemical breakdown by microbial enzymes (bacteria, fungi).

Humification and Mineralization occur alongside these processes.

130. 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 heterosporous. Heterosporous plants produce two different types of spores: smaller microspores (male) and larger megaspores (female).

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

- **Homosporous Pteridophytes:** Produce only one type of spore, which develops into a bisexual gametophyte. Examples include most pteridophytes like *Psilotum*, *Lycopodium*, and *Equisetum*.
- **Heterosporous Pteridophytes:** Produce two types of spores (microspores and megaspores). This condition is a precursor to the seed habit seen in gymnosperms and angiosperms. Key examples are *Selaginella*, *Salvinia*, *Azolla*, and *Marsilea*.

Now let's evaluate the pairs given:
(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). Both are heterosporous. This is the correct pair.
(D) *Psilotum* (homosporous) and *Salvinia* (heterosporous). Not a pair of heterosporous plants.

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

Quick Tip

To remember the heterosporous pteridophytes, use a simple mnemonic like "Selaginella and Salvinia Show Seed-habit Start". This links the two most common examples with the important evolutionary concept of heterospory leading to the seed habit.

131. 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 sequence of structures from a fertilized angiosperm embryo sac that are haploid (n), diploid (2n), and triploid (3n), respectively.

Step 2: Detailed Explanation:
Let's determine the ploidy level of the structures in a fertilized embryo sac:

- **Haploid (n) structures:** These originate from the functional megaspore without fusion. Before fertilization, these are the egg cell, synergids, and antipodal cells. After fertilization, the synergids and antipodals degenerate, but for the sake of the question, we consider their ploidy. So, **Synergids** are haploid (n). **Antipodals** are also 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 central cell, which contains two polar nuclei (n + n). This process is called triple fusion, resulting in a triploid (3n) nucleus.

Now let's check the options for the sequence: haploid, diploid, triploid.
(A) Synergids (n), antipodals (n), Polar nuclei (n+n, but not triploid itself). Incorrect sequence.
(B) Synergids (n), Primary endosperm nucleus (3n), zygote (2n). Incorrect sequence (n, 3n, 2n).
(C) Antipodals (n), synergids (n), and primary endosperm nucleus (3n). Incorrect sequence.
(D) **Synergids (n)**, **Zygote (2n)**, and **Primary endosperm nucleus (3n)**. This correctly matches the required n, 2n, 3n sequence.

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

Quick Tip

Remember the unique "double fertilization" in angiosperms. One male gamete (n) + Egg (n) → Zygote (2n). Second male gamete (n) + Central Cell (2 polar nuclei, n+n) → PEN (3n). This central concept helps solve any question on ploidy in the embryo sac.

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132. 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 srRNA and snRNA
(D) Transcription of precursor of mRNA

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

Solution:

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

Step 2: Detailed Explanation:
In eukaryotes, there are three main types of RNA polymerases, each responsible for transcribing different classes of genes. Their roles are highly specific:

- **RNA Polymerase I:** Located in the nucleolus, it transcribes ribosomal RNAs (rRNAs), specifically the 28S, 18S, and 5.8S rRNA genes.
- **RNA Polymerase II:** Located in the nucleoplasm, it transcribes the precursor of messenger RNA (pre-mRNA or hnRNA), which is then processed to form mature mRNA. It also transcribes most small nuclear RNAs (snRNAs) and microRNAs (miRNAs).
- **RNA Polymerase III:** Located in the nucleoplasm, it transcribes transfer RNA (tRNA), the 5S ribosomal RNA (5S rRNA), and some small nuclear RNAs (snRNAs) like U6 snRNA.

Let's analyze the options based on this information:
(A) Transcription of only snRNAs - Incorrect. It transcribes more than just snRNAs, and Pol II also transcribes some snRNAs.
(B) Transcription of rRNAs (28S, 18S and 5.8S) - Incorrect. This is the function of RNA Polymerase I.
(C) Transcription of tRNA, 5S srRNA and snRNA - **Correct**. This accurately describes the main products of RNA Polymerase III. (Note: srRNA is a typo for rRNA).
(D) Transcription of precursor of mRNA - Incorrect. This is the function of RNA Polymerase II.

Step 3: 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" to remember the main products of the polymerases. Pol I → rRNA, Pol II → mRNA, Pol III → tRNA. Remember that Pol III also makes the small 5S rRNA, while Pol I makes the large rRNAs.

