# Karnataka Board Class 12 Biology Question Paper with Solutions

| Time Allowed :3 Hours | Maximum Marks :70 | Total Questions :44 |
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**General Instructions**

**Read the following instructions very carefully and strictly follow them:**

1. The question paper consists of Parts - A, B, C, D and E.
2. PART-A consists of I and II and Part-D consists of V and VI.
3. All Parts are compulsory.
4. For PART-A questions, only the first written answers will be considered for evaluation.
5. Draw diagrams whenever necessary. Unlabelled diagrams do not attract any marks.
6. PART-E, consists of questions, for Visually Challenged Students only.

## PART A

**1. In artificial hybridisation approach, if the female parent produces unisexual flowers, there is no need for**

(A) Bagging
(B) Tagging
(C) Rebagging
(D) Emasculation

**Correct Answer:** (D) Emasculation

**Solution:**

**Step 1: Understanding the Question:**
The question asks which step of artificial hybridization can be skipped if the female parent plant bears unisexual flowers.

**Step 2: Key Concepts:**
- **Artificial Hybridization:** A technique used in plant breeding to cross two different plants with desired characteristics.
- **Emasculation:** The process of removing anthers (male reproductive parts) from a bisexual flower before they mature to prevent self-pollination.
- **Bagging:** Covering the emasculated flower with a bag to prevent contamination from unwanted pollen.

- **Unisexual flower:** A flower that has either male parts (stamens) or female parts (pistil), but not both. A female unisexual flower only has a pistil.

**Step 3: Detailed Explanation:**
The purpose of emasculation is to remove the anthers to prevent the flower from pollinating itself.
However, if the female parent plant produces only unisexual flowers (i.e., pistillate flowers), it naturally lacks anthers.
Since there are no anthers to remove, the step of emasculation is not necessary.
Bagging is still required to protect the stigma from being pollinated by any unwanted pollen grains from other plants. Tagging and rebagging (after pollination) are also performed as usual.

**Step 4: Final Answer:**
Since the female flower is unisexual, it does not have anthers, so there is no need for their removal. Therefore, emasculation is not required.

Quick Tip

Remember the purpose of each step in artificial hybridization. Emasculation is solely to prevent self-pollination in bisexual flowers. If the flower is already unisexual (female), this step is redundant.

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**2. The cells that secrete androgens are**

(A) Sertoli cells
(B) Leydig cells
(C) Germ cells
(D) Spermatogonia

**Correct Answer:** (B) Leydig cells

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the specific cells responsible for the secretion of androgens (male sex hormones) in the testes.

**Step 2: Key Concepts:**
- **Testes:** The male primary reproductive organs.
- **Seminiferous tubules:** Structures within the testes where sperm production (spermatogenesis) occurs.
- **Interstitial spaces:** The regions outside the seminiferous tubules.

- **Androgens:** A group of male sex hormones, with testosterone being the most important.

**Step 3: Detailed Explanation:**
(A) **Sertoli cells:** Found within the seminiferous tubules, they provide nourishment to the developing sperm cells. They do not secrete androgens.
(B) **Leydig cells (or Interstitial cells):** Located in the interstitial spaces between the seminiferous tubules. These cells are stimulated by Luteinizing Hormone (LH) from the pituitary gland to synthesize and secrete androgens, primarily testosterone.
(C) **Germ cells:** These are the cells that undergo meiosis to form sperm. They are involved in reproduction, not hormone secretion.
(D) **Spermatogonia:** These are the male germ cells at the earliest stage, which divide to produce spermatocytes and eventually sperm. They are not endocrine cells.

**Step 4: Final Answer:**
Leydig cells are the interstitial cells of the testes that secrete androgens. Therefore, option (B) is the correct answer.

Quick Tip

Associate "Leydig" or "Interstitial" cells with the production of testosterone. Remember that they are located in between (interstitial) the seminiferous tubules, where sperm production happens.

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**3. Sexually transmitted infection that can be completely curable is**

(A) Gonorrhea
(B) Hepatitis-B
(C) AIDS
(D) Genital herpes

**Correct Answer:** (A) Gonorrhea

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify which of the listed sexually transmitted infections (STIs) can be completely cured with medical treatment.

**Step 2: Key Concepts:**
STIs can be caused by bacteria, viruses, protozoa, etc.
- **Bacterial STIs:** Generally curable with antibiotics if detected early.
- **Viral STIs:** Generally not curable, though their symptoms can be managed with antiviral

medications.

**Step 3: Detailed Explanation:**
(A) **Gonorrhea:** This is a bacterial infection caused by Neisseria gonorrhoeae. It can be completely cured with a course of appropriate antibiotics.
(B) **Hepatitis-B:** This is a viral infection that affects the liver. While there is a vaccine to prevent it and treatments to manage it, there is no complete cure for chronic Hepatitis-B.
(C) **AIDS (Acquired Immunodeficiency Syndrome):** This is caused by the Human Immunodeficiency Virus (HIV). There is no cure for HIV/AIDS, but antiretroviral therapy (ART) can manage the virus and allow people to live long, healthy lives.
(D) **Genital herpes:** This is a viral infection caused by the herpes simplex virus (HSV). There is no cure. Antiviral medications can prevent or shorten outbreaks.

**Step 4: Final Answer:**
Among the given options, only Gonorrhea is a bacterial infection and is therefore completely curable with antibiotics. The other three are viral infections and are not currently curable.

