

Rajasthan JET Biology Sample Paper-11

Duration: 40 Minutes

Maximum Marks: 160

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries: **–1 marks**.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Q1. In which of the following pteridophytes are distinct microspores and megaspores produced within specialized structures called sporocarps?

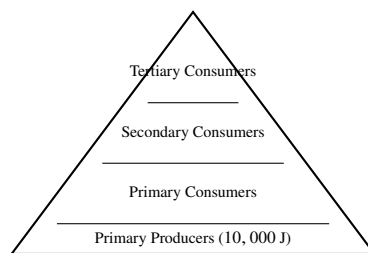
- (A) *Equisetum*
- (B) *Marsilea*
- (C) *Lycopodium*
- (D) *Adiantum*

Q2. Red rot of sugarcane, a devastating disease observed in both Kharif and rabi peripheral seasons, is caused by which of the following fungal pathogens?

- (A) *Albugo candida*
- (B) *Colletotrichum falcatum*
- (C) *Xanthomonas albilineans*
- (D) *Fusarium oxysporum*

Q3. Consider a terrestrial ecosystem where the energy available at the primary producer level is 10,000 Joules. According to Lindeman's efficiency law, what will be the available energy at the tertiary consumer level?





- (A) 1,000 J
- (B) 100 J
- (C) 10 J
- (D) 1 J

Q4. Which of the following parameters is correctly matched with its specific function during the process of downstream processing in recombinant DNA technology?

- (A) Lysozyme – Isolation of viral DNA from mammalian host cells
- (B) Elution – Extraction of DNA fragments from an agarose gel matrix
- (C) Chilled ethanol – Lysis of bacterial cell wall boundaries
- (D) PCR – Separation of protein molecules based on molecular weight

Q5. A farmer in Rajasthan notices significant damage to his stored wheat grains, characterized by irregular boring holes and powdered frass. Which of the following insect pests is most likely responsible for this damage?

- (A) *Sitophilus oryzae*
- (B) *Tribolium castaneum*
- (C) *Callosobruchus maculatus*
- (D) *Rhyzopertha dominica*

Q6. During the digestion of dietary proteins in the vertebrate stomach, the inactive zymogen pepsinogen is primarily converted into active pepsin by the action of:

- (A) Enterokinase
- (B) Hydrochloric acid



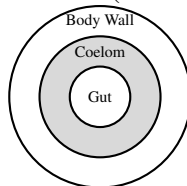
- (C) Trypsin
- (D) Bile salts

Q7. The botanical name of 'Ashwagandha', a prominent medicinal plant cultivated widely in the arid regions of Rajasthan, is:

- (A) *Chlorophytum borivillianum*
- (B) *Withania somnifera*
- (C) *Commiphora wightii*
- (D) *Aloe vera*

Q8. Which of the following phyla exhibits an evolutionarily advanced true coelom lined entirely by mesoderm, along with metameric segmentation, but completely lacks jointed appendages?

True Coelom (Schematic)



- (A) Aschelminthes
- (B) Annelida
- (C) Arthropoda
- (D) Mollusca

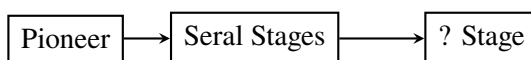
Q9. In the C_4 photosynthetic pathway, the primary fixation of atmospheric carbon dioxide (CO_2) occurs within the cytoplasm of mesophyll cells. What is the primary CO_2 acceptor molecule in this reaction?

- (A) Ribulose-1,5-bisphosphate (RuBP)
- (B) Phosphoenolpyruvate (PEP)
- (C) Oxaloacetic acid (OAA)
- (D) 3-phosphoglyceric acid (3-PGA)

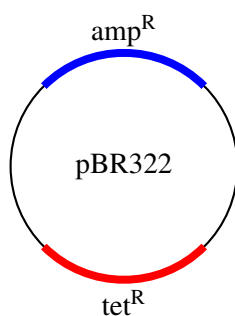


- Q10.** The biological control agent *Trichoderma harzianum* is most widely recommended and utilized in sustainable agriculture for the management of:
- (A) Sucking insect pests like aphids and jassids
 - (B) Soil-borne fungal plant pathogens causing root rots and wilts
 - (C) Plant parasitic root-knot nematodes
 - (D) Systemic viral infections in solanaceous crops

- Q11.** The ecological community that represents the ultimate, stable, and final structural stage of biotic succession in a specific climatic region is known as the:



- (A) Seral community
 - (B) Pioneer community
 - (C) Climax community
 - (D) Ecotone community
- Q12.** What is the specific role of the selectable marker gene, such as amp^R or tet^R , inserted within a standard cloning vector like pBR322?



- (A) To initiate the replication process of the foreign plasmid DNA
 - (B) To identify and eliminate non-transformant host cells
 - (C) To guide the restriction endonuclease to its specific cleavage site
 - (D) To increase the copy number of the integrated target gene
- Q13.** The structural and functional units of the human liver, which are arranged in the form of cords radiating from a central vein and covered by a thin connective tissue sheath called Glisson's capsule, are the:



- (A) Crypts of Lieberkühn
- (B) Hepatic lobules
- (C) Sphincters of Oddi
- (D) Brunner's glands

Q14. The larvae of the famous diamondback moth (*Plutella xylostella*) cause severe economic damage by feeding on the leaves of which specific group of agricultural crops?

- (A) Malvaceous crops like cotton and okra
- (B) Cruciferous crops like mustard, cabbage, and cauliflower
- (C) Leguminous crops like chickpea and pigeon pea
- (D) Solanaceous crops like potato and tomato

Q15. Botanical name of 'Cluster bean' (Guar), a key drought-hardy cash crop of Rajasthan valued highly for its endospermic gum, is:

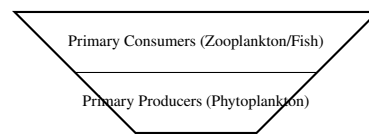
- (A) *Cyamopsis tetragonoloba*
- (B) *Vigna aconitifolia*
- (C) *Cajanus cajan*
- (D) *Phaseolus vulgaris*

Q16. Which of the following statements regarding the division Gymnospermae is botanically correct?

- (A) Double fertilization is a universal feature of all gymnosperms
- (B) The ovules are naked and not enclosed within an ovary wall before or after fertilization
- (C) The dominant independent phase of the life cycle is a multicellular gametophyte
- (D) Xylem vessels are universally present in all gymnospermous wood specimens

Q17. The ecological pyramid of biomass in a deep open-sea ecosystem is typically inverted. This structural anomaly occurs because:





- (A) Primary consumers have a much shorter lifespan than primary producers
- (B) The standing crop biomass of phytoplankton at any given instant is significantly lower than that of zooplankton and fish
- (C) Energy transfer efficiency between marine trophic levels exceeds 50%
- (D) Phytoplankton are rapidly consumed and completely lack cellulose cell walls

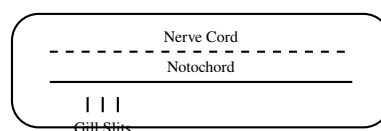
Q18. The process of introducing foreign DNA into target plant cells by bombarding them with high-velocity microparticles of gold or tungsten coated with the genetic material is called:

- (A) Microinjection
- (B) Electroporation
- (C) Biolistics or Gene gun
- (D) Liposome-mediated transfer

Q19. White rust of crucifers is a prominent disease affecting mustard crops in Rajasthan. This disease is caused by which of the following obligate biotrophic pathogens?