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133. 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 internode or petiole elongation specifically in deep water rice plants when they are submerged.

Step 2: Detailed Explanation:
Deep water rice is a variety of rice that has adapted to grow in flooded conditions. When the plant is submerged, it needs to rapidly elongate its stems (internodes) to keep its leaves and flowers above the water surface for photosynthesis and pollination.
This rapid elongation is primarily triggered by the plant hormone **Ethylene**.
The mechanism is as follows:

1. When the plant is submerged, the gaseous hormone ethylene accumulates in the submerged parts because its diffusion out of the plant is greatly reduced in water.
2. This increased concentration of ethylene stimulates the synthesis of gibberellins.
3. Gibberellins then promote cell division and elongation in the internodes, causing the stem to grow rapidly and emerge from the water.

While gibberellin (GA_3) is involved in stem elongation, ethylene is the primary trigger in this specific case of deep water rice. 2,4-D is a synthetic auxin, and kinetin is a cytokinin.

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

Quick Tip

Associate specific, unusual plant responses with their primary hormonal trigger. For "deep water rice elongation" or "submergence response," the key hormone is Ethylene. For "bolting in rosette plants," think Gibberellin.

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134. 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 consists of an Assertion (A) about the characteristics of late wood and a Reason (R) about the activity of cambium in winter. We need to evaluate if both statements are true and if R correctly explains A.

Step 2: Detailed Explanation:
Analysis of Assertion A:
In temperate regions, the vascular cambium produces secondary xylem (wood) at different rates throughout the year, leading to the formation of annual rings.

- **Spring wood (or early wood):** Formed during the spring season when conditions are favorable. The cambium is highly active, producing a large number of xylary elements with wider vessels to transport more water.
- **Autumn wood (or late wood):** Formed during late summer or autumn. The cambium is less active, producing fewer xylary elements. The vessels are narrower and the wood is denser.

So, the assertion "Late wood has fewer xylary elements with narrow vessels" is **true**.

Analysis of Reason R:
The activity of the vascular cambium is influenced by physiological and environmental factors like temperature and water availability. In winters or the dry season, the conditions are unfavorable for growth. Consequently, the cambium becomes less active or dormant. So, the reason

"Cambium is less active in winters" is also **true**.

Connecting A and R:
The reason for the structural difference between early and late wood is the change in cambial activity. Because the cambium is less active in the later part of the growing season (autumn/winter), it produces fewer and narrower xylem elements. Therefore, Reason R is the correct explanation for Assertion A.

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

Quick Tip

For Assertion-Reason questions, follow a three-step process: 1. Check if A is true. 2. Check if R is true. 3. If both are true, check if R explains A by asking "Is A true *because* R is true?".

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135. 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 asks to identify the type of pollination associated with flowers that are large, colorful, fragrant, and produce nectar.

Step 2: Detailed Explanation:
Plants have evolved different floral characteristics to attract specific pollinators. This is known as a pollination syndrome. Let's analyze the characteristics mentioned:

- **Large and Colourful petals:** These act as visual cues to attract pollinators from a distance.
- **Fragrance:** This is a chemical attractant, especially for insects like bees and moths that have a strong sense of smell.
- **Nectar:** This is a sugary fluid that serves as a food reward for the pollinator.

These features are all adaptations for attracting animal pollinators. Let's look at the options:

- **(A) Wind pollinated (anemophilous) plants:** Flowers are typically small, inconspicuous, not colorful, lack fragrance and nectar. They produce large amounts of light, dry pollen.
- **(B) Insect pollinated (entomophilous) plants:** These flowers typically fit the description perfectly. They use color, scent, and nectar to attract insects like bees, butterflies, moths, and flies.
- **(C) Bird pollinated (ornithophilous) plants:** Flowers are often large and brightly colored (especially red), have abundant nectar, but usually lack a strong fragrance as birds have a poor sense of smell.
- **(D) Bat pollinated (chiropterophilous) plants:** Flowers are often large, pale or white, open at night, and have a strong, musty or fermented odor. They produce copious nectar.

The combination of all four traits—large, colorful, fragrant, and nectar-rich—is most characteristic of insect-pollinated plants.

Step 3: Final Answer:
Flowers that are large, colourful, fragrant, and contain nectar are adaptations for pollination by insects.