Quick Tip

A simple way to remember is that, in general, bacterial infections (like Gonorrhea, Syphilis, Chlamydia) are curable, while viral infections (like HIV/AIDS, Herpes, Hepatitis-B, HPV) are not.

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**4. Identify the correct match.**
(A) XO - Male grasshopper
(B) XX - Male Drosophila
(C) ZW - Male bird
(D) ZZ - Female bird

**Correct Answer:** (A) XO - Male grasshopper

**Solution:**

**Step 1: Understanding the Question:**
The question requires us to identify the correctly matched pair of sex chromosome combination and the corresponding sex of the organism.

**Step 2: Key Concepts of Sex Determination:**
- **XX-XO system:** Found in insects like grasshoppers. Females have two X chromosomes (XX), while males have only one (XO), where 'O' denotes the absence of a second sex chromosome.
- **XX-XY system:** Found in humans and Drosophila. Females are XX (homogametic) and males are XY (heterogametic).

- **ZZ-ZW system:** Found in birds, some reptiles, and fishes. Males are ZZ (homogametic) and females are ZW (heterogametic).

**Step 3: Detailed Explanation:**
(A) **XO - Male grasshopper:** In the XO system of sex determination, males have only one X chromosome. This is a correct match.
(B) **XX - Male Drosophila:** Drosophila (fruit fly) follows the XX-XY system. Males are XY, not XX. Females are XX. So, this is incorrect.
(C) **ZW - Male bird:** Birds follow the ZZ-ZW system. Males are ZZ, not ZW. Females are ZW. So, this is incorrect.
(D) **ZZ - Female bird:** In the ZZ-ZW system, females are ZW, not ZZ. Males are ZZ. So, this is incorrect.

**Step 4: Final Answer:**
The only correct match is the XO chromosome constitution for a male grasshopper.

Quick Tip

Remember the three main types of chromosomal sex determination: XY (humans, fruit flies), XO (grasshoppers), and ZW (birds). In XY and XO, the male is heterogametic or has fewer sex chromosomes. In the ZW system, the female is heterogametic (ZW).

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**5. Statement I: A nitrogenous base is linked to the -OH of 1'C pentose sugar through N-glycosidic linkage to form a nucleoside.**
**Statement II: Two nucleosides are linked through 3'-5' phosphodiester linkage to form a dinucleotide.**
(A) Both statement I and statement II are correct
(B) Both statement I and statement II are incorrect
(C) Statement I is correct, but statement II is incorrect
(D) Statement I is incorrect but statement II is correct

**Correct Answer:** (C) Statement I is correct, but statement II is incorrect

**Solution:**

**Step 1: Understanding the Question:**
We need to evaluate the correctness of two statements regarding the chemical structure of nucleic acids.

**Step 2: Key Concepts of Nucleic Acid Structure:**
- **Nucleoside:** A molecule formed by a nitrogenous base linked to a pentose sugar.
- **Nucleotide:** A molecule formed by a nucleoside linked to a phosphate group.
- **Dinucleotide:** Two nucleotides linked together.

- **N-glycosidic linkage:** The bond between the sugar and the nitrogenous base.
- **Phosphodiester linkage:** The bond that links nucleotides together in a polynucleotide chain.

**Step 3: Detailed Explanation:**
**Analysis of Statement I:** "A nitrogenous base is linked to the -OH of 1'C pentose sugar through N-glycosidic linkage to form a nucleoside."
This statement is **correct**. A nitrogenous base (like Adenine, Guanine, Cytosine, Thymine, or Uracil) attaches to the 1' carbon of the pentose sugar (deoxyribose or ribose) via an N-glycosidic bond, forming a nucleoside.

**Analysis of Statement II:** "Two nucleosides are linked through 3'-5' phosphodiester linkage to form a dinucleotide."
This statement is **incorrect**. A phosphodiester linkage joins two **nucleotides**, not two nucleosides. A phosphate group on the 5' carbon of one nucleotide forms a bond with the hydroxyl group on the 3' carbon of the next nucleotide. Nucleosides lack the phosphate group necessary to form this bond.

**Step 4: Final Answer:**
Statement I accurately describes the formation of a nucleoside, while Statement II incorrectly states that phosphodiester bonds link nucleosides instead of nucleotides. Therefore, Statement I is correct and Statement II is incorrect.

Quick Tip

Remember the hierarchy: Base + Sugar = Nucleo**s**ide. Nucleo**s**ide + Phosphate = Nucleo**t**ide. Multiple Nucleo**t**ides are linked by phosphodiester bonds. The 't' in nucleotide can remind you that it has the 'third' component (phosphate) and is the unit that forms the polymer.

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**6. Correct sequence of evolution of animal groups according to geological time scale is**
(A) Amphibians - Fishes - Reptiles - Mammals
(B) Mammals - Fishes - Reptiles - Amphibians
(C) Reptiles - Amphibians - Fishes - Mammals
(D) Fishes - Amphibians - Reptiles - Mammals

**Correct Answer:** (D) Fishes - Amphibians - Reptiles - Mammals

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the correct chronological order of the evolution of the major vertebrate

groups.

**Step 2: Key Concepts of Vertebrate Evolution:**
The evolution of vertebrates followed a general path from aquatic life to terrestrial life, with key adaptations at each stage.
- **Fishes:** The first vertebrates, evolved in water.
- **Amphibians:** Evolved from lobe-finned fishes. They were the first vertebrates to colonize land but still required water for reproduction.
- **Reptiles:** Evolved from amphibians. They developed key adaptations for a fully terrestrial life, such as amniotic eggs and scaly skin, freeing them from dependence on water for reproduction.
- **Mammals and Birds:** Both groups evolved from different lineages of reptiles.