- (A) *Alternaria brassicae*
- (B) *Albugo candida*
- (C) *Erysiphe cruciferarum*
- (D) *Peronospora parasitica*

Q20. Which of the following combinations of diagnostic characteristics is uniquely shared by all members belonging to Phylum Chordata at some stage of their life cycle?



- (A) Dorsal solid nerve cord, pharyngeal gill slits, and an open circulatory system
- (B) Ventral hollow nerve cord, closed circulatory system, and a muscular post-anal tail
- (C) Notochord, dorsal hollow nerve cord, and pharyngeal gill slits
- (D) Notochord, ventral solid nerve cord, and absence of an anal structure

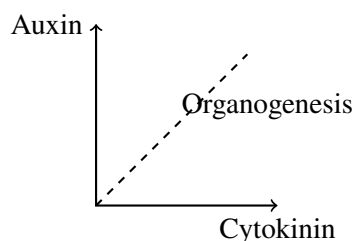
Q21. The adult stages of the Red Hairy Caterpillar (*Amsacta moorei*), a major polyphagous pest encountered during the Kharif season in Rajasthan, belong to which insect order?

- (A) Coleoptera
- (B) Lepidoptera
- (C) Hemiptera
- (D) Orthoptera

Q22. Which of the following pituitary hormones stimulates the Leydig cells of the vertebrate testes to synthesize and secrete androgens like testosterone?

- (A) Follicle-Stimulating Hormone (FSH)
- (B) Luteinizing Hormone (LH)
- (C) Adrenocorticotrophic Hormone (ACTH)
- (D) Prolactin

Q23. In plant tissue culture, the regeneration of root or shoot organs directly from an unorganized mass of cells known as callus is predominantly controlled by manipulating the ratio of which two plant growth regulators?



- (A) Gibberellins and Absciscic acid

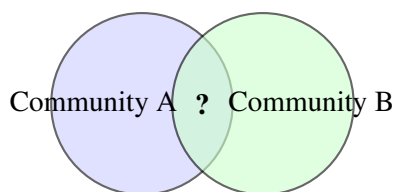


- (B) Auxins and Cytokinins
- (C) Ethylene and Auxins
- (D) Cytokinins and Gibberellins

Q24. 'Fenugreek' (Methi) is a vital seed spice crop grown extensively in Rajasthan. To which of the following botanical families does this economic plant belong?

- (A) Apiaceae
- (B) Fabaceae
- (C) Asteraceae
- (D) Solanaceae

Q25. Which of the following statements provides the most accurate definition of an ecological "Ecotone"?



- (A) The physical geographic zone where a single population undergoes exponential growth
- (B) A highly localized zone within an ecosystem showing the maximum concentration of toxic pollutants
- (C) A transition area or junction zone where two or more diverse ecological communities meet and integrate
- (D) The specific functional micro-habitat occupied by a single biological species in nature

Q26. Green ear disease of Pearl millet (Bajra), characterized by the transformation of floral parts into green leafy structures, is caused by the oomycete pathogen:

- (A) *Sclerospora graminicola*
- (B) *Tolysporium penicillariae*



(C) *Claviceps fusiformis*

(D) *Puccinia penniseti*

Q27. In the human ABO blood grouping system, a female with blood group A (genotype $I^A i$) marries a male with blood group B (genotype $I^B i$). What is the probability that their first child will possess the blood group O?

(A) 0%

(B) 25%

(C) 50%

(D) 100%

Q28. Water vascular system, which functions actively in locomotion, capture and transport of food, and respiration, is a unique diagnostic feature observed in which of the following animal phyla?

(A) Porifera

(B) Coelenterata

(C) Echinodermata

(D) Aschelminthes

Q29. A strategy of Integrated Pest Management (IPM) that targets the reproductive capabilities of insects by releasing laboratory-sterilized male individuals into wild populations is specifically classified as:

(A) Mechanical control

(B) Biological control

(C) Genetic or Autocidal control

(D) Legal control

Q30. The specific region of the human brain that functions as the primary regulatory center for homeostatic activities such as thermoregulation, hunger, and thirst is the:



- (A) Cerebrum
- (B) Cerebellum
- (C) Hypothalamus
- (D) Medulla oblongata

Q31. Which of the following free-living, nitrogen-fixing bacteria is widely used as a bio-fertilizer for non-leguminous crops like wheat, mustard, and maize to improve soil fertility?

- (A) *Rhizobium leguminosarum*
- (B) *Azotobacter chroococcum*
- (C) *Frankia alni*
- (D) *Anabaena azollae*

Q32. The production of transgenic Bt cotton crops, the specific crystalline endotoxin proteins synthesized by *Bacillus thuringiensis* do not kill the bacterium itself because:

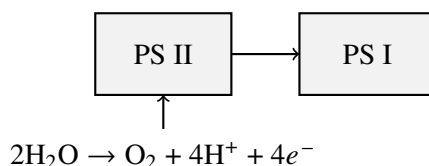
- (A) The bacterium contains an active intracellular enzyme that degrades the toxin instantly
- (B) The toxin exists as an inactive protoxin within the bacterial cell
- (C) The bacterial cell wall is completely impermeable to the crystalline protein
- (D) The toxin requires an acidic intracellular pH to achieve activation

Q33. Which of the following geographic regions located within India is internationally recognized as a major biodiversity hotspot characterized by high endemism?

- (A) Indo-Gangetic Plains
- (B) Western Ghats
- (C) Thar Desert Range
- (D) Aravalli Hill Complex



- Q34.** Citrus canker is a highly contagious bacterial disease that affects lime and lemon crops in Rajasthan, causing necrotic lesions on leaves, twigs, and fruits. The causative agent of this disease is:
- (A) *Xanthomonas citri*
(B) *Pseudomonas syringae*
(C) *Erwinia amylovora*
(D) *Agrobacterium tumefaciens*
- Q35.** Flame cells (protonephridia) are the specialized excretory and osmoregulatory structures characteristic of which animal phylum?
- (A) Platyhelminthes
(B) Nematoda
(C) Annelida
(D) Arthropoda
- Q36.** During the light reaction of photosynthesis, photolysis of water molecule (H_2O) takes place on the inner side of the thylakoid membrane. This water-splitting complex is structurally associated with:



- (A) Photosystem I (PS I)
(B) Photosystem II (PS II)
(C) Cytochrome b_6f complex
(D) ATP synthase enzyme unit
- Q37.** The scientific concept of 'Totipotency', which forms the fundamental basis of modern plant tissue culture, refers to the:
- (A) Ability of a plant cell to withstand extreme osmotic shock under *in vitro* setups



- (B) Capacity of a single living plant cell to divide and differentiate into a whole complete plant
- (C) Rate at which a plant cell fixes atmospheric carbon under high light intensity
- (D) Rapid fusion of two somatic protoplasts using polyethylene glycol (PEG)

Q38. Which of the following structures represents the primary site where the final fertilization of the mammalian ovum by a sperm cell normally takes place?

- (A) Endometrium of the uterus
- (B) Ampullary region of the fallopian tube
- (C) Cervical canal
- (D) Fimbriae of the infundibulum

Q39. Gram pod borer (*Helicoverpa armigera*) is a highly destructive insect pest that feeds on the reproductive parts of several crops. It belongs to which family of the order Lepidoptera?

- (A) Pyralidae
- (B) Noctuidae
- (C) Gelechiidae
- (D) Aphididae

Q40. The botanical name of 'Safflower', an important oilseed crop grown for its high polyunsaturated fatty acid content, is:

- (A) *Carthamus tinctorius*
- (B) *Ricinus communis*
- (C) *Linum usitatissimum*
- (D) *Helianthus annuus*



Detailed Solutions**Q1.****Solution**

Concept: Heterospory is the production of two distinct types of spores (microspores and megaspores) within specialized structures. In certain advanced aquatic pteridophytes, these structures are highly specialized, multicellular, and jacketed organs called sporocarps.