Quick Tip

Create a table to remember pollination syndromes. List the pollinator (wind, water, insect, bird, bat) and the corresponding typical floral characteristics (size, color, scent, nectar, pollen type). This makes it easy to compare and contrast.

---

136. 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:
This is an Assertion-Reason question about the morphological nature of a flower. We need to evaluate the truthfulness of both statements and determine if the reason correctly explains the assertion.

Step 2: Detailed Explanation:
Analysis of Assertion A:
The assertion states that a flower is a modified shoot. This is a fundamental concept in plant morphology. During the transition to flowering, the vegetative shoot apical meristem (SAM) transforms into an inflorescence or floral meristem. This meristem then gives rise to the flower parts instead of vegetative parts like leaves and stems. This statement is **true**.

Analysis of Reason R:
The reason describes the process of this modification. In a normal shoot, nodes (where leaves arise) are separated by elongated internodes. In a flower, the axis (receptacle or thalamus) is condensed, meaning the internodes do not elongate. The floral appendages (sepals, petals, stamens, and carpels), which are homologous to leaves, are produced at these condensed, successive nodes. This statement is also **true**.

Connecting A and R:
The reason explains *how* a shoot is modified to become a flower. The condensation of the internodes and the production of floral appendages instead of leaves are the key modifications that transform the shoot apical meristem into a floral structure. Therefore, the Reason (R) is the correct explanation for the Assertion (A).

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

Quick Tip

Remember that all parts of a flower (sepals, petals, stamens, carpels) are considered modified leaves. This concept of homology helps understand the structure of a flower as a highly modified and condensed reproductive shoot.

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137. 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 for the essential components required for the process of chemiosmosis, which is the mechanism for synthesizing ATP.

Step 2: Detailed Explanation:
Chemiosmosis, as proposed by Peter Mitchell, is the movement of ions across a semipermeable membrane down their electrochemical gradient. This process is used to generate ATP in both cellular respiration (in mitochondria) and photosynthesis (in chloroplasts). The core requirements are:

1. **A Membrane:** A selectively permeable membrane (like the inner mitochondrial membrane or the thylakoid membrane) is necessary to establish and maintain a concentration gradient of ions.

2. **A Proton Pump:** An active transport system, typically part of an electron transport chain, that pumps protons (H^+ ions) across the membrane from one compartment to another, using energy from electrons.

3. **A Proton Gradient:** The pumping of protons creates a concentration and electrical potential difference across the membrane, also known as the proton-motive force. This gradient stores potential energy.

4. **ATP Synthase:** A transmembrane enzyme complex that provides a channel for protons to flow back across the membrane, down their concentration gradient. It uses the kinetic energy of this proton flow to catalyze the synthesis of ATP from ADP and inorganic phosphate (Pi).

Let's evaluate the options:
(A) and (D) are missing the essential membrane component. An "electron gradient" is not the correct term; it's a proton gradient generated using energy from electron transport.
(C) incorrectly lists NADP synthase instead of ATP synthase. NADP reductase (synthase is not the standard term) uses protons and electrons to reduce $NADP^+$, but it is not the enzyme for ATP synthesis via chemiosmosis.
(B) correctly lists all four essential components: the membrane, the pump, the gradient, and the ATP synthase enzyme.

Step 3: 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 machine that pumps water up into the reservoir. The stored water is the **proton gradient** (potential energy). The **ATP synthase** is the turbine that generates electricity (ATP) as the water flows back down.

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138. 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 found in a ribosome. Since the options are quite distinct, it is likely referring to a eukaryotic ribosome.

Step 2: Detailed Explanation:
Ribosomes are complex molecular machines composed of ribosomal RNA (rRNA) and ribosomal proteins. Their composition differs between prokaryotes and eukaryotes.

- **Prokaryotic Ribosome (70S):**
  - Large subunit (50S): contains 2 rRNA molecules and about 31-34 proteins.
  - Small subunit (30S): contains 1 rRNA molecule and about 21 proteins.
  - Total: $\sim$55 different proteins.
- **Eukaryotic Ribosome (80S):**
  - Large subunit (60S): contains 3 rRNA molecules and about 49 proteins.
  - Small subunit (40S): contains 1 rRNA molecule and about 33 proteins.
  - Total: $\sim$82 different proteins.