**Step 3: Detailed Explanation:**
Based on the fossil record and evolutionary principles:
1. **Fishes** were the earliest vertebrates.
2. **Amphibians** evolved from fishes and made the transition from water to land.
3. **Reptiles** evolved from amphibians, becoming better adapted to dry land.
4. **Mammals** evolved from a specific group of reptiles (synapsids).
Therefore, the correct evolutionary sequence is Fishes $\rightarrow$ Amphibians $\rightarrow$ Reptiles $\rightarrow$ Mammals.

**Step 4: Final Answer:**
Option (D) correctly represents the evolutionary timeline of these vertebrate groups.

Quick Tip

Think of the story of vertebrate evolution as a move from water to land. Fishes are fully aquatic. Amphibians are the "bridge" group (living in both environments). Reptiles mastered life on land. Mammals are a later, more specialized group that also evolved from reptiles. This simple narrative helps remember the sequence.

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**7. The molecules trapped in the lymph nodes responsible for the activation of lymphocytes present there and cause the immune response are**
(A) Antibodies
(B) Anti-histamines
(C) Antigens
(D) Interferons

**Correct Answer:** (C) Antigens

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the molecules that are filtered by lymph nodes and are responsible for triggering an immune response by activating lymphocytes.

**Step 2: Key Concepts of the Immune System:**
- **Lymph nodes:** Small, bean-shaped organs that are part of the lymphatic system. They filter lymph fluid and house immune cells (lymphocytes).
- **Antigen:** Any substance (usually a part of a pathogen like a virus or bacterium) that the immune system recognizes as foreign and that elicits an immune response.
- **Lymphocytes:** A type of white blood cell (B-cells and T-cells) that recognizes specific antigens and mounts an immune response against them.
- **Antibodies:** Proteins produced by B-lymphocytes in response to an antigen. They bind to antigens to neutralize them.

**Step 3: Detailed Explanation:**
(A) **Antibodies:** These are the products of an immune response, not the triggers. They are produced by activated B-cells.
(B) **Anti-histamines:** These are drugs that block the action of histamine, a substance released during allergic and inflammatory reactions. They do not activate lymphocytes.
(C) **Antigens:** When pathogens invade tissues, they or their parts (antigens) are carried by the lymph fluid to the lymph nodes. Here, they are "presented" to lymphocytes, which become activated and initiate an immune response. This is the correct answer.
(D) **Interferons:** These are signaling proteins released by virus-infected cells to alert neighboring cells to heighten their anti-viral defenses. They are part of the immune response, but not the primary activators of lymphocytes in lymph nodes.

**Step 4: Final Answer:**
Antigens are the foreign molecules that are trapped in lymph nodes and activate lymphocytes, initiating a specific immune response.

Quick Tip

Remember the cause and effect in immunology: **Anti**gen **gen**erates an **anti**body response. The antigen is the trigger (the "bad guy"), and the antibody is the response (the "good guy's weapon"). Lymph nodes are the "police stations" where the bad guys are brought in and identified.

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**8. The plants with hallucinogenic properties are**
(A) Atropa and Cannabis
(B) Datura and Atropa
(C) Datura and Cannabis
(D) Atropa and Papaver

**Correct Answer:** (C) Datura and Cannabis

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify a pair of plants both of which are known for their hallucinogenic effects.

**Step 2: Key Concepts of Psychoactive Plants:**
- **Hallucinogen:** A psychoactive agent which can cause hallucinations, perceptual anomalies, and other substantial subjective changes in thoughts, emotion, and consciousness.
- Datura: A genus of plants known for containing potent deliriant hallucinogens (tropane alkaloids like scopolamine and atropine).
- Cannabis: A genus of flowering plants, the source of marijuana. Its main psychoactive constituent is THC, which has complex effects, including hallucinogenic properties at high doses.
- Atropa belladonna (deadly nightshade): Contains the same class of tropane alkaloids as Datura and has hallucinogenic properties.
- Papaver somniferum (opium poppy): The source of opium and its derivative opiates like morphine and heroin. These are primarily classified as narcotics (depressants), not hallucinogens, although they can cause altered mental states.

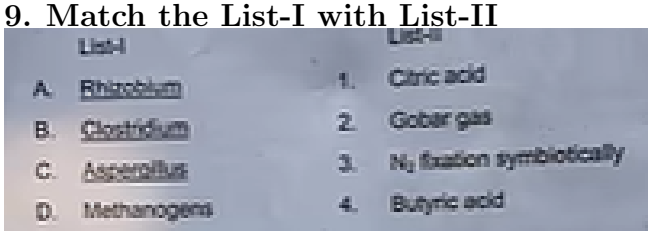
**Step 3: Detailed Explanation:**
We need to find the pair where both plants are primarily known for being hallucinogenic.
(A) Atropa (hallucinogenic) and Cannabis (hallucinogenic). This is a possible correct pair.
(B) Datura (hallucinogenic) and Atropa (hallucinogenic). This is also a possible correct pair.
(C) Datura (hallucinogenic) and Cannabis (hallucinogenic). This is also a possible correct pair.
(D) Atropa (hallucinogenic) and Papaver (narcotic/depressant). This pair is incorrect because Papaver is not classified as a hallucinogen.
There seems to be ambiguity as options (A), (B), and (C) all contain pairs of hallucinogenic plants. However, in the context of typical textbook examples, Datura and Cannabis are frequently cited together as plants with hallucinogenic properties. The checkmark in the image is on (C), making it the designated correct answer for this exam.

