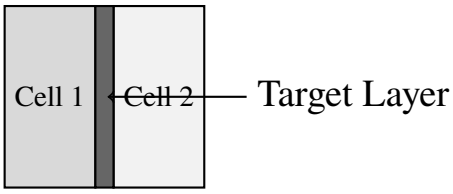
Rajasthan JET Biology Sample Paper-6

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. Which of the following cell wall layers is rich in pectin and functions to glue neighboring plant cells together?



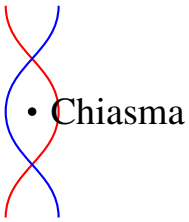
(A) Primary cell wall

(B) Secondary cell wall

(C) Middle lamella

(D) Plasmodesmata

Q2. During which specific stage of prophase-I in meiosis does the process of crossing over take place via chiasmata formation?



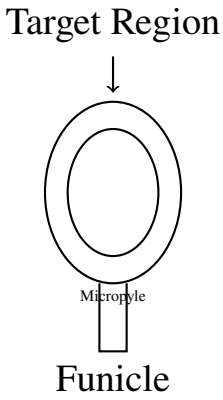
(A) Leptotene

(B) Zygotene

(C) Pachytene

(D) Diplotene

Q3. In a typical anatomy schematic of an anatropous ovule, the region marked by the arrow at the absolute structural base opposite to the micropyle represents which structure?



(A) The chalaza

(B) The hilum

(C) The nucellus

(D) The integument

Q4. When a true-breeding yellow-seeded and round-seeded pea plant is crossed with a green-seeded and wrinkled-seeded plant, the expected phenotypic ratio in the F_2 generation is:

(A) 3 : 1

(B) 9 : 3 : 3 : 1

(C) 1 : 2 : 1

(D) 1 : 1 : 1 : 1

Q5. Which enzyme catalyzes the primary carboxylation step in C_4 plants within the mesophyll cells?

(A) RuBisCO

(B) PEP carboxylase

(C) Malate dehydrogenase

(D) Pyruvate kinase

Q6. The condition in which stamens are fused by their filaments into a single bundle or tube, as characteristically seen in the family Malvaceae, is known as:

(A) Syngenesious

(B) Monadelphous

(C) Diadelphous

(D) Polyadelphous

Q7. According to Bentham and Hooker's system of classification, the dicotyledons are divided into three cohorts/subclasses. What is the correct chronological grouping?

(A) Polypetalae, Gamopetalae, and Monochlamydae

(B) Monocotyledonae, Dicotyledonae, and Gymnospermae

(C) Thallophyta, Bryophyta, and Pteridophyta

(D) Archichlamydeae, Metachlamydeae, and Sympetalae

Q8. Water movement through the non-living parts of the plant, such as intercellular spaces and cell walls without crossing any plasma membrane, is referred to as:

(A) Symplastic pathway

(B) Apoplastic pathway

(C) Vacuolar pathway

(D) Transcellular pathway

Q9. Which plant hormone is primarily responsible for inducing triple response in seedlings, promoting fruit ripening, and overcoming apical dominance?

(A) Auxin

(B) Gibberellin

(C) Cytokinin

(D) Ethylene

Q10. The non-protein organic part of an enzyme that is tightly and permanently bound to the apoenzyme is called a/an:

(A) Coenzyme

(B) Prosthetic group

(C) Metal ion activator

(D) Isoenzyme

Q11. In which anatomical region of a typical dicotyledonous root is the Casparian strip located?

(A) Pericycle

(B) Epidermis

(C) Endodermis

(D) Cortex

Q12. A mutation that occurs due to the replacement of a purine base by a pyrimidine base or vice-versa is classified as:

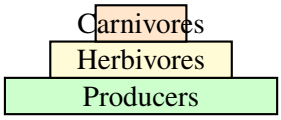
(A) Transition

(B) Transversion

(C) Frame-shift mutation

(D) Deletion

Q13. Consider the stable ecological trophic framework below. Which type of ecological pyramid is structurally guaranteed to always match this upright configuration in any stable terrestrial ecosystem?



(A) Pyramid of numbers

(B) Pyramid of biomass

(C) Pyramid of energy

(D) Pyramid of volume

Q14. The phenomenon of gradual increase in the concentration of toxic, non-biodegradable pollutants at successive trophic levels in a food chain is defined as:

(A) Eutrophication

(B) Biomagnification

(C) Algal bloom

(D) Bioaccumulation

Q15. Which National Park of Rajasthan is globally recognized as a UNESCO World Heritage Site and serves as a major habitat for migratory birds like the Siberian Crane?

(A) Ranthambore National Park

(B) Sariska Tiger Reserve

(C) Keoladeo Ghana National Park

(D) Mukundra Hills National Park

Q16. An interaction between two distinct species where one species is systematically harmed while the other remains completely unaffected $(-, 0)$ is known as:

(A) Commensalism

(B) Amensalism

(C) Mutualism

(D) Parasitism

Q17. Which of the following options represents a major cash crop of Rajasthan belonging to the family Fabaceae, primarily grown for its mucilaginous seed gum?

(A) Cluster bean (Guar)

(B) Mustard

(C) Sugarcane

(D) Cotton

Q18. What is the botanical name and family of the highly valuable medicinal plant commonly known as 'Ashwagandha'?

(A) *Aloe vera* (Liliaceae)

(B) *Withania somnifera* (Solanaceae)

(C) *Chlorophytum borivilianum* (Liliaceae)

(D) *Papaver somniferum* (Papaveraceae)

Q19. Which of the following spices is botanically an umbelliferous fruit and represents a major seed spice exported from Rajasthan?

(A) Cumin (*Cuminum cyminum*)

(B) Fenugreek (*Trigonella foenum-graecum*)

(C) Black pepper (*Piper nigrum*)

(D) Clove (*Syzygium aromaticum*)

Q20. In plant tissue culture, the mass of unorganized, actively dividing parenchymatous cells obtained from an explant is termed:

(A) Callus

(B) Somaclone

(C) Cybrid

(D) Protoplast

Q21. Which vector is widely exploited as a natural genetic engineer to transfer targeted T-DNA into dicotyledonous plant genomes?

(A) *Escherichia coli*

(B) *Agrobacterium tumefaciens*

(C) pBR322

(D) Bacteriophage lambda

Q22. The molecular scissors that precisely recognize and cleave specific palindromic nucleotide sequences within double-stranded DNA are:

(A) DNA Ligases

(B) Restriction Endonucleases

(C) DNA Polymerases

(D) Reverse Transcriptases

Q23. The devastating Green Ear disease, which causes leaf-like proliferation of the earhead in Pearl Millet (Bajra), is caused by which pathogen?