Solution: Step 1: Pteridophytes are classified into homosporous and heterosporous types based on the morphology of the spores they produce. Homosporous pteridophytes produce a single type of spore, whereas heterosporous ones produce small male microspores and large female megaspores.

Step 2: Among the choices given, *Lycopodium* and *Adiantum* are strictly homosporous pteridophytes, producing identical spores that give rise to monoecious prothalli.

Step 3: *Equisetum* is also homosporous, although it exhibits physiological heterospory in some species. Its spores are wrapped in structures known as elaters to assist in wind dispersal.

Step 4: *Marsilea* is a specialized aquatic fern belonging to the order Marsileales. It is characteristically heterosporous.

Step 5: In *Marsilea*, both the microsporangia and megasporangia are enclosed together within a tough, drought-resistant, bean-like structure called a sporocarp. This allows the plant to survive unfavorable conditions before releasing spores in water.

Final Answer:

Answer: (B)

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Q2.

Solution

Concept: Plant diseases of economic significance are identified by unique visual symptoms on their agricultural host crops and are linked to distinct causative fungal, bacterial, or viral agents.

Solution: Step 1: Red rot of sugarcane is one of the most destructive diseases affecting sugarcane plantations globally, significantly harming sugar yield during major agricultural seasons.

Step 2: The external symptoms involve a distinct loss of color in the canopy leaves, which eventually drop and wither. Internally, when the affected cane is split open longitudinally, the pith shows characteristic red tissues interspersed with white transverse bands running across the length.

Step 3: This characteristic red coloration is caused by host plant secretions reacting with the invading pathogen.

Step 4: The causative organism is a member of Ascomycota. Let us evaluate the options provided: *Albugo candida* is responsible for causing white rust in crucifers.

Xanthomonas albilineans is a bacterium that causes sugarcane leaf scald.

Fusarium oxysporum is known for causing vascular wilt in various crops.

Step 5: The fungus *Colletotrichum falcatum* (the asexual stage of *Glomerella tucumanensis*) is the established causative agent responsible for Red rot of sugarcane.

Final Answer:

Answer: (B)

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Q3.

Solution

Concept: The flow of energy through successive trophic levels in an ecosystem is governed by Lindeman's 10% Law of Ecological Efficiency. This law dictates that only a fraction of the captured energy is transferred to the next level.

Solution: Step 1: Identify the sequential trophic levels in a standard terrestrial ecosystem chain:

Trophic Level 1 (T_1): Primary Producers (Green Plants)

Trophic Level 2 (T_2): Primary Consumers (Herbivores)

Trophic Level 3 (T_3): Secondary Consumers (Primary Carnivores)

Trophic Level 4 (T_4): Tertiary Consumers (Secondary Carnivores)

Step 2: Lindeman's law states that during the transfer of organic matter from one trophic level to the next, exactly 10% of the energy is stored as biomass. The remaining 90% is lost via respiration, metabolic heat, and decomposition.

Step 3: Calculate the energy at the primary consumer level (T_2):

$$\text{Energy at } T_2 = 10\% \text{ of } 10,000 \text{ J} = \frac{10}{100} \times 10,000 = 1,000 \text{ J}$$

Step 4: Calculate the energy at the secondary consumer level (T_3):

$$\text{Energy at } T_3 = 10\% \text{ of } 1,000 \text{ J} = \frac{10}{100} \times 1,000 = 100 \text{ J}$$

Step 5: Calculate the energy at the tertiary consumer level (T_4):

$$\text{Energy at } T_4 = 10\% \text{ of } 100 \text{ J} = \frac{10}{100} \times 100 = 1 \text{ J}$$

Final Answer:

Answer: (D)

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Q4.

Solution

Concept: Biotechnology processes require precise methodology steps. Downstream processing encompasses all the steps needed for the isolation, purification, and recovery of a desired bioproduct from a complex cell matrix after biosynthesis.

Solution: Step 1: Analyze option A: Lysozyme is an enzyme utilized to break down bacterial peptidoglycan cell walls during initial DNA extraction protocols, not for isolating viral DNA from mammalian hosts. Thus, option A is incorrect.

Step 2: Analyze option C: Chilled ethanol is added at the end of cell lysis to precipitate the isolated DNA out of the solution, rather than acting as a lytic agent itself. Thus, option C is incorrect.

Step 3: Analyze option D: Polymerase Chain Reaction (PCR) is an *in vitro* enzymatic amplification technique used to make multiple copies of a targeted DNA segment, not for protein separation. Protein separation based on weight is typically performed via SDS-PAGE. Thus, option D is incorrect.

Step 4: Analyze option B: Elution is a specific technique in agarose gel electrophoresis where the resolved, desired DNA fragment band is cut out from the gel matrix and extracted using chemical buffers. This is a crucial step in downstream purification.

Final Answer: Elution – Extraction of DNA fragments from an agarose gel matrix

Answer: (B)

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Q5.

Solution

Concept: Post-harvest agricultural management requires the correct identification of storage insect pests based on the nature of their feeding damage and grain vulnerability.

Solution: Step 1: Stored grains are highly susceptible to secondary and primary insect pests that compromise the quality of the agricultural yield.

Step 2: Let us evaluate the options presented:

Tribolium castaneum (Rust red flour beetle) is a secondary pest; it cannot damage intact whole grains and feeds only on pre-milled flour or grains broken by other pests.

Callosobruchus maculatus (Pulse beetle) primarily targets leguminous pulses rather than cereal grain starch.

Sitophilus oryzae (Rice weevil) is a primary pest that creates circular bore holes using its snout, attacking both rice and wheat.

Step 3: The question describes a specific type of damage consisting of highly irregular boring tunnels coupled with a large volume of clear, powdery frass material.

Step 4: This severe boring and powdering of internal endosperm is a signature damage pattern caused by the Lesser Grain Borer, scientifically known as *Rhyzopertha dominica*, which belongs to the family Bostrichidae. It is a major economic threat in the dry storage conditions of Rajasthan.

Final Answer: *Rhyzopertha dominica*

Answer: (D)

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Q6.

Solution

Concept: Digestion in vertebrates involves the activation of proenzymes within the gastrointestinal tract by specific biochemical triggers or localized pH conditions.

Solution: Step 1: The gastric mucosa contains chief cells (peptic cells) that secrete the inactive proenzyme pepsinogen into the stomach lumen. This prevents the auto-digestion of cellular proteins within the gastric wall.

Step 2: Oxyntic (parietal) cells in the stomach wall secrete concentrated hydrochloric acid (HCl), maintaining a highly acidic gastric environment with a pH of approximately 1.8.

Step 3: When pepsinogen comes into contact with this highly acidic environment created by HCl, it undergoes conformational changes and autocatalytic cleavage to remove an inhibitory peptide block.

Step 4: This cleavage converts the inactive zymogen into the active proteolytic enzyme pepsin. Once active, pepsin can catalytically activate more pepsinogen molecules.

Step 5: Reviewing the alternatives: Enterokinase and trypsin operate in the alkaline environment of the small intestine, while bile salts act as lipid emulsifiers. Therefore, HCl is the required activation factor in the stomach.

Final Answer:

Answer: (B)

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Q7.

Solution

Concept: Economic botany requires remembering the binomial nomenclature and botanical identification of commercially important medicinal plants that grow in specific semi-arid and arid geographic zones.

Solution: Step 1: Ashwagandha, also known as Indian Ginseng, is an important medicinal plant utilized in traditional Ayurvedic medicine for its immunomodulatory and stress-relieving properties. It is widely cultivated in the dry regions of Rajasthan.