**Step 4: Final Answer:**
Both Datura and Cannabis are well-known plants that possess hallucinogenic properties. Therefore, option (C) is the correct answer.

Quick Tip

For exams, focus on the most common examples provided in your textbook. Cannabis, Datura, and Atropa are classic examples of plants with hallucinogenic properties. Papaver is the classic example for opiates (depressants).

**9. Match the List-I with List-II**




(A) A-1, B-2, C-3, D-4
(B) A-2, B-1, C-3, D-4
(C) A-3, B-4, C-1, D-2
(D) A-4, B-2, C-1, D-3

**Correct Answer:** (C) A-3, B-4, C-1, D-2

**Solution:**

**Step 1: Understanding the Question:**
The question requires matching microorganisms from List-I with their corresponding product or function from List-II.

**Step 2: Matching each item:**
- **A. Rhizobium:** This is a well-known bacterium that lives in the root nodules of leguminous plants and performs symbiotic nitrogen fixation. So, **A matches with 3 ($N_2$ fixation symbiotically)**.
- **B. Clostridium:** Specifically, Clostridium butylicum is a bacterium known for producing butyric acid through fermentation. So, **B matches with 4 (Butyric acid)**.
- **C. Aspergillus:** Specifically, Aspergillus niger is a fungus used in the industrial production of citric acid. So, **C matches with 1 (Citric acid)**.
- **D. Methanogens:** These are archaea that produce methane as a metabolic byproduct. Methane is the primary component of gobar gas (biogas). So, **D matches with 2 (Gober gas)**.

**Step 3: Assembling the Correct Combination:**
Based on the matching:
A $\rightarrow$ 3
B $\rightarrow$ 4
C $\rightarrow$ 1
D $\rightarrow$ 2
This combination corresponds to option (C).

**Step 4: Final Answer:**
The correct set of matches is A-3, B-4, C-1, D-2.

Quick Tip

In 'match the following' questions, start with the pair you are most confident about. For example, if you know for sure that Methanogens produce Gober gas (D-2), you can immediately eliminate options (A), (B), and (D), leaving only (C) as the correct answer. This saves a lot of time.

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**10. Which of the following is the correct representation of primer annealing step in PCR?**


**Correct Answer:** (D)

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the diagram that correctly illustrates the annealing step of the Polymerase Chain Reaction (PCR).

**Step 2: Key Concepts of PCR:**
- **PCR (Polymerase Chain Reaction):** A technique to amplify a specific segment of DNA.
- **Step 1: Denaturation:** The double-stranded DNA is heated (to 95°C) to separate it into two single strands.
- **Step 2: Annealing:** The temperature is lowered (to 50-65°C), allowing short DNA sequences called primers to bind (anneal) to their complementary sequences on the single-stranded DNA templates.
- **Step 3: Extension:** The temperature is raised again (to 72°C), and DNA polymerase extends the primers, synthesizing new DNA strands.
- **Key Rule for Annealing:** DNA strands are antiparallel (one runs 5' to 3', its complement runs 3' to 5'). Primers always anneal to the 3' end of the template strand and are synthesized in the 5' to 3' direction.

**Step 3: Detailed Explanation of the Diagrams:**
- The diagrams show two separated DNA template strands. The top strand runs 5' to 3' left to right. The bottom strand runs 3' to 5' left to right. - **Primer for the top strand:** It must bind to the 3' end of the top strand. So, it will be on the right side of the top strand. It will run 5' to 3' from right to left. - **Primer for the bottom strand:** It must bind to the 3' end of the bottom strand. So, it will be on the left side of the bottom strand. It will run 5' to 3' from left to right.
- **Option (A), (B), (C):** These diagrams show incorrect binding of primers. For example, primers might be shown binding to the 5' ends, or both on one strand, or in the wrong orientation. - **Option (D):** This diagram correctly shows the two template strands separated. A short primer is shown annealed to the 3' end of the top strand, and another primer is shown annealed to the 3' end of the bottom strand. The primers are short and correctly positioned to allow for extension towards the other end of the template. This represents the correct annealing step.

**Step 4: Final Answer:**
Diagram (D) correctly depicts the annealing of primers to the 3' ends of the separated template DNA strands.

Quick Tip

Remember two key rules for primer annealing: 1) DNA is antiparallel. 2) DNA polymerase synthesizes only in the 5' to 3' direction. This means the primer must bind to the 3' end of the template strand to provide a starting point for synthesis.

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**11. Identify the incorrect statement.**
(A) First letter of the restriction enzyme is derived from genus of the bacterium
(B) Second and third letters of the restriction enzyme are derived from species of the bacterium
(C) The fourth letter of the restriction enzyme is derived from the strain of the bacterium
(D) The Roman letter after the strain indicate the Roman origin of bacterium from which the restriction enzyme is isolated

**Correct Answer:** (D) The Roman letter after the strain indicate the Roman origin of bacterium from which the restriction enzyme is isolated

**Solution:**

**Step 1: Understanding the Question:**
The question asks us to identify the false statement among the given options regarding the nomenclature of restriction enzymes.

**Step 2: Key Concepts of Restriction Enzyme Nomenclature:**
Let's take the example of **EcoRI**.
- The **first letter** comes from the genus of the bacterium. Here, '**E**' comes from Escherichia.