Looking at the options provided:
(A) 20 - too low. This is the number of standard amino acids.
(B) 80 - This is a very close approximation for the number of proteins in a eukaryotic (80S) ribosome.
(C) 60 - This is the Svedberg unit for the large eukaryotic subunit, not the number of proteins.
(D) 40 - This is the Svedberg unit for the small eukaryotic subunit, not the number of proteins.
Thus, the most appropriate answer is 80, which corresponds to the eukaryotic ribosome.

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

Quick Tip

Be careful not to confuse Svedberg units (S) with the number of components. The 'S' value relates to the sedimentation rate and is not additive (e.g., 30S + 50S = 70S, not 80S). For this question, associate the number 80 with the 80S eukaryotic ribosome's protein count.

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139. 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:
This is an Assertion-Reason question about the process of pollination and fertilization in gymnosperms. We must evaluate both statements and their relationship.

Step 2: Detailed Explanation:
Analysis of Assertion A:
Gymnosperms (like pines, cycads) are predominantly wind-pollinated (anemophilous). The pollen grains, which develop inside the microsporangium (pollen sac), are released and carried by wind (air currents) to the female cones, where the ovules are located. This statement is **true**.

Analysis of Reason R:
This statement describes what happens after the pollen grain reaches the ovule. It correctly states that air currents carry the pollen grains. However, it incorrectly states that the pollen grain reaches the mouth of the archegonia and that a pollen tube is not formed.
In reality, the pollen grain lands on the micropyle of the ovule. It then germinates and forms a **pollen tube**. This pollen tube grows through the nucellus tissue towards the archegonium.

The male gametes are then released from the pollen tube to fertilize the egg cell inside the archegonium. The formation of a pollen tube (siphonogamy) is a characteristic feature of seed plants, including gymnosperms. Therefore, the statement "pollen tube is not formed" is **false**.

Step 3: Final Answer:
Assertion A is a true statement, but Reason R is a false statement.

Quick Tip

Remember that the development of the pollen tube is a key evolutionary innovation of seed plants (gymnosperms and angiosperms). It eliminates the need for free water for fertilization, which was a limitation for bryophytes and pteridophytes. Any statement claiming gymnosperms lack a pollen tube is incorrect.

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140. Match List I with List II:

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

Choose the correct answer from the options given below :

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

Solution:

Step 1: Understanding the Question:
The question asks to match the terms in List I, which are related to properties of water and a plant physiological process, with their correct definitions or descriptions in List II.

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

- **A. Cohesion:** This is the property of water molecules being attracted to each other due to hydrogen bonds. This matches with **II. Mutual attraction among water molecules**.

- **B. Adhesion:** This is the property of water molecules being attracted to other types of molecules, especially polar surfaces like the xylem walls. This matches with **IV. Attraction towards polar surfaces**.

- **C. Surface tension:** This is a result of cohesion, where water molecules at the surface are more strongly attracted to each other than to the air above, creating a "film". This results in **I. More attraction in the liquid phase** than in the gas phase.

- **D. Guttation:** This is the process of exudation of water droplets (xylem sap) from the tips or margins of leaves, which is a form of **III. Water loss in liquid phase**. This occurs when root pressure is high and transpiration is low.

Step 3: Final Answer:
Based on the matching above:
A matches with II.
B matches with IV.
C matches with I.
D matches with III.
This combination, A-II, B-IV, C-I, D-III, corresponds to option (2).

Quick Tip

The properties of water (cohesion, adhesion, surface tension) are fundamental to understanding the ascent of sap in plants. Guttation is often confused with dew, but it's an internal process of the plant, not condensation from the atmosphere.

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141. 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: (3) 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 2: Detailed Explanation:
Let's analyze each statement.

- **Statement (1):** This describes biomagnification, where the concentration of toxic substances like DDT or mercury increases at successive trophic levels in a food chain. This statement is correct.

- **Statement (2):** This describes the effect of sewage pollution. Decomposing microorganisms consume dissolved oxygen, increasing the Biochemical Oxygen Demand (BOD) of the water. This depletion of oxygen can lead to the death of fish and other aquatic life. This statement is correct.

- **Statement (3):** Algal blooms are caused by an excess of nutrients (eutrophication), not directly by organic matter. These blooms severely deteriorate water quality by blocking sunlight and, upon their death and decomposition, depleting oxygen levels. This leads to the death of fish and is detrimental to fisheries, not promoting them. Therefore, this statement is incorrect.