(A) *Sclerospora graminicola*

(B) *Albugo candida*

(C) *Alternaria solani*

(D) *Xanthomonas axonopodis*

Q24. Citrus Canker is a severe bacterial disease widespread in lemon orchards. What is the definitive causative organism?

(A) *Pseudomonas syringae*

(B) *Xanthomonas citri*

(C) *Erwinia amylovora*

(D) *Agrobacterium vitis*

Q25. Which type of fungicide is globally recommended to manage and control the Powdery Mildew diseases affecting various fruit and rabi crops?

(A) Copper-based fungicides

(B) Sulphur-based fungicides

(C) Streptomycin antibiotics

(D) Zinc phosphide formulations

Q26. Which of the following phyla exhibits a pseudocoelomate body plan and is characterized by the presence of syncytial epidermis?

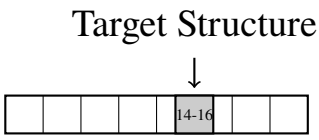
(A) Platyhelminthes

(B) Aschelminthes (Nematoda)

(C) Annelida

(D) Arthropoda

Q27. The stylized morphology below charts a segmented worm. The localized glandular thickening of the body wall encompassing segments 14, 15, and 16 in an adult earthworm (*Pheretima posthuma*) is called the:



(A) Prostomium

(B) Peristomium

(C) Clitellum

(D) Typhlosole

Q28. The specialized respiratory structures found inside the branchial chamber of a cockroach that communicate directly to the exterior via spiracles are:

(A) Malpighian tubules

(B) Tracheae and tracheoles

(C) Book lungs

(D) Gills

Q29. Which type of animal epithelial tissue forms the inner lining of blood vessels and alveoli, facilitating rapid diffusion?

(A) Cuboidal epithelium

(B) Columnar epithelium

(C) Simple squamous epithelium

(D) Ciliated epithelium

Q30. Osmoregulation and elimination of excess water in *Amoeba proteus* is dynamically carried out by which structure?

(A) Food vacuole

(B) Contractile vacuole

(C) Pseudopodia

(D) Plasmalemma

Q31. The destructive polyphagous agricultural pest commonly known as the White Grub belongs to which insect order?

(A) Lepidoptera

(B) Coleoptera

(C) Orthoptera

(D) Isoptera

Q32. Which dangerous storage pest primarily attacks stored wheat grains, with its larvae causing extensive internal damage by hollow grinding?

(A) Khapra beetle (*Trogoderma granarium*)

(B) Rice weevil (*Sitophilus oryzae*)

(C) Pulse beetle (*Callosobruchus maculatus*)

(D) Red flour beetle (*Tribolium castaneum*)

Q33. The use of specific biological agents such as *Trichogramma* wasps to parasitize and suppress lepidopteran crop pests is a classic strategy of:

(A) Chemical control

(B) Cultural control

(C) Biological control

(D) Legislative control

Q34. Which category of hand-operated spray equipment utilizing an airtight pressure chamber is most suited for uniform chemical application in small agricultural holdings?

(A) Knapsack sprayer

(B) Power sprayer

(C) Duster machine

(D) Ultra-low volume (ULV) sprayer

Q35. Which phylum of invertebrates contains animals with a water vascular system, tube feet, and complete radial symmetry in adults?

(A) Mollusca

(B) Echinodermata

(C) Arthropoda

(D) Porifera

Q36. Deficiency of which fat-soluble vitamin causes xerophthalmia and night blindness due to the non-formation of rhodopsin pigment?

(A) Vitamin K

(B) Vitamin D

(C) Vitamin A

(D) Vitamin E

Q37. The primary site for the enzymatic digestion of proteins in the vertebrate digestive system via the action of pepsin at highly acidic pH is the:

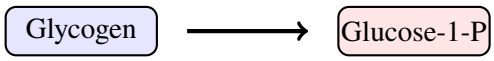
(A) Mouth cavity

(B) Stomach

(C) Duodenum

(D) Ileum

Q38. The biochemical pathway outlined below represents the breakdown of stored glycogen into individual glucose units to rapidly raise blood sugar levels under fasting conditions. This path is known as:



(A) Glycolysis

(B) Glycogenolysis

(C) Glycogenesis

(D) Gluconeogenesis

Q39. Which mineral macro-element is critically required for skeletal structural integrity, normal blood clotting mechanism, and muscle contraction pathways?

(A) Iron

(B) Iodine

(C) Calcium

(D) Zinc

Q40. A complete diet that contains all essential nutrients, vitamins, minerals, and caloric content required in accurate proportions for optimal physiological health is defined as a:

(A) High-protein diet

(B) Balanced diet

(C) Therapeutic diet

(D) Restricted diet

Detailed Solutions

Q1.

Solution

Concept: Plant cell walls are multi-layered structures providing rigidity and structural support. Individual plant cells are synthesized adjacent to one another, requiring a specialized extracellular cement to bind their walls together permanently. This intercellular layer is rich in structural polysaccharides, primarily pectic substances, which function to keep the tissues structurally cohesive.

Solution:

(a) The middle lamella is the first formed layer deposited during cytokinesis via the cell plate, composed predominantly of calcium and magnesium pectates.

(b) It forms the outermost interface layer between the primary walls of contiguous plant cells, effectively gluing them together mechanically.

(c) When fruits undergo ripening, the enzyme polygalacturonase selectively degrades this pectin-rich middle lamella, causing tissue loosening and fruit softening.

(d) In contrast, the primary cell wall is composed of cellulose microfibrils embedded in a hemicellulose matrix, deposited after the middle lamella.

(e) The secondary wall develops later inside the primary wall, whereas plasmodesmata are microscopic cytoplasmic channels that cross the cell walls to facilitate communication rather than serving as structural glue.

Final Answer: Middle lamella

Answer: (C)

Go Back to Question 1

Q2.

Solution

Concept: Meiosis I is characterized by a prolonged and complex prophase I, which is sub-divided into five sequential substages: leptotene, zygotene, pachytene, diplotene, and diakinesis. This phase is evolutionary critical because it is responsible for genetic recombination, driven by physical interactions between non-sister chromatids of homologous chromosomal pairs.

Solution:

(a) Homologous chromosomes undergo alignment and close pairing during the zygotene stage, a specific structural matching process known as synapsis.

(b) Once synapsis is complete, the cell enters the pachytene stage, where the paired chromosomes form bivalents or tetrads with clear visible strands.

(c) During pachytene, the enzyme recombinase facilitates the physical exchange of genetic material between non-sister chromatids, a process termed crossing over.

(d) The points of exchange form physical cross-connections known as chiasmata, which only become distinct during the subsequent diplotene stage as the synaptonemal complex dissolves.

