UPCATET Agriculture Zoology Sample Paper-2

Duration: 20 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions.
- Each correct answer carries **+4** mark. Incorrect answer: **−1** marks. Only **one** correct option.
- Unattempted questions carry **0** marks.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. The function of the gizzard in the alimentary canal of *Pheretima posthuma* is primarily associated with which of the following mechanical processes?

(A) Enzymatic digestion of humic acid

(B) Grinding of soil particles and organic debris

(C) Absorption of nitrogenous wastes from the coelom

(D) Secretion of calcium carbonate to neutralize food acidity

Q2. During a field survey, an agricultural supervisor observes a specific stage of an insect pest that lacks wings, possesses chewing mouthparts, and structurally resembles a miniature adult except for underdeveloped gonads. This nymphal stage is characteristic of which of the following orders and destructive pests?

(A) Order Orthoptera, represented by *Schistocerca gregaria*

(B) Order Lepidoptera, represented by *Chilo partellus*

(C) Order Diptera, represented by *Bactrocera cucurbitae*

(D) Order Coleoptera, represented by *Sitophilus oryzae*

Q3. A parasitic worm isolated from the liver of infected farm cattle exhibits a dorsoventrally flattened body, lacks a true coelom, and uses flame cells for osmoregulation. To which phylum does this organism belong?

(A) Nematoda

(B) Acanthocephala

(C) Annelida

(D) Platyhelminthes

Q4. Which of the following cellular modifications is prominently observed in the microvilli-lined cuboidal epithelium of the proximal convoluted tubule and the ciliated epithelium of the respiratory tract in higher animals?

(A) They are structural variations of simple epithelial tissue designed to maximize surface area and facilitate directional fluid movement respectively.

(B) They are stratified protective linings composed of dense keratinized matrix.

(C) They are derived exclusively from the embryonic mesoderm to support glandular secretion.

(D) They represent specialized connective tissues containing lacunae and chondrocytes.

Q5. The destructive phase of the swarming desert locust (*Schistocerca gregaria*) shifts from the solitary phase to the gregarious phase under specific environmental conditions. This phenotypic transformation is biologically triggered by which physiological and behavioral stimulus?

(A) Extended periods of low temperature causing hibernation

(B) Mechanical stimulation of the hind legs due to high population density crowding

(C) Direct ingestion of synthetic organophosphate residues on green foliage

(D) Prolonged water scarcity causing the insects to seek shelter in subterranean nests

Q6. In *Periplaneta americana*, the structural units of the compound eyes, known as ommatidia, produce a specific type of vision during low light intensity (nocturnal conditions). Identify the correct nature of this image and its primary characteristic.

(A) Apposition image, providing high resolution and low sensitivity

(B) Mosaic image with high distinctness and minimal overlap

(C) Superposition image, providing high sensitivity and low resolution

(D) Xerographic image, relying entirely on polarized light detection

Q7. A microscopic evaluation of an unidentified animal tissue reveals cells embedded in a solid, pliable matrix composed of chondroitin salts. The tissue lacks direct vascular supply and relies on diffusion through the perichondrium. This tissue is classified as:

(A) Dense regular fibrous connective tissue

(B) Hyaline cartilage

(C) Compact osseous tissue

(D) Adipose tissue

Q8. An agricultural pest causes severe white-ear damage in paddy crops by boring into the stem during its larval stage. Identify this pest and its specific metamorphic pattern.

(A) *Scirpophaga incertulas*, showing holometabolous development

(B) *Leucinodes orbonalis*, showing hemimetabolous development

(C) *Gundhi bug*, showing ametabolous development

(D) *Mustard sawfly*, showing hypermetabolous development

Q9. Members of Phylum Nematoda, such as *Meloidogyne incognita*, cause massive economic loss in solarized fields. Which unique structural feature characterizes this phylum?

(A) True metameric segmentation with chitinous parapodia

(B) Triploblastic body organization with a fluid-filled pseudocoelom derived from the blastocoel

(C) Flame cells forming a complex protonephridial network for excretion

(D) Calcareous shell enclosing a distinct muscular foot and mantle cavity

Q10. Which structural component of the earthworm's integumentary and circulatory system enables efficient cutaneous respiration in moist agricultural soils?

(A) A thick, dry, heavily keratinized stratum corneum that prevents all moisture loss

(B) A thin, moist cuticle maintained by epidermal mucous glands, running parallel to an extensive network of sub-epidermal blood capillaries

(C) Internalized tracheal tubes communicating directly with the atmosphere via lateral spiracles

(D) Specialized dermal branchiae protruding from the intersegmental furrows

Q11. The caste system of *Odontotermes obesus* (subterranean termite) includes workers, soldiers, and reproductives. What is the primary chemical nature and origin of the primary structural matrix of their mounds?