- The **second and third letters** come from the species. Here, '**co**' comes from coli.
- The **fourth letter** comes from the strain of the bacterium. Here, '**R**' comes from the strain RY13.
- The **Roman numeral** at the end indicates the order in which the enzyme was discovered from that particular strain of bacteria. Here, '**I**' means it was the first restriction enzyme isolated from E. coli strain RY13.

**Step 3: Detailed Explanation:**
(A) This statement is correct. 'E' in EcoRI is from Escherichia (genus).
(B) This statement is correct. 'co' in EcoRI is from coli (species).
(C) This statement is correct. 'R' in EcoRI is from strain RY13.
(D) This statement is incorrect. The Roman numeral (like 'I', 'II', 'III') indicates the order of discovery of the enzyme from that strain, not the "Roman origin of the bacterium".

**Step 4: Final Answer:**
Statement (D) provides a false explanation for the meaning of the Roman numeral in a restriction enzyme's name.

Quick Tip

Break down the name of a common restriction enzyme like EcoRI to remember the naming rules: E (Genus: Escherichia), co (species: coli), R (Strain: RY13), I (Order of discovery: First).

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**12. The corn borers are controlled by the protein encoded by the gene**
(A) Cry I Ab
(B) Cry II Ab
(C) Cry IV Ab
(D) Cry I Ac

**Correct Answer:** (A) Cry I Ab

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the specific Cry gene whose protein product is effective against corn borers.

**Step 2: Key Concepts of Bt Cotton and Cry Genes:**
- Bt (Bacillus thuringiensis): A bacterium that produces insecticidal proteins called Cry proteins.
- Cry genes: The genes that code for these Cry proteins.
- Specificity: Different Cry proteins are toxic to different groups of insects. This specificity is

crucial for creating targeted transgenic crops.

**Step 3: Detailed Explanation:**
The specificity of different Cry proteins is a key fact to remember:
- **Cry I Ac** and **Cry II Ab** proteins control cotton bollworms.
- **Cry I Ab** protein controls corn borers.
- Other Cry proteins, like Cry IV Ab, might target other insects like flies or mosquitoes.

Based on this established specificity:
(A) **Cry I Ab** is the gene that codes for the protein that controls corn borers. This is correct.
(B) **Cry II Ab** controls cotton bollworms. This is incorrect.
(C) **Cry IV Ab** does not target corn borers. This is incorrect.
(D) **Cry I Ac** controls cotton bollworms. This is incorrect.

**Step 4: Final Answer:**
The gene that encodes the protein to control corn borers is Cry I Ab.

Quick Tip

To remember the Cry gene specificities, create a small table: - Cotton Bollworms: Cry I Ac, Cry II Ab - Corn Borer: Cry I Ab Note the small difference: 'Ac' for cotton, 'Ab' for borer (and also cotton). Linking the letters to the pest can be a helpful mnemonic.

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**13. Herbivores in a broad ecological context not very different from**
(A) Commensals
(B) Predators
(C) Parasites
(D) Producers

**Correct Answer:** (B) Predators

**Solution:**

**Step 1: Understanding the Question:**
The question asks which ecological role is most functionally similar to that of an herbivore, from a broad perspective of interspecific interactions.

**Step 2: Key Concepts of Ecological Interactions:**
- **Herbivory (+/-):** An interaction where an animal (herbivore) feeds on a plant (producer). One organism benefits, the other is harmed.
- **Predation (+/-):** An interaction where one animal (predator) hunts and kills another animal (prey). One organism benefits, the other is harmed.

- **Commensalism (+/0):** An interaction where one organism benefits, and the other is neither helped nor harmed.
- **Parasitism (+/-):** An interaction where one organism (parasite) lives on or in another organism (host), causing it harm. The host is typically not killed immediately.
- **Producers:** Organisms that produce their own food, usually through photosynthesis (e.g., plants). They are at the base of the food chain.

**Step 3: Detailed Explanation:**
In a broad functional sense, both herbivory and predation are trophic (feeding) interactions where one organism consumes another. The main difference is the type of organism being consumed (plant vs. animal). From the perspective of energy flow and the (+/-) nature of the interaction (one benefits by eating, the other is harmed by being eaten), herbivory is a form of predation.
- (A) Commensals involve a neutral outcome for one partner, which is different from herbivory.
- (C) Parasites typically live in close association with their host and weaken it over time, which is a different strategy from an herbivore that consumes parts of or the whole plant.
- (D) Producers are the organisms that herbivores eat; they are on the opposite side of the interaction.
Therefore, the role of a predator is functionally the most similar to that of an herbivore.

**Step 4: Final Answer:**
In a broad ecological context, herbivores are not very different from predators, as both are consumers that feed on other organisms.

Quick Tip

Think about ecological interactions in terms of their outcomes (+, -, 0). Predation, Herbivory, and Parasitism are all (+/-) interactions. In this context, herbivory can be considered a special type of predation where the "prey" is a plant.

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**14. Dead plant remains such as leaves, bark and flowers constitute**
(A) Debris
(B) Humus
(C) Detritus
(D) Fossil

**Correct Answer:** (C) Detritus

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the specific ecological term for dead organic matter derived from plants,

such as fallen leaves, bark, and flowers.

**Step 2: Key Concepts of Decomposition:**
- **Detritus:** The specific term for non-living particulate organic material. It includes the bodies or fragments of dead organisms as well as fecal matter. This is the raw material for decomposition.
- **Debris:** A general, non-scientific term for scattered pieces of waste or remains. While technically correct, it's not the specific ecological term.
- **Humus:** A dark, organic material that forms in soil when plant and animal matter decays. It is the end product of decomposition (humification), is highly resistant to further decay, and is rich in nutrients.
- **Fossil:** The preserved remains, impression, or trace of a once-living thing from a past geological age.