(e) Therefore, while chiasmata are visualized during diplotene due to desynapsis, the actual physical process of crossing over occurs strictly inside the pachytene stage.

Final Answer: Pachytene

Answer: (C)

Go Back to Question 2

Q3.

Solution

Concept: An anatropous ovule is the most common structural type found in angiosperms, characterized by an inverted body where the micropyle is brought close to the hilum. Understanding the anatomical polarity of the ovule is vital to recognizing where protective coats originate and where the pollen tube safely gains entry into the embryo sac.

Solution:

(a) The anatropous ovule consists of a central tissue mass called the nucellus, enveloped by one or two protective layers known as integuments.

(b) The integuments do not completely enclose the nucellus, leaving a small passage or pore at the apex termed the micropyle.

(c) The exact structural base of the ovule, from which the integuments arise and develop, is located directly opposite the micropylar end.

(d) This basal anatomical region is designated as the chalaza, representing the posterior structural pole of the megasporangium body.

(e) The stalk holding the ovule is the funicle, and its point of fusion with the ovule body is the hilum, making the chalaza exclusively the basal part.

Final Answer: The basal part opposite to the micropyle

Answer: (A)

Go Back to Question 3

Q4.

Solution

Concept: Mendelian genetics analyzes inheritance patterns of independent traits across generations. A dihybrid cross tracks two distinct traits governed by non-linked genes. According to Mendel's law of independent assortment, alleles for separate traits segregate entirely independently of one another during gamete formation, creating a predictable distribution of combinations in offspring.

Solution:

(a) Crossing homozygous yellow-round (YYRR) and green-wrinkled (yyrr) plants produces an entirely uniform heterozygous yellow-round (YyRr) generation in the F1 stage.

(b) When these F1 dihybrid individuals are self-pollinated, they produce four distinct types of gametes with equal mathematical probability: YR, Yr, yR, and yr.

(c) Punnett square analysis reveals sixteen possible fertilization combinations, yielding four distinct phenotypes in a highly stable mathematical distribution.

(d) The resulting phenotypic distribution is nine yellow-round, three yellow-wrinkled, three green-round, and one green-wrinkled plant.

(e) This gives the classical dihybrid phenotypic ratio of 9:3:3:1, whereas 3:1 represents a monohybrid cross and 1:1:1:1 represents a dihybrid test cross ratio.

Final Answer: 9 : 3 : 3 : 1

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: Plants utilizing the C4 photosynthetic pathway display spatial separation of carbon fixation steps to eliminate photorespiratory energy losses. This anatomical adaptation requires two distinct cell types, mesophyll cells and bundle sheath cells, each equipped with specific enzymes specialized to optimize carbon capture efficiency under high temperatures.

Solution:

(a) Atmosphere-derived carbon dioxide enters the mesophyll cells, where it quickly hydrates into bicarbonate ions within the cytoplasm.

(b) The primary acceptor of this carbon molecule is a three-carbon compound called phosphoenolpyruvate, rather than the five-carbon RuBP compound found in C3 systems.

(c) The enzyme phosphoenolpyruvate carboxylase, or PEP carboxylase, catalyzes this initial fixation step to generate a four-carbon organic acid, oxaloacetate.

(d) PEP carboxylase exhibits an extremely high affinity for inorganic carbon and is completely insensitive to oxygen, preventing competitive photorespiration.

(e) RuBisCO is isolated inside the bundle sheath cells where it executes the secondary carboxylation step, keeping it shielded from high oxygen levels.

Final Answer: PEP carboxylase

Answer: (B)

Go Back to Question 5

Q6.

Solution

Concept: Floral morphology uses specialized descriptive terminology to categorize structural variations and fusion patterns within reproductive whorls. The androecium exhibits significant differences in stamen cohesion, where filaments, anthers, or both may fuse to form distinctive bundles that serve as critical identification keys for plant families.

Solution:

(a) When stamens remain entirely un-fused with their filaments and anthers separate, the condition is referred to as polyandrous.

(b) If fusion occurs across the filaments while the anthers remain entirely free, the stamens are described using adelphous terminology.

(c) In the family Malvaceae, all staminal filaments fuse together to create a central, hollow structural tube surrounding the elongated style.

(d) This structural arrangement where all stamens are united into a single continuous bundle is specifically termed monadelphous fusion.

(e) Diadelphous denotes fusion into two distinct bundles, polyadelphous indicates multiple filament groups, and syngenesious describes stamens with fused anthers but completely separate filaments.

Final Answer: Monadelphous

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept: The taxonomy system published by George Bentham and Joseph Dalton Hooker is a highly prominent natural system of classification for seed plants. It groups angiosperms based on shared structural characteristics, creating a systematic hierarchy that organizes plants into subclasses, series, and cohorts for identification.

Solution:

(a) Bentham and Hooker divided Phanerogams into three main classes: Dicotyledones, Gymnospermae, and Monocotyledones, intentionally placing Gymnosperms between the two angiosperm groups.

(b) The class Dicotyledones is further broken down into three major subclasses based strictly on the presence, absence, or fusion of floral petals.

(c) The first subclass is Polypetalae, which accommodates flowers with distinct, entirely free petals grouped across three evolutionary series.

(d) The second subclass is Gamopetalae, containing flowers characterized by petals fused to form a unified corolla tube.

(e) The third subclass is Monochlamydae, which contains flowers lacking a distinct corolla and calyx. This establishes the sequence as Polypetalae, Gamopetalae, and Monochlamydae.

Final Answer: Polypetalae, Gamopetalae, and Monochlamydae

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept: Water transport across root cortical tissues toward the vascular cylinder occurs through distinct physiological pathways. These pathways operate simultaneously across different cell domains, determined by whether water encounters physical barriers like the selective plasma membrane or moves freely through interconnected non-living extracellular spaces.

Solution:

(a) The apoplastic pathway represents water movement restricted exclusively to the non-living structural domains of the plant tissue matrix.

(b) In this mode, water and dissolved mineral ions diffuse through cell walls and intercellular spaces without traversing any semipermeable cell membranes.

(c) This pathway provides low resistance to flow but is interrupted at the endodermis by suberized Casparian strips.

(d) Conversely, the symplastic pathway requires water to cross the plasma membrane, moving through interconnected living protoplasts via plasmodesmata connections.

(e) Vacuolar and transcellular pathways involve water crossing cell membranes and central vacuoles sequentially, making the apoplast the sole non-living cell wall route.

Final Answer: Apoplastic pathway

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: Plant growth regulators coordinate development by triggering specific physiological responses in target tissues. While some hormones are primarily growth promoters, others function as volatile signaling molecules that coordinate stress adaptations, structural modifications in developing seedlings, and tissue aging processes.