- **Statement (4):** Water hyacinth (Eichhornia crassipes) is a notorious invasive weed that thrives in nutrient-rich (eutrophic) water bodies. Its rapid growth covers the water surface, blocks sunlight, depletes oxygen, and disrupts the aquatic ecosystem. This statement is correct.

Step 3: Final Answer:
Statement (3) is incorrect because algal blooms degrade water quality and harm fisheries.

Quick Tip

Remember the key terms related to water pollution: Eutrophication (nutrient enrichment), Algal Bloom (result of eutrophication), Biomagnification (toxin increase in food chain), and BOD (Biochemical Oxygen Demand, a measure of organic pollution). Algal blooms are always a negative indicator of water quality.

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142. 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: (4) B and E only

Solution:

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

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

- **A.** This disorder was first described by Langdon Down (1866). **Incorrect**. Langdon Down described Down's Syndrome (Trisomy 21). 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. **Correct**. Individuals are phenotypically male but have some female characteristics like gynaecomastia (development of breasts).

- **C.** The affected individual is short statured. **Incorrect**. Individuals with Klinefelter's Syndrome are typically taller than average, with longer limbs. Short stature is characteristic of Turner's Syndrome (XO).

- **D.** Physical, psychomotor and mental development is retarded. **Incorrect**. While some learning disabilities may be present, significant mental retardation is not a typical feature. This is more characteristic of Down's Syndrome.

- **E.** Such individuals are sterile. **Correct**. The presence of an extra X chromosome leads to underdeveloped testes (testicular atrophy) and, consequently, sterility due to lack of sperm production (azoospermia).

Step 3: Final Answer:
The correct statements are B and E. Therefore, the correct option is (4).

Quick Tip

Create a comparison chart for the main chromosomal disorders: Down's Syndrome (Trisomy 21, mental retardation, short stature), Klinefelter's Syndrome (XXY, tall sterile male with gynaecomastia), and Turner's Syndrome (XO, short sterile female). This helps in quick recall of their distinct features.

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143. 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: (4) Statement I is correct but Statement II is false.

Solution:

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

Step 2: Detailed Explanation:

- **Analysis of Statement I:**
  Gause's 'Competitive Exclusion Principle' is a fundamental concept in ecology. It posits that if two species with identical niches (i.e., competing for the exact same limited resources) are in the same environment, one will eventually outcompete and eliminate the other. The statement provides an accurate definition of this principle. Therefore, **Statement I is correct**.

- **Analysis of Statement II:**
  This statement claims that, in general, carnivores are more adversely affected by compe-

tition than herbivores. This is a generalization that is considered false in many ecological contexts. Competition can be intense for both groups. Herbivores often compete for specific host plants, water, or nutrients, which can be severely limiting. For example, competition among different insect species on a single plant can be fierce. While carnivores do compete for prey, which may be mobile and scarce, it is an oversimplification to state they are *always* more adversely affected than herbivores. The intensity of competition depends on factors like resource availability, degree of niche overlap, and environmental conditions, not just the trophic level. Therefore, **Statement II is false**.

Step 3: Final Answer:
Since Statement I is correct and Statement II is false, the correct option is (4).

Quick Tip

Be wary of broad generalizations in biology like "always," "never," or "more than." Ecological principles often have exceptions and depend on specific contexts. Gause's principle is a cornerstone of competitive interaction theory.

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144. Match List I with List II :

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

Choose the correct answer from the options given below :

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

Solution:

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

Step 2: Detailed Explanation:
Let's match each phase from List I.

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

- **B. G_2 Phase:** This is the gap 2 phase, which occurs after DNA synthesis (S phase) and before the M phase. During this phase, the cell continues to grow, and proteins necessary for mitosis (like tubulin for spindle fibers) are synthesized. So, B matches with **I**.

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

- **D. G_1 Phase:** This is the gap 1 phase, which is the **interval between mitosis (M phase) and the initiation of DNA replication (S phase)**. The cell grows and prepares for DNA synthesis during this stage. So, D matches with **III**.

Step 3: Final Answer:
The correct matching is: A-IV, B-I, C-II, D-III. This corresponds to option (4).

Quick Tip

Drawing a diagram of the cell cycle ($G_1 \rightarrow S \rightarrow G_2 \rightarrow M$, with G_0 as an exit from G_1) and labeling the main event of each phase is the best way to memorize this topic. It's a very high-yield concept for biology exams.