(A) Pure calcium carbonate secreted from the sub-esophageal glands mixed with sand

(B) Excreted cellulose sheets reinforced by wax glands located on the abdominal sterna

(C) Saliva-mixed excavated soil particles combined with their own fecal matter

(D) Decomposed plant resin concentrated by the soldier caste via specialized mandibular pores

Q12. Identify the structural configuration and functional role of the typhlosole found in the intestinal tract of *Pheretima posthuma*.

(A) It is a muscular valve between the stomach and intestine that prevents the backflow of sand particles.

(B) It is an internal median fold of the dorsal wall of the intestine that significantly increases the effective area of absorption.

(C) It is a glandular structure located in the pharyngeal region responsible for secreting proteolytic enzymes.

(D) It is a pair of lateral diverticula that stores excess calcium ions absorbed from the soil.

(E)

Q13. A biological analyst discovers a flagellated protozoan living mutualistically within the gut of wood-eating termites. This protozoan digests cellulose into fermentable fatty acids. To which specific group or phylum does this microscopic organism historically relate under veterinary/agricultural classification?

(A) Mastigophora (Zooflagellates), such as *Trichonympha*

(B) Ciliophora, such as *Paramecium*

(C) Sporozoa, such as *Eimeria*

(D) Sarcodina, such as *Entamoeba*

Q14. During the ultrastructural analysis of a secretory cell from the salivary gland of an insect, a student observes an abundance of double-membrane bound organelles with highly folded inner membranes forming cristae. What is the fundamental role of this organelle?

(A) Ribosomal RNA synthesis and ribosomal subunit assembly

(B) Generation of adenosine triphosphate (ATP) via the electron transport chain and oxidative phosphorylation

(C) Hydrolytic degradation of old cellular debris and foreign pathogens

(D) Packaging and modification of proteins received from the rough endoplasmic reticulum

Q15. The "Gundhi bug" (*Leptocorisa varicornis*) is a major pest of paddy. Which specific mouthpart configuration and feeding damage pattern are associated with this insect?

(A) Chewing and biting mouthparts; defoliation of leaves leaving only midribs

(B) Piercing and sucking mouthparts; sucking of sap from the developing grains during the milky stage, turning them into empty white chaff

(C) Siphoning mouthparts; scraping the chlorophyll content of the flag leaf

(D) Chewing-lapping mouthparts; boring into the roots of the seedlings below the soil surface

Q16. Which of the following descriptions accurately distinguishes the anatomical structure of the heart and circulatory flow of *Periplaneta americana* from that of a typical vertebrate?

(A) It has a 13-chambered dorsal tubular heart located in the pericardial sinus, operating within an open circulatory system where blood flows through hemocoelic sinuses.

(B) It has a 4-chambered ventral heart with highly muscular ventricles that pump hemoglobin-rich blood through a closed network of capillaries.

(C) It possesses a single-chambered neurogenic heart that pumps blood directly into a dorsal aorta without any lateral ostia.

(D) It features a myogenic 3-chambered heart that lacks sinuses and utilizes hemocyanin as the sole oxygen carrier.

Q17. Earthworms are widely recognized as "friends of farmers" and structural engineers of agricultural soil. Which of the following processes details their ecological utility?

(A) They decrease the nitrogen content of the soil by converting nitrates into atmospheric nitrogen gas via their chloragogen cells.

(B) They burrow deep into the soil, which increases aeration, enhances water infiltration, and deposits vermicastings rich in exchangeable plant nutrients.

(C) They eliminate all soil-borne fungal pathogens by releasing heavy concentrations of sulfuric acid from their calciferous glands.

(D) They compress the soil matrix tightly to prevent the evaporation of essential ground moisture.

Q18. An animal specimen collected from an agro-forestry unit shows true metameric segmentation, chitinous bristles (setae) embedded in pits for locomotion, a closed vascular network, and paired nephridia in each segment. This animal belongs to Phylum:

(A) Arthropoda

(B) Mollusca

(C) Annelida

(D) Aschelminthes

Q19. The "Red Pumpkin Beetle" (*Aulacophora foveicollis*) is a notorious pest of cucurbitaceous crops. At which stage of its life cycle does it cause severe damage, and where does this specific stage primarily operate?