**Step 3: Detailed Explanation:**
The material described—dead leaves, bark, and flowers—is the starting point for the decomposition process in an ecosystem. The correct scientific term for this raw dead organic matter is detritus. The organisms that feed on it are called detritivores. Humus is what this material becomes after extensive decomposition.
Therefore, detritus is the most accurate and specific term.

**Step 4: Final Answer:**
Dead plant remains such as leaves, bark, and flowers constitute detritus.

Quick Tip

Remember the decomposition sequence: **Detritus** (raw material) → Decomposition by detritivores/microbes → **Humus** (stable end product). Detritus is what falls, and humus is what remains in the soil after decay.

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**15. An estimate of about 7 million global species diversity was made by**
(A) Edward Wilson
(B) Robert May
(C) David Tilman
(D) Paul Ehrlich

**Correct Answer:** (B) Robert May

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the scientist who provided a more conservative and scientifically

sound estimate of global species diversity at around 7 million.

**Step 2: Key Contributions of Ecologists:**
- **Edward Wilson:** A famous sociobiologist and conservationist who popularized the term "biodiversity". He has made many contributions but is not specifically known for the 7 million estimate.
- **Robert May:** An ecologist who used statistical analysis of taxonomic groups to make a more sound estimate of global species diversity. His work led to the widely cited figure of about 7 million species.
- **David Tilman:** Known for his experimental work demonstrating that biodiversity increases the stability of ecosystems.
- **Paul Ehrlich:** Known for his work on population biology and his "rivet popper" hypothesis, which is an analogy for the importance of individual species in an ecosystem.

**Step 3: Detailed Explanation:**
While the number of species described by scientists is around 1.5 million, the total number on Earth is unknown. Various ecologists have made estimates. Robert May's estimate, based on a logical extrapolation from well-studied groups of insects to all species, proposed that a more conservative and scientifically plausible estimate was around 7 million. This is a key fact mentioned in ecology textbooks.

**Step 4: Final Answer:**
The estimate of about 7 million global species was made by Robert May.

Quick Tip

Associate key ecologists with their main ideas: Robert **May** - **M**aybe 7 million species; Paul **Ehrlich** - Rivet popper (**E**cosystems are like airplanes); David **Tilman** - Biodiversity leads to s**t**ability; Edward **Wilson** - Popularized **biodiversity**.

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**II. Fill in the blanks by choosing the appropriate word/words from those given below :**
**(650 CC, macrophages, inoculum, animals, 900 CC, colostrum)**

**16. The initial few days of milk produced after parturition is _____.**

**Correct Answer:** colostrum

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the specific term used to describe the first milk produced by a mother

immediately after childbirth (parturition).

**Step 2: Key Concepts:**
- **Parturition:** The act of giving birth.
- **Lactation:** The process of milk production.
- **Colostrum:** The first form of milk produced by the mammary glands of mammals immediately following delivery of the newborn.

**Step 3: Detailed Explanation:**
The milk produced during the initial few days of lactation is called colostrum. It is a thick, yellowish fluid.
Colostrum is rich in antibodies (especially IgA), which provide passive immunity to the newborn baby, protecting it from infections. It is also high in protein and low in fat compared to mature milk.
From the list provided, 'colostrum' is the correct term for this initial milk.

**Step 4: Final Answer:**
The initial few days of milk produced after parturition is **colostrum**.

Quick Tip

Associate "colostrum" with "first milk". It's often called "liquid gold" because of its high concentration of antibodies and nutrients, which are crucial for a newborn's initial health and immunity.

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**17. Homo erectus had a brain size around _____.**

**Correct Answer:** 900 CC

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the approximate brain capacity (cranial capacity) of Homo erectus, an extinct species of archaic human.

**Step 2: Key Concepts in Human Evolution:**
The evolution of humans is characterized by a significant increase in brain size over time. It's important to know the approximate cranial capacities of major hominids.
- Australopithecus: 400-500 CC
- Homo habilis: 650-800 CC
- Homo erectus: 900 CC (with a range from about 850 to 1100 CC)
- Homo neanderthalensis: 1400 CC

- Homo sapiens: 1350 CC

**Step 3: Detailed Explanation:**
Homo erectus is an important intermediate in human evolution, showing a larger brain size than earlier hominids like Homo habilis. Fossil evidence indicates that their cranial capacity was approximately 900 cubic centimetres (CC).
From the list provided, '900 CC' is the correct value. '650 CC' is closer to Homo habilis.

**Step 4: Final Answer:**
Homo erectus had a brain size around **900 CC**.

Quick Tip

Create a simple timeline of human ancestors and memorize their key features, especially the trend of increasing brain size: habilis (≈700cc) → erectus (≈900cc) → neanderthalensis/sapiens (≈1400cc). This helps in quickly answering such factual questions.

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**18. Human immuno deficiency virus replicates in _____.**

**Correct Answer:** macrophages

**Solution:**

**Step 1: Understanding the Question:**
The question asks to identify the type of cell where the Human Immunodeficiency Virus (HIV) replicates, acting as a "factory" for producing more viruses.

**Step 2: Key Concepts of HIV Life Cycle:**
- HIV (Human Immunodeficiency Virus): A retrovirus that attacks the immune system.
- Helper T-cells (CD4+ cells): The primary target of HIV. The destruction of these cells leads to AIDS.
- Macrophages: Large white blood cells that are part of the innate immune system. They are also targeted by HIV.