Step 2: Let us verify the binomial definitions of the given options:

Chlorophytum borivilianum is the scientific name for Safed Musli, which belongs to the Asparagaceae family.

Commiphora wightii is the scientific name for Guggul, a resin-yielding plant of the Burseraceae family.

Aloe vera is the scientific name for Gwarpatha, belonging to the Asphodelaceae family.

Step 3: Ashwagandha belongs to the nightshade family, Solanaceae. Its validated binomial designation is *Withania somnifera*.

Step 4: The root parts of *Withania somnifera* contain active chemical alkaloids known as withanolides, which are harvested for medicinal formulations.

Final Answer: *Withania somnifera*

Answer: (B)

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Q8.

Solution

Concept: Animal taxonomy is based on structural criteria, including body symmetry, germ layers, coelom organization, body segmentation, and specialized external appendages.

Solution: Step 1: A true coelom is a fluid-filled body cavity that develops within the embryonic mesoderm, providing a lining called the peritoneum over both the body wall and the gut.

Step 2: Let us cross-verify the taxonomic groups listed in the choices against these features:

Phylum Aschelminthes contains unsegmented worms that possess a pseudocoelom, where the mesoderm is scattered as pouches instead of forming a complete lining. Thus, option A is incorrect.

Phylum Arthropoda shows true coelomate structures and distinct metameric segmentation, but it is characterized by jointed appendages. Thus, option C is incorrect.

Phylum Mollusca contains coelomate animals that are unsegmented and have non-jointed muscular foot configurations. Thus, option D is incorrect.

Step 3: Phylum Annelida represents the first group in animal evolution to display a true coelom (specifically a schizocoelom) along with clear internal and external metameric segmentation.

Step 4: Annelids possess unjointed locomotor structures, such as lateral parapodia or chitinous setae, rather than the jointed legs typical of arthropods.

Final Answer:

Answer: (B)

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Q9.

Solution

Concept: C_4 plants have evolved a specialized leaf anatomy called Kranz anatomy to prevent photorespiratory losses. This setup separates initial carbon fixation from the Calvin cycle across two different cell types.

Solution: Step 1: The initial step of carbon capture in C_4 photosynthesis takes place within the cytoplasm of the mesophyll cells, where atmospheric carbon dioxide dissolves to form bicarbonate ions (HCO_3^-).

Step 2: In C_3 plants, the initial acceptor is Ribulose-1,5-bisphosphate (RuBP), a 5-carbon compound processed by the enzyme RuBisCO in a reaction that creates 3-phosphoglyceric acid (3-PGA).

Step 3: In C_4 pathways, the mesophyll cells lack RuBisCO. Instead, they use the enzyme Phosphoenolpyruvate carboxylase (PEP carboxylase), which has a high affinity for carbon dioxide and is not affected by oxygen.

Step 4: The substrate that reacts with carbon dioxide in the mesophyll cytoplasm is Phosphoenolpyruvate (PEP), a 3-carbon compound.

Step 5: This carboxylation reaction produces Oxaloacetic acid (OAA), a 4-carbon dicarboxylic acid that gives the C_4 pathway its name. Therefore, PEP is the primary acceptor molecule.

Final Answer:

Answer: (B)

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Q10.

Solution

Concept: Biological control methods utilize natural predatory or antagonistic relationships to suppress crop pest and disease populations, reducing reliance on chemical pesticides.

Solution: Step 1: *Trichoderma harzianum* is a free-living, soil-borne filamentous fungus found widely in root ecosystems.

Step 2: This fungus acts as a highly effective biocontrol agent against plant diseases through mechanisms such as mycoparasitism, the secretion of lytic enzymes (chitinases and glucanases), and competition for nutrients.

Step 3: It specifically colonizes plant root surfaces, forming a protective barrier that prevents soil-borne fungal pathogens from causing root rots, damping-off, and vascular wilts.

Step 4: It does not target insect pests like aphids or jassids, nor is it effective against mobile root-knot nematodes or systemic viral plant infections.

Step 5: Thus, its primary agricultural application is the management of soil-borne fungal plant pathogens, offering an eco-friendly alternative for crop protection.

Final Answer: Soil-borne fungal plant pathogens causing root rots and wilts

Answer: (B)

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Q11.

Solution

Concept: Ecological succession is the predictable, directional process of community change and replacement in an ecosystem over an environmental timeframe.

Solution: Step 1: Ecological succession begins in a barren area with the arrival of the pioneer community, which consists of hardy species capable of colonizing nutrient-poor substrates.

Step 2: Over time, the activities of the pioneer community modify the local environment, allowing intermediate communities called seral communities to establish and sequentially replace one another.

Step 3: These transitional seral stages continue to modify the soil quality and microclimate until a state of equilibrium is reached with the local climate.

Step 4: The final, stable, and self-perpetuating community that establishes itself at the end of this ecological sequence is known as the climax community.

Step 5: Unlike seral communities, a climax community remains unchanged as long as the regional climate stays constant. An ecotone, by contrast, is a spatial boundary zone between two ecosystems, not a temporal stage of succession.

Final Answer: Climax community

Answer: (C)

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Q12.

Solution

Concept: Cloning vectors used in recombinant DNA technology require specific functional regions, including an origin of replication (ori), unique restriction endonuclease cleavage sites, and selectable markers.

Solution: Step 1: During a genetic transformation protocol, a mixture of host cells results, consisting of non-transformed cells, transformed cells containing the empty vector, and recombinant cells containing the vector with the target gene insert.

Step 2: Selectable marker genes, such as the antibiotic resistance genes amp^R (ampicillin resistance) and tet^R (tetracycline resistance) in plasmid pBR322, confer resistance to specific antibiotics that would otherwise kill the host cell.

Step 3: When the host cells are cultured on medium containing these antibiotics, cells without the vector (non-transformants) cannot grow and are eliminated.

Step 4: Selectable markers are therefore used to differentiate transformants from non-transformants, facilitating the selection of cells that have successfully taken up the foreign plasmid.

Step 5: They do not initiate replication, guide restriction enzymes, or alter the vector's copy number.

Final Answer: To identify and eliminate non-transformant host cells

Answer: (B)

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Q13.

Solution

Concept: Vertebrate anatomy requires understanding the microscopic, histological architecture of metabolic and digestive organs.

Solution: Step 1: The liver is the largest gland in the vertebrate body and performs central metabolic and detoxification functions.

Step 2: Let us evaluate the histological structures mentioned in the options:

Crypts of Lieberkühn are tubular glands located between the villi in the mucosal lining of the small intestine.

Brunner's glands are specialized mucus-secreting glands located in the duodenal submucosa.

The Sphincter of Oddi is a muscular valve that controls the flow of bile and pancreatic juice into the duodenum.

Step 3: Microscopic examination of liver tissue reveals distinct functional units known as hepatic lobules. These lobules are polygonal structures composed of cords of hepatocytes radiating outwards from a central vein.

Step 4: Each hepatic lobule is enclosed by a thin connective tissue sheath called Glisson's capsule, which is a defining histological characteristic of the mammalian liver.

Final Answer:

Answer: (B)

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Q14.

Solution

Concept: Agricultural entomology involves identifying major insect pests and matching them with their preferred host crop families based on their feeding habits.

Solution: Step 1: The diamondback moth, scientifically classified as *Plutella xylostella*, is a highly destructive lepidopteran insect pest distributed worldwide.

Step 2: The larval stages of this moth damage crops by grazing on foliage, creating small holes that can skeletalize leaves and severely reduce the plant's photosynthetic capacity.