Solution:

(a) Ethylene is a unique gaseous hormone synthesized in tissues undergoing senescence and ripening, regulating multi-axial growth patterns.

(b) It induces the classic triple response in etiolated dicot seedlings: inhibition of elongation, radial swelling, and horizontal growth.

(c) Ethylene triggers autocatalytic respiratory bursts that break down complex cell carbohydrates, driving rapid fruit ripening.

(d) It alters auxin transport dynamics to promote lateral bud activation, overriding apical dominance patterns under specific environmental conditions.

(e) Auxins control apical dominance directly, gibberellins drive stem elongation, and cytokinins stimulate cell division, making ethylene the correct multifunction regulator.

Final Answer: Ethylene

Answer: (D)

Go Back to Question 9

Q10.

Solution

Concept: Enzymes can be simple proteins or complex conjugated proteins known as holoenzymes. A holoenzyme requires a catalytic protein component, called the apoenzyme, bound to a non-protein chemical structure to become active. These non-protein components are classified based on their structural chemistry and how tightly they bind to the protein.

Solution:

(a) The non-protein component of a holoenzyme is broadly termed a cofactor, providing chemical groups required for catalysis.

(b) If this cofactor is an organic molecule that binds transiently to the apoenzyme during catalysis, it is called a coenzyme.

(c) When an organic cofactor binds tightly and permanently via strong covalent or non-covalent bonds, it is designated a prosthetic group.

(d) Prosthetic groups remain attached to the enzyme structure throughout its catalytic cycle, as seen with heme in peroxidase enzymes.

(e) Metal ions function as inorganic activators, while isoenzymes are structural variants of the same enzyme, confirming the prosthetic group definition.

Final Answer: Prosthetic group

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept: The internal anatomy of a plant root is organized into distinct concentric tissue layers that regulate the radial transport of water and solutes. The innermost layer of the root cortex functions as a selective physiological barrier between the ground tissue system and the central vascular cylinder, playing a critical role in selective nutrient uptake.

Solution:

(a) The endodermis forms a single layer of tightly packed barrel-shaped cells without any intercellular spaces, separating the cortex from the pericycle.

(b) The radial and transverse walls of these endodermal cells feature a localized deposition of a water-impermeable, waxy material called suberin.

(c) This specialized bands or rings of suberized matrix are anatomically known as the Casparian strips, which block the passive apoplastic movement of water.

(d) Because of the Casparian strip, water and dissolved mineral ions are forced to cross the semipermeable plasma membrane and enter the symplastic pathway.

(e) In contrast, the epidermis forms the outer boundary, the cortex comprises parenchyma layers, and the pericycle sits internal to the endodermis, leaving the endodermis as the exclusive site.

Final Answer: Endodermis

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept: Point mutations are sub-classified based on the specific molecular alterations made to the nitrogenous base sequence of DNA. Nitrogenous bases belong to two distinct chemical families: double-ringed purines, which include adenine and guanine, and single-ringed pyrimidines, which include cytosine, thymine, and uracil.

Solution:

(a) Point mutations involving simple base substitutions are categorized into two major types: transitions and transversions, based on structural homology.

(b) A transition mutation occurs when a purine base is replaced by another purine, or when a pyrimidine base is substituted by another pyrimidine.

(c) A transversion mutation describes a structural substitution where a purine base is replaced by a pyrimidine base, or a pyrimidine is replaced by a purine.

(d) Frame-shift mutations involve insertions or deletions of nucleotides that completely shift the downstream triplet reading frame during translation.

(e) Because the question specifies the replacement of a purine by a pyrimidine or vice-versa, it describes a transversion mutation rather than a transition or structural deletion.

Final Answer: Transversion

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: Ecological pyramids provide a graphical representation of trophic structures across successive feeding levels within an ecosystem. These pyramids track the total number of individual organisms, total dry organic biomass, or the thermodynamic energy transfer across the primary producer, herbivore, and carnivore levels.

Solution:

(a) The pyramid of numbers can be inverted in specific scenarios, such as a single large tree supporting numerous herbivorous insects and parasites.

(b) The pyramid of biomass is inverted in aquatic ecosystems, where a small standing crop of phytoplankton supports a larger biomass of zooplankton and fish.

(c) The pyramid of energy charts the absolute rate of energy flow through the food chain, which is governed by the laws of thermodynamics.

(d) According to Lindeman's ten percent law, only about ten percent of the organic energy stored at one trophic level is transferred to the next.

Final Answer: Pyramid of energy

Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept: Ecosystem pollution dynamics are heavily influenced by how synthetic chemicals interact with living tissues and biological food chains. Toxic agents that are lipophilic, metabolically stable, and non-biodegradable cannot be broken down or excreted efficiently by organisms, leading to systemic accumulation over time.

Solution:

(a) When an organism absorbs a toxic pollutant faster than it can excrete or lose it through metabolic clearance, the process is termed bioaccumulation.

(b) When this toxic substance passes up a food chain, its relative concentration per unit biomass amplifies significantly at each successive trophic step.

(c) This progressive magnification of toxin concentration from producers up to top carnivores is defined as biomagnification or biological magnification.

(d) Classic examples include chlorinated hydrocarbons like DDT and heavy metals like methylmercury, which reach damaging concentrations in apex predators.

(e) Eutrophication describes nutrient enrichment in water bodies leading to algal blooms, making biomagnification the correct term for food chain concentration increases.

Final Answer: Biomagnification

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept: In-situ biodiversity conservation relies on establishing a network of protected areas, including National Parks and Wildlife Sanctuaries, to safeguard critical ecosystems. Rajasthan hosts unique ecological landscapes that provide vital wintering habitats for specialized migratory avifauna travelling along the Central Asian Flyway.

Solution:

(a) Keoladeo Ghana National Park, situated in Bharatpur, is a famous avifaunal wetland sanctuary recognized globally for its immense ecological significance.

(b) It was designated as a UNESCO World Heritage Site due to its role as a premier wintering ground for thousands of rare migratory birds.

(c) The park is historically celebrated for hosting the critically endangered Siberian Crane during the winter seasons, alongside numerous waterfowl species.

(d) Ranthambore National Park and Sariska Tiger Reserve are premier semi-arid forest reserves primarily dedicated to the conservation of the Royal Bengal Tiger.

(e) Mukundra Hills National Park protects a distinct valley ecosystem, confirming that Keoladeo Ghana is the premier UNESCO wetland habitat for migratory waterfowl.

Final Answer: Keoladeo Ghana National Park

Answer: (C)

Go Back to Question 15

Q16.

Solution

Concept: Biotic interactions define the dynamic relationships between coexisting species within an ecological community. These interspecific actions are classified as positive, negative, or neutral based on whether they enhance, reduce, or have no physiological effect on the fitness and survival of the interacting populations.