**Step 3: Detailed Explanation:**
After entering the body, HIV first infects macrophages. Inside the macrophage, the virus uses its reverse transcriptase enzyme to convert its RNA genome into DNA, which then integrates into the host cell's DNA. The infected macrophage then starts producing new virus particles. Because the macrophages continue to produce the virus over a long period without being killed quickly, they are often referred to as the "HIV factory". The virus then goes on to infect helper T-lymphocytes, which are the main cells of the immune system.
From the given list, 'macrophages' is the correct answer.

**Step 4: Final Answer:**
Human immunodeficiency virus replicates in **macrophages**.

Quick Tip

Remember that while HIV's main target and cause of immune collapse is the helper T-cell, its initial and persistent replication site is the macrophage. Think of the macrophage as the virus's first hideout and long-term factory.

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**19. A small amount of curd added to the fresh milk as _____.**

**Correct Answer:** inoculum

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the scientific term for the small amount of starter culture (in this case, curd) that is added to fresh milk to initiate the process of curdling.

**Step 2: Key Concepts in Microbiology:**
- Fermentation: A metabolic process that produces chemical changes in organic substrates through the action of enzymes. In curd making, it's lactic acid fermentation.
- Inoculum (or starter): A small quantity of a substance containing microorganisms that is introduced into a suitable medium to start a culture or fermentation process.

**Step 3: Detailed Explanation:**
To make curd from milk, a small amount of existing curd is added to warm milk. This starter curd contains millions of Lactic Acid Bacteria (LAB), such as Lactobacillus.
This small starting population of bacteria is called the inoculum. The LAB in the inoculum multiply in the milk, converting the lactose sugar into lactic acid. The acid causes the milk proteins (casein) to coagulate and partially digest, forming curd.
From the list of options, 'inoculum' is the correct term.

**Step 4: Final Answer:**
A small amount of curd added to the fresh milk as **inoculum**.

Quick Tip

The word "inoculum" is used broadly in microbiology to mean any starting material for a culture. Think of it like planting a "seed" (the inoculum) in fertile "soil" (the milk or culture medium) to grow a "crop" (the final product, like curd).

**20. Based on currently available species inventories, 70% of species recorded are _____.**

**Correct Answer:** animals

**Solution:**

**Step 1: Understanding the Question:**
The question asks which major group of organisms constitutes the vast majority (specifically, over 70%) of all species that have been scientifically recorded and named so far.

**Step 2: Key Concepts of Biodiversity:**
Biodiversity refers to the variety of life on Earth. When cataloging species, scientists group them into major kingdoms like Animalia, Plantae, Fungi, etc.
- **Kingdom Animalia:** This kingdom is incredibly diverse, especially the phylum Arthropoda (insects, arachnids, crustaceans).
- **Kingdom Plantae:** Includes all plants.
- **Fungi, Protists, Monerans:** Other major kingdoms.

**Step 3: Detailed Explanation:**
According to current taxonomic inventories, the total number of species described is over 1.5 million. Of these, more than 70 percent are animals. Within the animal kingdom, insects are the most species-rich group, making up over 70 percent of all animals.
Plants (including algae, fungi, bryophytes, gymnosperms, and angiosperms) comprise no more than 22 percent of the total.
Therefore, animals overwhelmingly dominate the list of recorded species. From the provided list, 'animals' is the correct answer.

**Step 4: Final Answer:**
Based on currently available species inventories, 70% of species recorded are **animals**.

Quick Tip

When thinking about the number of species, remember that insects rule the world! Since insects are animals, the animal kingdom as a whole represents the largest fraction of known species diversity on the planet.

## PART B

**21. Draw a labelled diagram of mature 2-celled pollen grain.**

**Correct Answer:** A correctly drawn diagram showing the outer exine, inner intine, a large vegetative cell with its nucleus, and a smaller generative cell floating in the vegetative cell's cytoplasm.

**Solution:**

**Step 1: Understanding the Question:**
The question requires a standard biological drawing of a pollen grain at the stage where it has divided into two cells, which is the stage at which it is typically shed in many plants.

**Step 2: Key Components to Draw and Label:**
A mature 2-celled pollen grain consists of the following structures:
1. **Exine:** The tough, outer layer. It is often sculptured or spiny and is made of sporopollenin. It has one or more thin areas called germ pores.
2. **Intine:** The thin, inner wall, made of cellulose and pectin.
3. **Vegetative Cell (or Tube Cell):** The larger of the two cells, which contains abundant cytoplasm and a large, irregularly shaped nucleus. Its function is to form the pollen tube.
4. **Generative Cell:** The smaller, spindle-shaped cell that floats within the cytoplasm of the vegetative cell. It has dense cytoplasm and a prominent nucleus. This cell will later divide to form the two male gametes.
5. **Germ Pore:** A specific region on the exine where it is thin or absent, from which the pollen tube emerges during germination.

**Step 3: Description of the Diagram:**
The diagram should show a roughly spherical structure. The outermost layer should be thick and labelled 'Exine', with a small gap labelled 'Germ Pore'. Inside this is a thinner, continuous layer labelled 'Intine'. The interior should be filled with cytoplasm. A large nucleus, labelled 'Vegetative Nucleus', should be shown within this cytoplasm (belonging to the vegetative cell). A smaller, distinct cell with its own membrane and nucleus, floating in the main cytoplasm, should be drawn and labelled 'Generative Cell'.