Step 3: *Plutella xylostella* specializes in feeding on plants that contain mustard oil glucosides (glucosinolates).

Step 4: These biochemical compounds are characteristic of the family Brassicaceae (Cruciferae). Consequently, this pest primarily targets cruciferous agricultural crops, including mustard, cabbage, cauliflower, broccoli, and radish.

Step 5: It does not target malvaceous crops like cotton, leguminous pulses, or solanaceous crops like potato. Identifying this host specificity is critical for designing effective integrated pest management strategies.

Final Answer: Cruciferous crops like mustard, cabbage, and cauliflower

Answer: (B)

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Q15.

Solution

Concept: Economic botany requires remembering the binomial nomenclature and taxonomic classifications of regional cash crops that are adapted to specific arid climates.

Solution: Step 1: Cluster bean, commonly referred to as Guar, is a drought-tolerant legume grown extensively in Rajasthan, which produces a major share of the global supply.

Step 2: Guar is highly valued for the galactomannan gum extracted from its seed endosperm, which is used globally in industries such as food processing, textiles, and oil drilling.

Step 3: Let us review the binomial choices provided:

Vigna aconitifolia is the scientific name for Moth bean, another crop grown in Rajasthan.

Cajanus cajan represents Pigeon pea (Arhar).

Phaseolus vulgaris corresponds to the Common kidney bean (Rajma).

Step 4: The accepted botanical name for Cluster bean is *Cyamopsis tetragonoloba*, belonging to the family Fabaceae.

Final Answer: *Cyamopsis tetragonoloba*

Answer: (A)

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Q16.

Solution

Concept: Plant taxonomy requires an understanding of the reproductive and anatomical characteristics that distinguish major plant divisions, such as gymnosperms and angiosperms.

Solution: Step 1: Let us evaluate each option to determine its taxonomic accuracy for gymnosperms.

Step 2: Option A states that double fertilization is universal in gymnosperms. This is incorrect; double fertilization is a defining characteristic of angiosperms, though it occurs in modified forms in *Ephedra*.

Step 3: Option C states that the dominant independent phase is a multicellular gametophyte. This is incorrect; the dominant phase in gymnosperms is the sporophyte ($2n$), while the gametophyte is microscopic and dependent on the sporophyte.

Step 4: Option D states that xylem vessels are universally present. This is incorrect; gymnosperm xylem generally consists of tracheids, and vessels are absent except in the order Gnetales (*Gnetum*, *Welwitschia*, *Ephedra*).

Step 5: Option B states that the ovules are naked and not enclosed within an ovary wall. This is correct; the term gymnosperm originates from "gymnos" (naked) and "sperma" (seed). Because they lack an ovary wall, their seeds develop exposed on the surfaces of megasporophylls or cone scales.

Final Answer:

The ovules are naked and not enclosed within an ovary wall before or after fertilization

Answer: (B)

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Q17.

Solution

Concept: Ecological pyramids graphically represent the trophic structure of an ecosystem, measuring parameters such as total organism numbers, biomass, or energy productivity across successive levels.

Solution: Step 1: In most terrestrial ecosystems, the pyramid of biomass is upright because the collective dry weight of primary producers (such as trees or grasses) is greater than that of the herbivores and carnivores they support.

Step 2: In deep open-sea aquatic ecosystems, the pyramid of biomass is typically inverted. This means the measured biomass of primary consumers (zooplankton and small fish) at any given time exceeds the biomass of the primary producers.

Step 3: The primary producers in marine ecosystems are microscopic phytoplankton. Although they fix large amounts of carbon, they have a small standing crop biomass at any single moment due to their small size and rapid turnover rate.

Step 4: Phytoplankton divide rapidly and are consumed almost immediately by zooplankton. This allows a small biomass of producers to support a larger biomass of longer-lived primary consumers.

Step 5: Therefore, this inverted structure occurs because the standing crop biomass of phytoplankton at any given instant is significantly lower than that of higher trophic levels.

Final Answer:

The standing crop biomass of phytoplankton at any given instant is significantly lower than that of zooplankton and fish

Answer: (B)

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Q18.

Solution

Concept: Genetic engineering utilizes various vector-mediated or direct (vectorless) gene transfer methods to introduce recombinant DNA into host plant cells.

Solution: Step 1: Let us evaluate the vectorless gene delivery methods listed in the options:

Microinjection involves using a fine glass microneedle to inject foreign DNA directly into the nucleus of an egg or protoplast.

Electroporation utilizes short, high-voltage electrical pulses to create transient pores in the plasma membrane through which DNA can enter.

Liposome-mediated transfer involves enclosing DNA within synthetic lipid bilayers that fuse with the cell membrane.

Step 2: The question describes a method where foreign DNA is coated onto high-velocity microparticles of heavy metals, such as gold or tungsten.

Step 3: These coated microparticles are accelerated using compressed helium gas or an electrical discharge to penetrate the thick cell walls of target plant tissues.

Step 4: This physical gene delivery system is known as Biolistics or the Gene Gun method. It is widely used to transform plant species that are resistant to *Agrobacterium*-mediated transformation.

Final Answer:

Answer: (C)

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Q19.

Solution

Concept: Fungal plant pathogens display host specificity, producing characteristic symptoms that allow for field diagnosis and targeted agricultural management.

Solution: Step 1: White rust of crucifers is a common disease affecting oilseed mustard crops (*Brassica juncea*) in Rajasthan, particularly during cool, humid weather.

Step 2: The disease is characterized by the appearance of shiny, white, pustule-like blisters on the underside of leaves, stems, and floral parts. These pustules contain asexual sporangia.

Step 3: Let us review the fungal pathogens listed in the choices:

Alternaria brassicae causes Alternaria black spot, which is characterized by concentric necrotic rings on leaves.

Erysiphe cruciferarum is the causative agent of powdery mildew, which forms a powdery white coating on leaf surfaces.

Peronospora parasitica causes downy mildew, which appears as fuzzy downy growth on the undersides of leaves.

Step 4: White rust is caused by *Albugo candida* (also known as *Cystopus candidus*), an obligate biotrophic oomycete pathogen that targets cruciferous hosts.

Final Answer:

Answer: (B)

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Q20.

Solution

Concept: Phylum Chordata is defined by a specific set of structural characteristics that appear during embryonic development or persist throughout the animal's life cycle.

Solution: Step 1: Chordates are distinguished from non-chordates by three core anatomical features:

1. A longitudinal, flexible supporting rod called the notochord, located dorsal to the digestive tract and ventral to the nerve cord.
2. A single, dorsal, hollow nerve cord that develops from the embryonic ectoderm, differentiating into the brain and spinal cord in vertebrates.
3. Pharyngeal gill slits, which are paired perforations in the pharyngeal wall used for filter-feeding or respiration at some stage of development.

Step 2: Let us evaluate the options:

Option A is incorrect because chordates possess a hollow nerve cord and a closed circulatory system, rather than a solid nerve cord and an open system.

Option B is incorrect because the chordate nerve cord is situated dorsally, not ventrally.

Option D is incorrect because non-chordates typically possess a ventral solid nerve cord, and a post-anal tail is a key feature of chordates.

Step 3: Option C correctly identifies the diagnostic combination: the presence of a notochord, a dorsal hollow nerve cord, and pharyngeal gill slits.

Final Answer: Notochord, dorsal hollow nerve cord, and pharyngeal gill slits

Answer: (C)

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Q21.

Solution

Concept: Insect taxonomy requires classifying major agricultural pests into their respective taxonomic orders based on morphological characteristics and life cycle stages.