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145. 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: (3) A and D only

Solution:

Step 1: Understanding the Question:
The question asks to identify which of the given statements about plant anatomy (specifically bark and related structures) are correct.

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

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

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

- **C. Bark is a technical term that refers to all tissues exterior to vascular cambium.** This is a broad, non-technical definition and is generally considered correct. However, in botany, a more precise definition is often used.

- **D. Bark refers to periderm and secondary phloem. Correct**. This is the more precise technical definition of bark used in botany. It includes all tissues outside the vascular cambium, but specifically points to the major components. Given that both C and D are definitions, and questions often seek the most precise one, D is a strong candidate.

- **E. Phellogen is single-layered in thickness. Incorrect**. Phellogen, or cork cambium, is a meristematic tissue and is typically a few cell layers thick, not strictly single-layered.

Step 3: Final Answer:
Statements A and D are definitively correct according to standard botanical definitions. Statement B and E are incorrect. Statement C is a broader, less precise definition than D. The combination of the most accurate statements is A and D. Therefore, option (3) is the best answer.

Quick Tip

In plant anatomy, terms can have both broad and narrow definitions. "Bark" is a classic example. Non-technically, it's everything outside the wood (vascular cambium). Technically, it comprises the periderm and all phloem tissues. Often, exams prefer the more precise technical definition.

146. 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: (2) B, C, D, A (Note: The provided answer key marks this question as 'E' for Error/Bonus, likely due to ambiguity. The sequence B, C, D, A represents one of the most logical workflows.)

Solution:

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

Step 2: Detailed Explanation:
Let's analyze the logical flow of the recombinant DNA technology process.
The overall goal is to isolate a specific gene, make copies of it, insert it into a vector, and then introduce this construct into a host organism. A very common and logical sequence of these specific steps is as follows:

1. **B. Cutting of DNA at specific location by restriction enzyme.** First, you need to cut the source DNA (e.g., a chromosome) with restriction enzymes to generate DNA fragments. The plasmid vector is also cut with the same enzyme.
2. **C. Isolation of desired DNA fragment.** After cutting the source DNA, you will have many fragments. The specific fragment containing the gene of interest must be isolated, usually by gel electrophoresis.
3. **D. Amplification of gene of interest using PCR.** Once the desired gene fragment is isolated, Polymerase Chain Reaction (PCR) is used to create millions of copies of it. This provides enough DNA to proceed with ligation.
4. **A. Insertion of recombinant DNA into the host cell.** The amplified gene is ligated into the prepared vector to create recombinant DNA. This recombinant DNA is then introduced into a host cell (like bacteria) in a process called transformation.

Step 3: Final Answer:
Following this logic, the correct sequence is B $\rightarrow$ C $\rightarrow$ D $\rightarrow$ A. This corresponds to option (2).

Another possible sequence could be C → D → B → A, where one first isolates the entire DNA, amplifies the gene directly from it using specific primers, then cuts the product and vector. However, B → C → D → A is a very standard laboratory workflow for cloning from a larger piece of DNA. Given the options, it is the most plausible intended answer.

Quick Tip

Remember the core mantra of rDNA technology: "Cut, Paste, Copy, Insert." 1. **Cut** (Restriction Enzymes) the source DNA and vector. 2. **Isolate** and **Amplify** (PCR) the gene of interest. 3. **Paste** (Ligation) the gene into the vector. 4. **Insert** (Transformation) the recombinant vector into a host.

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147. Match List I with List II :

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

Choose the correct answer from the options given below :

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

Solution:

Step 1: Understanding the Question:
The question requires matching different types of ecological interactions (List I) with their symbolic representation (List II), where '+' denotes benefit, '-' denotes harm, and 'O' denotes a neutral effect.

Step 2: Detailed Explanation:
Let's define each interaction and match it to its symbol.

- **A. Mutualism:** An interaction where both species A and B benefit. This is represented as (+, +). So, A matches with **IV. +(A), +(B)**.

- **B. Commensalism:** An interaction where one species (A) benefits, and the other species (B) is neither harmed nor benefited (unaffected). This is represented as (+, 0). So, B matches with **I. +(A), O(B)**.