Solution:

(a) Commensalism describes an interaction where one species derives a clear biological benefit while the host species remains entirely unaffected or neutral.

(b) Parasitism is a hostile relationship where one small species benefits by living on or inside a host organism, causing physical harm.

(c) Amensalism is an interspecific interaction where one population is strongly inhibited, suppressed, or harmed while the other species remains completely unaffected.

(d) A classic example of amensalism is antibiosis, where penicillium molds secrete chemical antibiotics that kill bacteria without affecting the mold.

(e) Because the question explicitly specifies a negative effect paired with a neutral effect, the relationship is defined as amensalism.

Final Answer: Amensalism

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept: Economic botany categorizes cultivated crops based on their primary industrial applications, physiological adaptations, and taxonomic lineages. Arid and semi-arid regions focus heavily on drought-hardy agricultural crops that yield valuable secondary metabolites or industrial raw materials from their seeds or vegetative parts.

Solution:

(a) Cluster bean, commonly referred to as Guar, is an annual legume crop highly adapted to the dry, sandy soils characteristic of western Rajasthan.

(b) Taxonomically, it belongs to the family Fabaceae, which is characterized by nitrogen-fixing root nodules and distinctive pod-like fruit structures.

(c) The endosperm of cluster bean seeds contains a high concentration of galactomannan, a complex polysaccharide that forms a viscous mucilaginous gum.

(d) This industrial guar gum is widely exported for use as a thickener and stabilizer in food, textiles, pharmaceuticals, and oil drilling applications.

(e) Mustard belongs to Brassicaceae, sugarcane belongs to Poaceae, and cotton belongs to Malvaceae, leaving cluster bean as the premier cash crop of Fabaceae.

Final Answer: Cluster bean (Guar)

Answer: (A)

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Q18.

Solution

Concept: Medicinal plants synthesize a wide array of secondary metabolites, such as alkaloids, glycosides, and steroids, which exhibit profound pharmacological activities. Correct taxonomic identification using standardized binomial nomenclature and family classification is essential for quality control and research in herbal pharmacology.

Solution:

(a) Ashwagandha, often called Indian ginseng, is a highly valued Ayurvedic medicinal plant famed for its adaptogenic, immunomodulatory, and sedative properties.

(b) The correct botanical name for Ashwagandha is Withania somnifera, where the specific epithet highlights its traditional use in promoting restful sleep.

(c) Taxonomically, Withania somnifera belongs to the family Solanaceae, which is also characterized by other economically important nightshade species.

(d) Aloe vera and Chlorophytum borivilianum both belong to the family Liliaceae, where the latter is commonly known as Safed Musli.

(e) Papaver somniferum belongs to Papaveraceae and yields opium alkaloids, confirming that Withania somnifera is the accurate botanical match for Ashwagandha.

Final Answer: *Withania somnifera* (Solanaceae)

Answer: (B)

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Q19.

Solution

Concept: The family Apiaceae, historically known as Umbelliferae, is characterized by flowers arranged in characteristic umbrella-like clusters called umbels. Most members of this family produce schizocarpic fruits that split into two single-seeded mericarps containing volatile essential oils, making them highly valuable as aromatic seed spices.

Solution:

(a) Rajasthan is an important agricultural hub for seed spice cultivation, dominating national production and export markets for several winter rabi spices.

(b) Cumin, known botanically as Cuminum cyminum, is a slender annual herb grown extensively in the arid and semi-arid tracts of the state.

(c) The harvested cumin seed is technically an umbelliferous schizocarpic fruit rich in cuminaldehyde, which imparts a characteristic warm aroma.

(d) Fenugreek belongs to the family Fabaceae, black pepper belongs to Piperaceae, and clove is an unopened flower bud belonging to the family Myrtaceae.

(e) Therefore, cumin is the correct example of a major umbelliferous seed spice exported from the agricultural regions of Rajasthan.

Final Answer: Cumin (*Cuminum cyminum*)

Answer: (A)

Go Back to Question 19

Q20.

Solution

Concept: Plant tissue culture utilizes the principle of totipotency, which is the inherent genetic capacity of a single isolated plant cell to divide and differentiate into a complete plant. This in-vitro micropropagation technique requires sterile conditions and precise control over nutrient media formulations and plant hormone ratios.

Solution:

(a) When a sterile piece of plant tissue, known as an explant, is inoculated onto a nutrient medium rich in auxins and cytokinins, cell division is triggered.

(b) The initial proliferative response is the formation of an amorphous, unorganized, and actively dividing mass of parenchymatous cells called a callus.

(c) The callus mass remains undifferentiated until the relative ratio of plant growth regulators is adjusted to initiate shoot or root organogenesis.

(d) Somaclones are genetic variations arising from tissue culture plants, cybrids are cytoplasmic hybrids, and protoplasts are cells lacking walls.

(e) This confirms that the unorganized mass of cells derived directly from an explant is correctly defined as a callus.

Final Answer: Callus

Answer: (A)

Go Back to Question 20

Q21.

Solution

Concept: Plant genetic engineering relies heavily on plasmid vectors capable of integrating foreign genetic sequences stably into a host plant genome. Soil-borne plant pathogenic bacteria possess specialized plasmid networks that naturally colonize wounded plant tissue and transform host cells by inserting a specific piece of their own DNA molecule.

Solution:

(a) Agrobacterium tumefaciens is a soil bacterium that naturally induces crown gall disease in dicotyledonous plants by transferring a portion of its plasmid DNA.

(b) This pathogenic organism contains a large tumor-inducing plasmid, commonly referred to as the Ti plasmid, which acts as a natural transformation vehicle.

(c) A specific segment of this Ti plasmid, designated as the T-DNA or transfer DNA, is physically cut out and transferred into the nucleus of the host plant cell.

(d) Once inside the plant nucleus, the T-DNA integrates randomly but stably into the genomic DNA, forcing the host cell to synthesize opines and phytohormones.

(e) Biologists modify this system by removing the disease-causing oncogenes and replacing them with desired foreign genes, turning the bacterium into an effective vector.

Final Answer: *Agrobacterium tumefaciens*

Answer: (B)

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Q22.

Solution

Concept: Recombinant DNA technology requires specialized enzymatic tools to manipulate double-stranded DNA molecules under highly controlled in-vitro conditions. To isolate individual genes or modify plasmids, molecular biologists utilize bacterial defensive enzymes that cleave phosphodiester bonds at highly specified biochemical sites.

Solution:

(a) Restriction endonucleases are bacterial enzymes that serve as a molecular defense mechanism against invading bacteriophage viruses by degrading foreign viral DNA.

(b) These enzymes recognize specific, symmetrical arrangements of base pairs within double-stranded DNA known as palindromic sequences, which read identically in both directions.