Solution: Step 1: The Red Hairy Caterpillar, scientifically named *Amsacta moorei*, is a polyphagous pest found in northern and western India, including Rajasthan.

Step 2: During the Kharif season, its larval stages cause severe damage by defoliating field crops such as pearl millet, sorghum, pulses, and sesame.

Step 3: To determine its taxonomic order, we look at its adult stage. The adult of the Red Hairy Caterpillar is a medium-sized moth with white wings marked with distinct red lines along the body edges.

Step 4: All moths and butterflies undergo complete metamorphosis (holometabolous development) and belong to the order Lepidoptera, which is characterized by scale-covered wings and siphoning mouthparts in adults.

Step 5: Reviewing the other choices: Coleoptera includes beetles, Hemiptera includes true bugs, and Orthoptera includes grasshoppers. Therefore, *Amsacta moorei* belongs to Lepidoptera.

Final Answer:

Answer: (B)

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Q22.

Solution

Concept: The endocrine regulation of reproduction involves hormonal axes, such as the hypothalamic-pituitary-gonadal axis, where pituitary gonadotropins regulate specific cell populations in the gonads.

Solution: Step 1: The anterior pituitary gland secretes two primary gonadotropic hormones that regulate reproductive function: Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH).

Step 2: In the male reproductive system, these hormones target different cell types within the testes.

Step 3: FSH acts on the Sertoli cells located within the seminiferous tubules, stimulating spermatogenesis and the secretion of androgen-binding protein (ABP).

Step 4: LH targets the interstitial cells of Leydig, which are located in the connective tissue spaces between the seminiferous tubules.

Step 5: Binding of LH to its receptors on Leydig cells activates signaling pathways that stimulate the synthesis and secretion of testicular androgens, primarily testosterone. Because of this specific function in males, LH is also called Interstitial Cell-Stimulating Hormone (ICSH).

Final Answer: Luteinizing Hormone (LH)

Answer: (B)

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Q23.

Solution

Concept: Plant tissue culture uses controlled formulations of plant growth regulators to induce organogenesis from unorganized cell masses, capitalizing on the totipotency of plant cells.

Solution: Step 1: Callus is an unorganized, proliferating mass of parenchymatous cells produced when an explant is cultured on a nutrient medium containing specific growth regulators.

Step 2: The differentiation of this undifferentiated callus into distinct plant organs (organogenesis) is regulated by the relative concentrations of auxins and cytokinins, a principle established by Skoog and Miller.

Step 3: A balanced ratio of auxin to cytokinin promotes continued cell division and callus proliferation without differentiation.

Step 4: A high auxin-to-cytokinin ratio promotes rhizogenesis, inducing the differentiation of roots from the callus mass.

Step 5: Conversely, a high cytokinin-to-auxin ratio shifts differentiation toward caulogenesis, stimulating shoot initiation. Thus, manipulating the interaction between auxins and cytokinins controls the regeneration of complete plantlets from callus.

Final Answer: Auxins and Cytokinins

Answer: (B)

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Q24.

Solution

Concept: Economic botany requires an understanding of the taxonomic classification of seed spices and agricultural crops, matching common regional varieties with their respective botanical families.

Solution: Step 1: Fenugreek, commonly known as Methi, is an annual seed spice crop cultivated during the rabi season in India, with Rajasthan being a major producing region.

Step 2: Fenugreek leaves are consumed as a vegetable, while its aromatic seeds are used as a spice and in traditional medicine due to their high mucilage and alkaloid content.

Step 3: Let us examine the botanical families listed in the choices:

Apiaceae (Umbelliferae) includes umbel-bearing spices like coriander, cumin, and fennel.

Asteraceae includes composite flowers like sunflower and safflower.

Solanaceae includes nightshades such as potato, tomato, and chili.

Step 4: Fenugreek (*Trigonella foenum-graecum*) produces typical papilionaceous flowers and bears its seeds in elongated pods (legumes). These morphological features place it in the legume family, Fabaceae (subfamily Papilionoideae).

Final Answer:

Answer: (B)

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Q25.

Solution

Concept: Ecology involves characterizing spatial boundaries and transition zones that form where distinct ecological communities interact.

Solution: Step 1: Ecosystem boundaries are rarely sharp lines; they are typically transitional gradients where adjacent communities meet and interact.

Step 2: This zone of transition between two or more distinct ecosystems is defined as an ecotone. Examples include estuaries (between freshwater and marine systems) and marshes (between dry land and open water).

Step 3: Ecotones often exhibit a progressive shift in species composition, hosting species from both adjacent communities alongside forms unique to the transition zone.

Step 4: This enrichment can lead to increased species density and biodiversity within the ecotone, a phenomenon known as the edge effect.

Step 5: Reviewing the options, an ecotone is defined as a transition area or junction zone where diverse ecological communities meet and integrate. It does not refer to exponential growth zones, pollutant concentrations, or specific species niches.

Final Answer:

A transition area or junction zone where two or more diverse ecological communities meet and integrate

Answer: (C)

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Q26.

Solution

Concept: Factual identification of crop diseases requires matching economic crops with their specific fungal, oomycete, or bacterial pathogens based on diagnostic symptoms.

Solution: Step 1: Pearl millet, commonly known as Bajra, is a major staple cereal crop cultivated in the arid and semi-arid regions of Rajasthan during the Kharif season.

Step 2: Green ear disease, also known as Downy Mildew of Bajra, is a damaging disease that affects this crop under warm, humid conditions.

Step 3: The disease presents two distinct phases: a downy mildew phase on the leaves, followed by a green ear phase where the floral organs of the panicle are converted into green, twisted, leaf-like structures, rendering the ear completely sterile.

Step 4: Let us examine the pathogens listed in the options:

Tolysporium penicillariae causes grain smut of bajra.

Claviceps fusiformis causes ergot of bajra, producing sugary exudates on the ears.

Puccinia penniseti is responsible for rust disease.

Step 5: Green ear disease is caused by *Sclerospora graminicola*, an obligate biotrophic oomycete pathogen.

Final Answer: *Sclerospora graminicola*

Answer: (A)

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Q27.

Solution

Concept: The inheritance of human ABO blood groups is governed by the I gene, which displays codominance and multiple allelism with three primary alleles: I^A , I^B , and i .

Solution: Step 1: Identify the parental genotypes given in the problem:

Female parent: Blood group A, genotype $I^A I^i$ (heterozygous)

Male parent: Blood group B, genotype $I^B I^i$ (heterozygous)

Step 2: Determine the gametes produced by each parent:

Female gametes: I^A and I^i (each with a 50% probability)

Male gametes: I^B and I^i (each with a 50% probability)

Step 3: Construct a Punnett square to determine the expected offspring genotypes:

- $I^A \times I^B \rightarrow I^A I^B$ (Blood Group AB)

- $I^A \times I^i \rightarrow I^A I^i$ (Blood Group A)

- $I^i \times I^B \rightarrow I^B I^i$ (Blood Group B)

- $I^i \times I^i \rightarrow I^i I^i$ (Blood Group O)

Step 4: Analyze the phenotypic frequencies from the cross: Each of the four distinct blood groups (AB, A, B, and O) has an equal probability of occurrence.

Step 5: The probability of producing a child with blood group O ($I^i I^i$) is 1 out of 4, which corresponds to a 25% probability.

Final Answer:

Answer: (B)

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Q28.

Solution

Concept: Animal taxonomy relies on identifying unique structural configurations that serve as defining characteristics for specific invertebrate phyla.

Solution: Step 1: Let us evaluate the unique physiological systems characteristic of the phyla listed in the options:

Phylum Porifera possesses a water transport or canal system lined with choanocytes, which functions in food gathering and respiration. This is distinct from a water vascular system.