- **C. Amensalism:** An interaction where one species (A) is harmed, and the other species (B) is unaffected. This is represented as (-, 0). So, C matches with **II. -(A), O(B)**. (e.g., Penicillium releasing penicillin, which kills bacteria, while the fungus is unaffected).

- **D. Parasitism:** An interaction where one species (the parasite, A) benefits at the expense of the other species (the host, B), which is harmed. This is represented as (+, -). So, D matches with **III. +(A), -(B)**.

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

Quick Tip

Create a simple table for all six major population interactions: Mutualism (+,+), Commensalism (+,0), Amensalism (-,0), Parasitism (+,-), Predation (+,-), and Competition (-,-). This makes it easy to remember and compare them.

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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: (2) Succinic dehydrogenase

Solution:

Step 1: Understanding the Question:
The question asks about the mechanism of action of malonate (referred to as 'Melonate') as an inhibitor, specifically which enzyme it targets.

Step 2: Detailed Explanation:
This is a classic example of competitive enzyme inhibition.

- The enzyme **succinic dehydrogenase** is a key component of the Krebs cycle (citric acid cycle) and the electron transport chain in cellular respiration.

- Its normal substrate is **succinate**.

- **Malonate** is a structural analogue of succinate, meaning it has a very similar chemical structure.

- Because of this structural similarity, malonate can bind to the active site of the succinic dehydrogenase enzyme, blocking the real substrate (succinate) from binding.

- This process is called **competitive inhibition**. By inhibiting this crucial enzyme, malonate disrupts cellular respiration, which can inhibit the growth of or kill the bacteria.

The other enzymes listed have different functions: Dinitrogenase is for nitrogen fixation, Amylase digests starch, and Lipase digests fats. Malonate does not inhibit them.

Step 3: Final Answer:
Malonate is a competitive inhibitor of the enzyme succinic dehydrogenase. Therefore, option (2) is correct.

Quick Tip

Remember the malonate-succinate relationship as the textbook example of competitive inhibition. The inhibitor resembles the substrate and competes for the same active site. This concept is frequently tested.

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149. 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: (4) A-III, B-I, C-IV, D-II

Solution:

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

(List II).

Step 2: Detailed Explanation:
Let's analyze the function of each micronutrient.

- **A. Iron (Fe):** Iron is a crucial component of proteins involved in electron transport, such as cytochromes. It is also an essential **activator of the enzyme catalase**. It is required in larger amounts than other micronutrients. So, A matches with **III**.

- **B. Zinc (Zn):** Zinc is required for the activity of various enzymes, including carboxylases. It is particularly known for its role in the **synthesis of auxin** (indole-3-acetic acid). So, B matches with **I**.

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

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

Step 3: Final Answer:
Based on the matching: A-III, B-I, C-IV, D-II. This combination corresponds to option (4).

Quick Tip

Mineral nutrition is a memory-intensive topic. Create flashcards or a table listing each essential element (macro and micro), its key function(s), and a prominent deficiency symptom. Focus on the unique roles, like Mo in nitrate reductase and Zn in auxin synthesis.

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150. Match List I with List II:

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

Choose the correct answer from the options given below :

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

Solution:

Step 1: Understanding the Question:
The question asks to match metabolic processes or pathways from cellular respiration (List I) with their associated enzymes, locations, or alternative names (List II).

Step 2: Detailed Explanation:
Let's connect each item from List I to its correct counterpart in List II.

- **A. Oxidative decarboxylation:** This is the process that links glycolysis to the Krebs cycle, where pyruvate is converted to acetyl-CoA. This reaction is catalyzed by the **Pyruvate dehydrogenase** complex. So, A matches with **II**.

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

- **C. Oxidative phosphorylation:** This is the metabolic pathway in which cells use enzymes to oxidize nutrients, thereby releasing energy which is used to produce ATP. This process takes place in the **Electron transport system** (ETS) located on the inner mitochondrial membrane. So, C matches with **III**.

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

Step 3: Final Answer:
The correct set of matches is A-II, B-IV, C-III, D-I. This corresponds to option (1).

Quick Tip

To master cellular respiration, visualize it as a four-stage process: 1. Glycolysis (in cytoplasm), 2. Link Reaction/Oxidative Decarboxylation (mitochondrial matrix), 3. Krebs/TCA Cycle (mitochondrial matrix), and 4. Oxidative Phosphorylation/ETS (inner mitochondrial membrane). Knowing the key enzyme or product of each stage is crucial.