(c) Upon binding to these sites, the endonuclease cuts the phosphodiester backbone of both strands at specific points, producing either blunt ends or sticky ends.

(d) Because they break the nucleotide chain internally with absolute sequence specificity, they are universally designated as molecular scissors in genomic engineering.

(e) DNA ligases function to join fragments together, DNA polymerases synthesize new strands, and reverse transcriptases convert RNA to DNA, leaving endonucleases as the sole cleavage tools.

Final Answer: Restriction Endonucleases

Answer: (B)

Go Back to Question 22

Q23.

Solution

Concept: Agricultural phytopathology studies the etiology and management of destructive crop diseases that limit yield in regional cropping patterns. Pearl millet, widely grown as Bajra across the arid tracts of Rajasthan, is highly vulnerable to systemic oomycete pathogens that alter the morphology of reproductive structures.

Solution:

(a) Green ear disease, also commonly designated as downy mildew of Bajra, is a severe systemic disease that disrupts normal grain formation in the earhead.

(b) The causative agent is Sclerospora graminicola, an obligate biotrophic oomycete organism that survives in infected soil and debris through thick-walled oospores.

(c) The most striking symptom occurs during the flowering stage, where normal floral organs inside the spike are transformed into green, twisted, leaf-like structures.

(d) This leaf-like proliferation renders the earhead completely sterile, preventing grain formation and resembling a chaotic green brush instead of a normal panicle.

(e) Albugo candida causes white rust in brassica crops, while Alternaria solani induces early blight in solanaceous plants, making Sclerospora graminicola the correct pathogen.

Final Answer: *Sclerospora graminicola*

Answer: (A)

Go Back to Question 23

Q24.

Solution

Concept: Bacterial plant pathogens invade host tissues through structural wounds or natural openings like stomata and hydathodes to colonize internal intercellular spaces. In citrus orchards, severe bacterial infections produce characteristic macroscopic lesions on leaves, twigs, and fruits, which significantly reduces the commercial value of the crop.

Solution:

(a) Citrus canker is a highly contagious, economically damaging bacterial disease affecting all commercial varieties of citrus fruits worldwide.

(b) The definitive causative pathogen is Xanthomonas citri, a rod-shaped, gram-negative bacterium equipped with a single polar flagellum for motility.

(c) The pathogen causes raised, brown, corky, and spongy necrotic lesions on leaves and fruits, which are typically surrounded by a distinctive yellow chlorotic halo.

(d) These lesions disrupt photosynthesis when present on leaves and cause premature fruit drop, making the remaining harvested fruits unmarketable.

(e) Erwinia amylovora induces fire blight in pome fruits, while Pseudomonas syringae causes bacterial specks, confirming Xanthomonas citri as the specific canker pathogen.

Final Answer: *Xanthomonas citri*

Answer: (B)

Go Back to Question 24

Q25.

Solution

Concept: Chemical disease management in agriculture requires matching specific classes of chemical pesticides to the unique biology of the invading fungal or bacterial pathogen. Certain fungal groups grow superficially on host surfaces, requiring specific elemental or synthetic compounds that disrupt external fungal structures without harming plant tissue.

Solution:

(a) Powdery mildew is an easily identifiable fungal disease characterized by a white, powdery growth of mycelia and conidia on upper leaf surfaces.

(b) The causal agents are obligate ectoparasites belonging to the order Erysiphales, which remain mostly superficial on the host epidermis.

(c) Sulphur-based fungicides, including wettable sulphur and elemental sulphur dusts, are highly effective against these powdery mildew fungi.

(d) The absorbed sulphur disrupts electron transport chains within the fungal mitochondria, acting as a direct metabolic toxin to suppress spore germination.

(e) Copper fungicides are preferred for downy mildews and leaf spots, while streptomycin is an antibacterial antibiotic, making sulphur formulations the correct choice.

Final Answer: Sulphur-based fungicides

Answer: (B)

Go Back to Question 25

Q26.

Solution

Concept: Animal kingdom classification organizes invertebrate groups based on fundamental structural parameters, including embryonic tissue layers, body symmetry, and the nature of the internal body cavity. The presence of a fluid-filled body space that is not fully lined by mesodermal tissue defines a unique evolutionary branch of invertebrates.

Solution:

(a) The phylum Aschelminthes, commonly known as Nematoda or roundworms, possesses a distinctive body cavity called a pseudocoelom, derived directly from the embryonic blastocoel.

(b) This pseudocoelom is filled with pressurized fluid but lacks a continuous internal lining of mesodermal epithelium on the visceral organs.

(c) The outer body wall of these roundworms features a thick, non-cellular protective cuticle underlaid by a syncytial epidermis with continuous multinucleated cytoplasm.

(d) Platyhelminthes are entirely acoelomate flatworms, while Annelida and Arthropoda are true coelomate invertebrates possessing a mesoderm-lined body cavity.

(e) Therefore, the combination of a pseudocoelomate body plan with a syncytial epidermis is exclusively characteristic of the phylum Aschelminthes.

Final Answer: Aschelminthes (Nematoda)

Answer: (B)

Go Back to Question 26

Q27.

Solution

Concept: The anatomical organization of the common earthworm exhibits a highly structured metameric segmentation pattern. Certain body segments undergo distinct structural modifications upon reaching sexual maturity, developing temporary or permanent glandular zones that assist in reproductive cross-fertilization.

Solution:

(a) An adult earthworm possesses a prominent, circular band of dark, swollen glandular tissue located near the anterior end of its elongated body.

(b) This thick glandular structure is called the clitellum, and it completely encircles the body segments numbered 14, 15, and 16.

(c) The cells of the clitellum secrete a viscous mucus and nutritive fluid required to form a protective chitinous cocoon around fertilized eggs.

(d) The prostomium is a pre-segmental fleshy lobe covering the mouth, the peristomium is the first true segment, and the typhlosole is an internal intestinal fold.

(e) Thus, the specialized glandular thickening encompassing segments 14 to 16 is precisely defined as the clitellum.

Final Answer: Clitellum

Answer: (C)

Go Back to Question 27

Q28.

Solution

Concept: Invertebrate respiratory physiology involves specialized adaptations tailored to body size, habitat, and structural constraints. Terrestrial arthropods require internal gas exchange systems that transport oxygen directly to metabolic tissues without relying on a slow, inefficient circulatory system.

Solution:

(a) The respiratory network of a cockroach consists of an intricate, branching internal system of air tubes known as the tracheal system.

(b) This network communicates with the external environment through ten pairs of small, regulated lateral openings called spiracles on the body wall.

(c) The main respiratory tubes, called tracheae, branch repeatedly into microscopic, fluid-filled terminal tubules designated as tracheoles.