Phylum Coelenterata features a gastrovascular cavity with a single opening and uses cnidocytes for defense and capturing prey.

Phylum Aschelminthes contains unsegmented pseudocoelomate roundworms with a complete digestive tract but lacks specialized vascular structures.

Step 2: Phylum Echinodermata contains marine organisms characterized by a spiny endoskeleton of calcareous ossicles and an internal water vascular system (ambulacral system).

Step 3: This water vascular system is a network of fluid-filled canals that branch into hydraulic projections called tube feet.

Step 4: The coordinated contraction and relaxation of these tube feet drive locomotion, assist in capturing and transporting prey, and facilitate respiratory gas exchange. This system is a defining characteristic unique to echinoderms.

Final Answer:

Answer: (C)

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Q29.

Solution

Concept: Integrated Pest Management (IPM) utilizes a combination of biological, cultural, physical, chemical, and genetic strategies to manage pest populations below economic injury levels while minimizing environmental impact.

Solution: Step 1: Let us define the control strategies listed in the options to determine the correct classification:

Mechanical control involves physical actions such as hand-picking, barriers, or traps to exclude or remove pests.

Biological control relies on natural enemies, such as predators, parasitoids, or pathogens, to suppress pest populations.

Legal control involves regulatory measures, such as quarantines and inspections, to prevent the introduction or spread of pests.

Step 2: The method described involves mass-rearing male insects in a laboratory, sterilizing them using ionizing radiation or chemosterilants, and releasing them into wild populations.

Step 3: When these sterile males mate with wild fertile females, no viable offspring are produced, causing the pest population to decline over successive generations.

Step 4: This technique, known as the Sterile Insect Technique (SIT), directly targets the pest's reproductive genome and is classified as a Genetic or Autocidal control strategy.

Final Answer: Genetic or Autocidal control

Answer: (C)

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Q30.

Solution

Concept: Vertebrate neuroanatomy requires understanding the functional specialization of different brain regions in maintaining homeostasis and coordinating physiological responses.

Solution: Step 1: Let us review the primary functional centers within the human brain to evaluate the choices:

The Cerebrum is the site of higher order cognitive functions, including memory, reasoning, conscious sensation, and voluntary motor control.

The Cerebellum coordinates complex muscular movements, posture, and spatial balance.

The Medulla oblongata contains vital autonomic reflex centers that regulate cardiovascular functions, respiration, and swallowing.

Step 2: The Hypothalamus is a small but critical region located at the base of the forebrain, directly below the thalamus.

Step 3: It serves as a major integration center between the nervous system and the endocrine system, controlling the release of pituitary hormones.

Step 4: The hypothalamus contains specialized neural centers that monitor and regulate physiological parameters, including core body temperature (thermoregulation), hunger, satiety, and fluid balance (thirst). Therefore, it acts as the primary homeostatic regulator.

Final Answer: Hypothalamus

Answer: (C)

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Q31.

Solution

Concept: Bio-fertilizers utilize living microorganisms to enhance soil nutrient availability, improving soil fertility through natural processes such as nitrogen fixation or phosphorus solubilization.

Solution: Step 1: Let us analyze the nitrogen-fixing microorganisms listed in the options:

Rhizobium leguminosarum is a symbiotic bacterium that fixes nitrogen only after forming nodules on the roots of leguminous plants. It cannot fix nitrogen independently in non-legumes.

Frankia is an actinomycete that forms nitrogen-fixing nodules symbiotically with non-leguminous woody plants like *Alnus*.

Anabaena azollae is a cyanobacterium that fixes nitrogen symbiotically within the leaves of the aquatic fern *Azolla*, commonly used in lowland rice paddies.

Step 2: The question specifies a free-living, nitrogen-fixing bacterium applied to non-leguminous upland crops such as wheat, maize, and mustard.

Step 3: *Azotobacter chroococcum* is a free-living, aerobic, heterotrophic bacterium capable of fixing atmospheric nitrogen in the rhizosphere independently, without establishing a symbiotic structural relationship.

Step 4: Application of *Azotobacter* inoculants improves crop growth by providing fixed nitrogen and synthesizing plant growth-promoting substances like auxins and gibberellins.

Final Answer: *Azotobacter chroococcum*

Answer: (B)

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Q32.

Solution

Concept: Biotechnology applications in agriculture utilize specific insecticidal proteins from soil bacteria to engineer pest-resistant transgenic crops.

Solution: Step 1: *Bacillus thuringiensis* synthesizes specific crystalline protein inclusions (Cry proteins) during its sporulation phase. These proteins are highly toxic to specific insect orders, such as Lepidoptera and Coleoptera.

Step 2: A common question is why this potent endotoxin does not harm the host bacterial cell that produces it.

Step 3: Inside the bacterium, the toxin is synthesized and deposited as an inactive crystalline protoxin, which lacks structural toxicity.

Step 4: The activation of this protoxin requires specific physiological conditions: it must be ingested by a susceptible insect, exposed to the highly alkaline pH (> 9.0) of the insect's midgut, and cleaved by specific alkaline proteases.

Step 5: This enzymatic cleavage converts the protoxin into an active, pore-forming toxin that binds to midgut epithelial cells, leading to osmotic lysis and the death of the insect. Because the bacterium maintains a neutral internal environment and lacks these midgut receptors, it remains unaffected by the protoxin.

Final Answer: The toxin exists as an inactive protoxin within the bacterial cell

Answer: (B)

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Q33.

Solution

Concept: Biodiversity conservation identifies global priorities called biodiversity hotspots based on specific criteria, including high species richness, high endemism, and significant habitat threat.

Solution: Step 1: The concept of biodiversity hotspots was developed by Norman Myers to prioritize regions worldwide that contain high concentrations of endemic species while facing severe habitat destruction.

Step 2: There are four internationally recognized biodiversity hotspots that extend into parts of India: the Western Ghats, the Himalayas, the Indo-Burma region, and Sundaland.

Step 3: Let us evaluate the options provided:

The Indo-Gangetic Plains are highly productive agricultural areas with low relative endemism.

The Thar Desert and the Aravalli Range contain unique ecosystems adapted to arid conditions, but they are not classified among the global biodiversity hotspots.

Step 4: The Western Ghats region running along the southwestern coast of India features high rainfall, tropical forest ecosystems, exceptional species richness, and a high proportion of endemic amphibians, plants, and birds. It faces ongoing environmental pressures, satisfying the criteria for global hotspot designation.

Final Answer: Western Ghats

Answer: (B)

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Q34.

Solution

Concept: Diagnosing crop diseases requires identifying the specific bacterial, fungal, or viral pathogens responsible for characteristic economic damage to fruit and field crops.

Solution: Step 1: Citrus canker is a bacterial disease that affects citrus species, including acid lime, lemons, and oranges, which are grown commercially in parts of Rajasthan.

Step 2: The disease produces raised, brown, corky, necrotic lesions surrounded by a yellow halo on leaves, twigs, and fruit surfaces. These lesions compromise fruit quality and market value.

Step 3: Let us review the bacterial species listed in the options:

Pseudomonas syringae causes bacterial speck and blights on various hosts.

Erwinia amylovora causes fire blight in rosaceous fruits like apples and pears.

Agrobacterium tumefaciens is a soil bacterium known for inducing crown gall tumors.

Step 4: Citrus canker is caused by the Gram-negative, rod-shaped bacterium *Xanthomonas citri* (formerly classified as *Xanthomonas axonopodis* pv. *citri*).

Step 5: This pathogen enters host tissues through natural stomatal openings or mechanical wounds, spreading via wind-driven rain and contaminated pruning tools.