**Step 4: Final Answer:**
The final answer is a neat, well-proportioned, and accurately labelled diagram illustrating the structures mentioned above.

Quick Tip

Remember the two cells have distinct roles: the **V**egetative cell is **V**ery large and forms the tube, while the **G**enerative cell will **G**enerate the male **G**ametes. This helps in remembering their names and functions.

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**22. How ZIFT is different from IUI?**

**Correct Answer:** ZIFT involves the transfer of a zygote or early embryo into the fallopian tube, whereas IUI involves the transfer of processed semen (sperm) directly into the uterus.

**Solution:**

**Step 1: Understanding the Question:**
The question asks for the key differences between two Assisted Reproductive Technologies (ART): ZIFT and IUI.

**Step 2: Defining the Techniques:**
- **ZIFT (Zygote Intra Fallopian Transfer):** This is an in-vitro fertilization (IVF) procedure. The ovum from the female and sperm from the male are fertilized outside the body in a laboratory to form a zygote. This zygote (or early embryo up to 8 blastomeres) is then transferred into the fallopian tube of the female.
- **IUI (Intra-Uterine Insemination):** This is a simpler procedure where fertilization occurs inside the body (in-vivo). Semen is collected from the male, processed in a lab to concentrate the healthy sperm, and then artificially introduced directly into the uterus of the female around the time of ovulation.

**Step 3: Listing the Differences:**
The main differences can be summarized in a table:

| Feature | ZIFT | IUI |
|---|---|---|
| What is transferred? | Zygote or early embryo. | Processed semen (sperm). |
| Site of transfer? | Fallopian tube. | Uterus. |
| Site of fertilization? | Outside the body (in-vitro). | Inside the body (in-vivo), in the fallopian tube. |
| Complexity | More complex and invasive. | Simpler and less invasive. |

**Step 4: Final Answer:**
The key differences are:
1. In ZIFT, a **zygote/embryo** is transferred, while in IUI, **sperm** is transferred.
2. The transfer site in ZIFT is the **fallopian tube**, whereas in IUI it is the **uterus**.
3. Fertilization in ZIFT is **in-vitro** (outside the body), while in IUI it is **in-vivo** (inside the body).

Quick Tip

Break down the acronyms to remember the difference: - **Z**IFT: **Z**ygote **I**ntra **F**allopian **T**ransfer. The name tells you what is transferred (Zygote) and where (Fallopian tube). - **IUI**: **I**ntra **U**terine **I**nsemination. The name tells you where the insemination occurs (Uterus).

**23. Sketch pedigree symbols for:**
**a) Sex unspecified**
**b) Mating**

**Correct Answer:** a) A diamond shape. b) A horizontal line connecting a square and a circle.

**Solution:**

**Step 1: Understanding the Question:**
The question asks to draw the standard symbols used in human pedigree analysis for two specific situations: an individual whose sex is not known, and a mating or marriage between two individuals.

**Step 2: Standard Pedigree Symbols:**
Pedigree charts use a standardized set of symbols to represent family relationships and track the inheritance of traits.
- A square represents a male.
- A circle represents a female.

**Step 3: Sketching the Required Symbols:**
**a) Sex unspecified:**
When the sex of an individual is unknown or not specified, the symbol used is a **diamond** ($\diamond$).

**b) Mating:**
A mating between a male and a female is represented by a **horizontal line** connecting a square and a circle. This line is known as the marriage line or mating line.

**Step 4: Final Answer:**
The symbol for 'sex unspecified' is a diamond. The symbol for 'mating' is a horizontal line connecting a square and a circle.

**Quick Tip**

Memorize the basic pedigree symbols: square for male, circle for female, diamond for unspecified, and shaded for affected. A horizontal line connecting two individuals indicates mating, and vertical lines descending from it show offspring.

**24. Mention four properties of a genetic material.**

**Correct Answer:** The four properties are:
1) Ability to self-replicate,
2) Chemical and structural stability,
3) Ability to store information, and
4) Scope for slow mutation.

**Solution:**

**Step 1: Understanding the Question:**
The question asks to list the essential characteristics that a molecule must possess to qualify as the genetic material for an organism.

**Step 2: Key Criteria for Genetic Material:**
Based on the experiments that established DNA as the genetic material and its known functions, a set of criteria was established.

**Step 3: Listing the Four Properties:**
A molecule that acts as a genetic material must fulfill the following four main criteria:
1. **It should be able to generate its replica (Replication):** The genetic material must be able to make exact copies of itself. This is essential for the transmission of genetic information from a parent cell to daughter cells and from one generation to the next.
2. **It should be chemically and structurally stable:** The genetic material should not change easily. Its stability ensures that the genetic information is reliably preserved and passed on without frequent errors.
3. **It should provide the scope for slow changes (mutation) that are required for evolution:** While it must be stable, it must also be capable of undergoing slow, inheritable changes (mutations). This variation is the raw material for natural selection and evolution.
4. **It should be able to express itself in the form of 'Mendelian Characters' (Information Storage and Expression):** The genetic material must contain the information needed to build and maintain an organism. This information must be expressible, typically through transcription and translation, to produce proteins and functional RNAs that determine the organism's traits.

**Step 4: Final Answer:**
The four key properties of a genetic material are its ability to replicate, its stability, its capacity for mutation, and its ability to store and express genetic information.

Quick Tip

Remember the four key roles of genetic material using the acronym **S-I-R-E**: - **S**tability: Must be stable. - **I**nformation: Must store genetic information. - **R**eplication: Must be able to self-replicate. - **E**volution: Must allow for mutation/evolution.