(d) These tracheoles extend into direct physical contact with individual muscle cells, allowing oxygen to diffuse directly into tissues without entering the blood.

(e) Book lungs are found in arachnids, gills are restricted to aquatic forms, and Malpighian tubules function as excretory organs, confirming the tracheal network.

Final Answer: Tracheae and tracheoles

Answer: (B)

Go Back to Question 28

Q29.

Solution

Concept: Animal histology classifies epithelial tissues based on cell shape, layer arrangement, and specialized physiological functions. Structural surfaces involved in rapid passive transport require an extremely thin cell barrier to minimize resistance and optimize diffusion rates across membranes.

Solution:

(a) Simple squamous epithelium consists of a single layer of flattened, tile-like polygonal cells resting on a thin basal membrane.

(b) The cells feature irregular boundaries and are extremely thin, presenting a minimal physical barrier that is ideal for filtration and gas exchange.

(c) This tissue forms the inner lining of blood vessels, where it is termed endothelium, as well as the microscopic air sacs or alveoli of the lungs.

(d) Cuboidal and columnar epithelia are thicker, providing secretory or absorptive functions, while ciliated epithelium moves materials along surfaces.

(e) Consequently, simple squamous epithelium is the specific histological tissue that lines structures optimized for rapid passive diffusion.

Final Answer: Simple squamous epithelium

Answer: (C)

Go Back to Question 29

Q30.

Solution

Concept: Freshwater protozoans live in a hypotonic environment, causing water to continuously enter their semipermeable bodies via passive osmosis. To prevent cellular swelling and lysis, these single-celled organisms utilize specialized organelles that actively gather and expel excess water.

Solution:

(a) Amoeba proteus relies on a specialized, membrane-bound cytoplasmic organelle called the contractile vacuole to manage internal water volume.

(b) This vacuole continuously accumulates excess water from the surrounding cytoplasm through active transport and structural fusion with smaller vesicles.

(c) Once it reaches maximum volume, the contractile vacuole migrates to the plasma membrane, fuses with it, and contracts forcefully to expel water.

(d) This cyclic process of water collection and elimination is the primary mechanism of physiological osmoregulation and volume control.

(e) Food vacuoles process ingested nutrients, pseudopodia facilitate locomotion, and the plasmalemma acts as a boundary, leaving the contractile vacuole as the regulatory organelle.

Final Answer: Contractile vacuole

Answer: (B)

Go Back to Question 30

Q31.

Solution

Concept: Agricultural entomology classifies economic insect pests according to their taxonomic hierarchy, lifecycle dynamics, and feeding habits. Polyphagous pests attack multiple plant families, causing systemic damage to root or shoot networks, which demands accurate identification of their adult beetles and subterranean larval stages.

Solution:

(a) White grub is a devastating soil-borne polyphagous agricultural pest that feeds voraciously on the root systems of various rainy kharif crops like groundnut and pearl millet.

(b) This pest represents the destructive larval stage of the scarab beetle, which belongs taxonomically to the diverse insect order Coleoptera.

(c) Order Coleoptera is universally characterized by insects possessing hardened, protective forewings known as elytra that shield the delicate membranous hindwings used for flight.

(d) The larvae live entirely underground, chewing plant roots and causing extensive wilting, yellowing, and eventual mortality across vast agricultural fields.

(e) Lepidoptera includes moths and butterflies, Orthoptera contains grasshoppers, and Isoptera covers termites, leaving Coleoptera as the correct taxonomic order for beetles and grubs.

Final Answer: Coleoptera

Answer: (B)

Go Back to Question 31

Q32.

Solution

Concept: Post-harvest agricultural management focuses on protecting stored food grains from destructive insect infestations. Storage pests are classified based on whether they act as primary internal feeders that bore directly into whole undamaged grains or secondary external feeders that consume pre-damaged grain dust.

Solution:

(a) The rice weevil, known scientifically as Sitophilus oryzae, is a highly destructive primary internal storage pest that infests wheat, rice, and maize grains.

(b) Adult female weevils use their specialized elongated snouts or rostra to chew a tiny hole directly into the hard exterior of a healthy wheat grain.

(c) The female deposits a single egg inside this cavity and seals it with a gelatinous secretion, ensuring the hatching larva is fully enclosed.

(d) The emerging larva spends its entire developmental cycle inside the grain, hollow-grinding the nutritious endosperm and leaving an empty structural shell.

(e) The Khapra beetle is an external feeder, the pulse beetle targets legumes, and the red flour beetle consumes processed flour, making the rice weevil the primary internal borer.

Final Answer: Rice weevil (*Sitophilus oryzae*)

Answer: (B)

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Q33.

Solution

Concept: Integrated Pest Management utilizes a combination of ecological, chemical, and biological strategies to suppress pest populations below economic injury levels. Deploying natural predators, parasitoids, or microbial pathogens to disrupt a pest's lifecycle offers a sustainable, non-toxic alternative to synthetic chemical treatments.

Solution:

(a) Biological control relies on living organisms to suppress or manage pest populations, eliminating the ecological drawbacks associated with synthetic pesticides.

(b) Wasps belonging to the genus Trichogramma are minute, specialized endoparasitoids that target the egg stage of highly destructive lepidopteran insect pests.

(c) The female wasp searches out pest eggs laid on host plants and inserts her own eggs directly inside them using a sharp ovipositor.

(d) The developing wasp larva consumes the internal contents of the pest egg, preventing it from ever hatching into a crop-damaging caterpillar.

(e) Chemical control uses synthetic toxins, cultural control modifies farming practices, and legislative control enforces quarantines, confirming that Trichogramma deployment represents biological control.

Final Answer: Biological control

Answer: (C)

Go Back to Question 33

Q34.

Solution

Concept: Plant protection equipment is engineered to atomize liquid pesticide formulations into uniform droplets for targeted distribution across crop canopies. Small-scale farmers require portable, manually operated machinery capable of maintaining consistent hydraulic pressure to ensure efficient foliage coverage without excessive chemical runoff.

Solution:

(a) The compression knapsack sprayer is a widely utilized, hand-operated appliance designed for applying liquid insecticides, fungicides, and herbicides.

(b) This equipment features a durable tank carried on the operator's back, integrated with an internal or external airtight pressure chamber.

(c) Manual pumping forces air and liquid into the chamber, compressing the air to build up steady pneumatic pressure before application begins.

(d) This stored pressure forces the fluid through the delivery hose and nozzle in a uniform, highly controlled spray pattern without requiring continuous pumping during application.

(e) Power sprayers require internal combustion engines, dusters dispense dry powders, and ultra-low volume sprayers require specialized spinning discs, making the knapsack sprayer ideal for smallholdings.