Final Answer: *Xanthomonas citri*

Answer: (A)

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Q35.

Solution

Concept: Animal taxonomy utilizes comparative anatomy to match invertebrate groups with their characteristic specialized organ systems for excretion and osmoregulation.

Solution: Step 1: Let us identify the primary excretory and osmoregulatory structures characteristic of each phylum listed in the options:

Phylum Nematoda (Aschelminthes) utilizes an intracellular canal network or Renette cells for excretion.

Phylum Annelida contains segmented worms that use metameric pairs of nephridia for waste removal and fluid balance.

Phylum Arthropoda utilizes specialized structures such as Malpighian tubules (in insects) or antennal/green glands (in crustaceans).

Step 2: Phylum Platyhelminthes consists of dorsoventrally flattened, unsegmented acoelomate worms known as flatworms.

Step 3: Flatworms lack dedicated circulatory and respiratory systems. For excretion and osmoregulation, they use a network of blind-ending tubules tipped with specialized cells called protonephridia.

Step 4: Under microscopic examination, these cells contain a tuft of beating cilia whose movement resembles a flickering flame. This appearance gives them the common name flame cells. Their main function is to maintain fluid balance by expelling excess water and metabolic wastes.

Final Answer: Platyhelminthes

Answer: (A)

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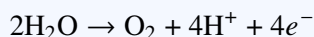
Q36.

Solution

Concept: The light-dependent reactions of photosynthesis involve multi-protein complexes embedded within the thylakoid membrane that execute linear electron transport (Z-scheme).

Solution: Step 1: Photolysis of water is the light-driven oxidation of water that supplies electrons to replace those lost from photosynthetic reaction centers during light absorption.

Step 2: The chemical equation representing this water-splitting process is:



Step 3: This reaction occurs via an Oxygen-Evolving Complex (OEC) containing a cluster of manganese, calcium, and chloride ions. The OEC is located on the luminal side of the thylakoid membrane.

Step 4: Let us evaluate the structural associations of the membrane complexes:

Photosystem I (PS I) absorbs light at a wavelength of 700 nm and transfers electrons to ferredoxin to reduce NADP^+ .

The Cytochrome b_6f complex mediates electron transport between the two photosystems and pumps protons across the membrane.

ATP synthase utilizes the resulting proton gradient to synthesize ATP.

Step 5: The Oxygen-Evolving Complex is structurally bound to Photosystem II (PS II), which contains the P600 reaction center chlorophyll. The electrons extracted from water are transferred to tyrosine residues in PS II to replace photoexcited electrons, sustaining continuous photosynthetic electron flow.

Final Answer: Photosystem II (PS II)

Answer: (B)

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Q37.

Solution

Concept: Plant tissue culture relies on the genetic and developmental plasticity of somatic plant cells, which allows them to reinitiate cell division and differentiation under appropriate *in vitro* conditions.

Solution: Step 1: Unlike advanced animal cells, which typically lose developmental flexibility after differentiation, many living adult somatic plant cells retain their complete genetic complement and the capacity to change their developmental path.

Step 2: When a segment of living tissue (an explant) is isolated, surface-sterilized, and transferred to a sterile nutrient medium containing appropriate carbon sources and hormones, its cells can undergo dedifferentiation.

Step 3: This dedifferentiation converts mature parenchymatous cells back into an actively dividing, unorganized cell mass called a callus.

Step 4: By modifying the balance of plant hormones, this callus can be induced to undergo redifferentiation, developing into roots, shoots, or somatic embryos that grow into complete, fertile plants.

Step 5: This physiological capacity of an individual living plant cell to divide, differentiate, and regenerate into a whole, organized organism is defined as cellular totipotency. This principle underlies micropropagation, protoplast culture, and transgenic plant production.

Final Answer:

Capacity of a single living plant cell to divide and differentiate into a whole complete plant

Answer: (B)

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Q38.

Solution

Concept: Vertebrate reproductive biology requires identifying the specific locations within the reproductive tract where gamete interaction, fertilization, and embryonic development take place.

Solution: Step 1: Following ovulation, the secondary oocyte is released from the Graafian follicle into the pelvic cavity and is captured by the finger-like fimbriae of the fallopian tube (oviduct).

Step 2: The oviduct is a tubular structure divided anatomically into three primary regions: the infundibulum, the ampulla, and the isthmus.

Step 3: Let us trace the path of the gametes to evaluate the options:

The fimbriae and infundibulum collect the egg but do not host fertilization.

The cervical canal and uterus receive the sperm, and the endometrium of the uterine wall is the site for blastocyst implantation, which occurs several days after fertilization.

Step 4: Sperm deposited in the female tract migrate through the cervix and uterus into the fallopian tube.

Step 5: The final interaction between the sperm and egg normally occurs within the wide, thin-walled middle segment of the oviduct, known as the ampullary region. The meeting of gametes at this site triggers the acrosome reaction, leading to fertilization and the formation of a diploid zygote.

Final Answer: Ampullary region of the fallopian tube

Answer: (B)

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Q39.

Solution

Concept: Agricultural entomology involves classifying economically significant insect pests into their respective families and orders to assist in designing targeted integrated management strategies.

Solution: Step 1: The Gram pod borer, scientifically known as *Helicoverpa armigera*, is a highly destructive polyphagous insect pest distributed across agricultural zones.

Step 2: Its larval stages cause severe economic damage by boring into the reproductive parts of various crops, including chickpea (gram), pigeon pea, cotton, tomato, and maize.

Step 3: To determine its taxonomic classification within the order Lepidoptera, we examine the structural characteristics of its family groups:

Pyrilidae includes snout moths, such as various stem borers.

Gelechiidae includes micro-moths, such as the pink bollworm of cotton.

Aphididae is a family of true sucking bugs belonging to the order Hemiptera, not Lepidoptera.

Step 4: *Helicoverpa armigera* belongs to the family Noctuidae, commonly referred to as owlet moths.

Step 5: Larvae of this family typically feed at night and often show resistance to various chemical insecticides, making them a primary target for transgenic Bt crop technologies.

Final Answer:

Answer: (B)

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Q40.

Solution

Concept: Economic botany requires an understanding of binomial nomenclature, matching the common names of agricultural oilseed crops with their valid scientific designations and commercial uses.

Solution: Step 1: Safflower is an important annual oilseed crop cultivated primarily during the rabi season in semi-arid regions. Its seeds yield an edible oil high in polyunsaturated fatty acids (such as linoleic acid), which is beneficial for cardiovascular health.

Step 2: Let us evaluate the botanical names provided in the choices to identify the correct match: *Ricinus communis* is the scientific name for Castor bean, an oilseed crop of the Euphorbiaceae family used for industrial lubricants.

Linum usitatissimum corresponds to Linseed or Flax, grown for both fiber and linseed oil.

Helianthus annuus represents the common Sunflower, another member of the Asteraceae family.

Step 3: Safflower belongs to the thistle family, Asteraceae (Compositae). Its accepted botanical name is *Carthamus tinctorius*.

Step 4: Historically, *Carthamus tinctorius* was also cultivated for the orange-red dye extracted from its florets before synthetic alternatives became available.

Final Answer: *Carthamus tinctorius*

Answer: (A)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	B	3	D	4	B	5	D
6	B	7	B	8	B	9	B	10	B
11	C	12	B	13	B	14	B	15	A
16	B	17	B	18	C	19	B	20	C
21	B	22	B	23	B	24	B	25	C
26	A	27	B	28	C	29	C	30	C
31	B	32	B	33	B	34	A	35	A
36	B	37	B	38	B	39	B	40	A