Final Answer: Knapsack sprayer

Answer: (A)

Go Back to Question 34

Q35.

Solution

Concept: Invertebrate zoology classifies animal phyla based on fundamental body architectural blueprints, embryonic development patterns, and specialized organ systems. Certain marine groups display an evolutionary transition in structural symmetry, moving from bilateral larval forms to a distinctive radial arrangement in adults.

Solution:

(a) Phylum Echinodermata comprises exclusively marine organisms characterized by a spiny calcareous endoskeleton and a coelom modified into a unique hydraulic network.

(b) This specialized system is known as the water vascular or ambulacral system, which regulates locomotion, food capture, and respiratory gas exchange.

(c) The system operates a multitude of fluid-filled projections called tube feet, which extend and contract via internal muscular ampullae.

(d) Echinoderm larvae exhibit bilateral symmetry, but during metamorphosis, they reorganize into adults displaying a classic five-part pentaradiate symmetry.

(e) Mollusca features an unsegmented soft body, Arthropoda has jointed appendages, and Porifera represents cellular-level sponges, leaving Echinodermata as the uniquely radial, tube-footed group.

Final Answer: Echinodermata

Answer: (B)

Go Back to Question 35

Q36.

Solution

Concept: Nutritional biochemistry divides vitamins into water-soluble and fat-soluble categories, each serving as essential cofactors or precursors for vital physiological processes. Visual phototransduction requires a continuous supply of specific lipophilic retinoic compounds to synthesize the light-sensitive pigments localized in retinal photoreceptor cells.

Solution:

(a) Vitamin A, or retinol, is a critical fat-soluble nutrient obtained from dietary carotenoids and preformed animal sources.

(b) Within the rod cells of the retina, retinol is converted into retinaldehyde, which binds with the protein opsin to synthesize the photopigment rhodopsin.

(c) Rhodopsin is essential for vision under low-light conditions, meaning a deficiency in Vitamin A directly impairs dark adaptation and causes night blindness.

(d) Chronic deficiency leads to xerophthalmia, a progressive condition characterized by severe conjunctival dryness, corneal keratinization, and eventual blindness.

(e) Vitamin K regulates coagulation, Vitamin D governs calcium homeostasis, and Vitamin E acts as an antioxidant, confirming Vitamin A's exclusive role in visual pigment synthesis.

Final Answer: Vitamin A

Answer: (C)

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Q37.

Solution

Concept: The vertebrate gastrointestinal tract relies on a sequence of organ-specific chemical environments to systematically break down complex dietary macromolecules. Protein digestion requires specialized proteolytic proenzymes that must be activated by specific pH thresholds inside muscular chambers before passing into the small intestine.

Solution:

(a) The stomach functions as a primary site for chemical protein digestion, utilizing a highly acidic gastric juice with a pH ranging between 1.5 and 2.5.

(b) Parietal cells in the gastric mucosa secrete hydrochloric acid, which kills ingested pathogens and denatures complex, folded dietary proteins.

(c) This acidic environment activates the zymogen pepsinogen, secreted by chief cells, converting it into the active proteolytic enzyme pepsin.

(d) Pepsin cleaves internal peptide bonds within proteins, breaking long polypeptide chains down into smaller proteoses and peptones.

(e) The mouth initiates starch breakdown, while the duodenum and ileum operate at alkaline pH levels using pancreatic enzymes, leaving the stomach as the acidic site for pepsin activity.

Final Answer: Stomach

Answer: (B)

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Q38.

Solution

Concept: Carbohydrate metabolism balances the synthesis and degradation of storage polymers to stabilize systemic blood glucose concentrations. Under fasting or high-stress conditions, endocrine signals trigger enzymatic pathways that mobilize glucose reserves from intracellular storage pools in liver and muscle tissues.

Solution:

(a) Glycogen represents the primary highly branched polysaccharide storage configuration of glucose found within animal hepatocytes and skeletal muscle cells.

(b) The biochemical pathway responsible for systematically cleaving this storage polymer into individual sugar units is designated as glycogenolysis.

(c) During glycogenolysis, the enzyme glycogen phosphorylase breaks internal glycosidic bonds to release glucose-1-phosphate molecules.

(d) Phosphoglucomutase then isomerizes this compound into glucose-6-phosphate, which is dephosphorylated in the liver to release free glucose into the bloodstream.

(e) Glycolysis degrades glucose to pyruvate, glycogenesis synthesizes glycogen, and gluconeogenesis creates glucose from non-carbohydrate precursors, leaving glycogenolysis as the correct catabolic pathway.

Final Answer: Glycogenolysis

Answer: (B)

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Q39.

Solution

Concept: Mineral macro-elements are essential inorganic nutrients required in substantial quantities to maintain structural, electrophysiological, and enzymatic processes. Certain divalent cations function simultaneously as structural anchors in hard tissues and as critical biochemical messengers in extracellular fluids and muscular systems.

Solution:

(a) Calcium is the most abundant mineral macro-element in the vertebrate body, with the vast majority stored within bones and teeth as hydroxyapatite crystals.

(b) Beyond its structural role, ionized calcium is a vital signaling molecule required to trigger the coagulation cascade, activating clotting factors like prothrombin.

(c) In muscular physiology, calcium ions are released from the sarcoplasmic reticulum to bind with troponin, initiating the cross-bridge cycle required for muscle contraction.

(d) Iron is restricted to oxygen transport in hemoglobin, iodine regulates thyroid hormone synthesis, and zinc serves as an enzyme cofactor.

(e) Therefore, calcium is the specific macro-element that coordinates skeletal mineralization, blood coagulation, and neuromuscular contractile pathways.

Final Answer: Calcium

Answer: (C)

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Q40.

Solution

Concept: Dietetics and human physiology analyze food intake based on its capacity to satisfy metabolic energy requirements and deliver vital biochemical building blocks. Achieving long-term physiological health requires consuming a diet where all nutrient groups are optimally distributed to prevent deficiency or toxicity.

Solution:

(a) A balanced diet is defined as a dietary regimen that contains all essential nutrients in the correct, biochemically optimal proportions required by the body.

(b) It must deliver adequate carbohydrates, lipids, and proteins to meet daily energy demands and support cellular growth and tissue repair.

(c) Additionally, it must incorporate vital micronutrients, including vitamins and trace minerals, alongside dietary fiber and sufficient water intake.

(d) Consuming a balanced diet prevents nutritional deficiencies like kwashiorkor or scurvy while avoiding chronic metabolic disorders associated with overnutrition.

(e) High-protein, therapeutic, and restricted diets are specialized regimens tailored for specific clinical or performance goals rather than standard optimal health maintenance.

Final Answer: Balanced diet

Answer: (B)

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Answer Key

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