(A) Only adults damage leaves by feeding on foliage, while grubs remain harmless inside old storage bins.

(B) Both adults and grubs cause damage; adults feed on the aerial leaves and flowers, while the subterranean grubs bore into roots and underground stems.

(C) Only the pupal stage causes damage by boring tunnels inside the fruit matrix.

(D) The nymphs suck sap from the vascular bundles of the main stem, while adults remain completely dormant.

Q20. Which of the following statements correctly identifies the anatomical location and primary physiological role of the Malpighian tubules in a cockroach?

(A) Located at the junction of the foregut and midgut; they secrete digestive enzymes for lipid assimilation.

(B) Located at the junction of the midgut and hindgut; they absorb nitrogenous wastes from the hemolymph and convert them into uric acid for excretion.

(C) Located along the dorsal blood vessel; they serve as accessory pulsatile organs to regulate blood pressure.

(D) Attached directly to the base of the antennae; they act as mechanoreceptors to detect environmental vibrations.

Q21. In *Pheretima posthuma*, the chloragogen cells present in the coelomic fluid and surrounding the intestine perform functions analogous to which vertebrate organ?

(A) Kidney

(B) Liver

(C) Heart

(D) Spleen

Q22. Which phylum among the following includes dynamic farm-associated vectors and pests characterized by the presence of a chitinous exoskeleton, jointed appendages, and periodic ecdysis?

(A) Mollusca

(B) Echinodermata

(C) Arthropoda

(D) Annelida

Q23. A serious polyphagous pest of agricultural crops is the gram pod borer (*Helicoverpa armigera*). To which insect order does it belong, and what is its specific damaging stage?

(A) Order Coleoptera; damaging stage is the adult weevil Order Lepidoptera; damaging stage is the caterpillar larva

(B) Order Hemiptera; damaging stage is the wingless nymph

(C) Order Isoptera; damaging stage is the sterile worker

Q24. The clitellum of the adult earthworm *Pheretima posthuma* is a prominent glandular ring. Which specific segments does it occupy, and what is its primary reproductive function?

(A) Segments 10, 11, and 12; responsible for the temporary storage of foreign spermatozoa

(B) Segments 14, 15, and 16; responsible for secreting the cocoon matrix that encloses eggs and sperm for external fertilization

(C) Segments 1, 2, and 3; functions as a sensory hood during subterranean burrowing

(D) Segments 24, 25, and 26; secretes specialized enzymes to digest complex soil organic matter

Q25. What distinctive reproductive structure is formed by the female cockroach (*Periplaneta americana*) through the secretions of her collateral glands to protect her fertilized eggs?

(A) Spermatophore

(B) Cocoon

(C) Ootheca

(D) Blastocyst

Detailed Solutions

Q1.

Solution

Concept: The digestive system of the earthworm (*Pheretima posthuma*) is adapted to its subterranean life, where it feeds on organic debris mixed with soil. Processing this dense mixture requires specialized structural modifications along its alimentary canal to break down hard, abrasive materials before chemical digestion occurs.

Solution:

(a) The gizzard is a prominent, highly muscular, oval structure situated in the 8th segment of the earthworm's alimentary canal.

(b) It features a exceptionally thick wall composed of circular muscle fibers and is lined internally by a tough, chitinous cuticle layer.

(c) As the earthworm feeds, it swallows large amounts of mineral soil particles, sand granules, decay debris, and complex organic matter.

(d) The rhythmic contractions of the powerful circular muscles compress the ingested material against the abrasive, hardened cuticular lining.

(e) This action functions mechanically as a grinding mill, crushing and pulverizing large soil blocks and tough organic fragments into fine particles.

(f) Fine grinding dramatically increases the overall surface area of the food mass, optimizing it for efficient chemical enzymatic hydrolysis downstream in the intestine.

Final Answer: Grinding of soil particles and organic debris

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept: Insect metamorphosis varies greatly across orders, dictated by the development pattern from egg to adult. Hemimetabolous (incomplete) metamorphosis skips the pupal stage, producing nymphs that occupy identical feeding niches as adults. Identifying these stages is crucial for managing destructive agricultural pests in field conditions.

Solution:

(a) Insects undergoing hemimetabolous development progress through three distinct life stages: egg, nymph, and sexually mature adult.

(b) The nymph is a juvenile form that closely mirrors the adult in structural organization, body symmetry, and feeding habits.

(c) Distinctly, nymphs completely lack functional wings, showing only small external wing pads that enlarge with successive molts.

(d) Nymphs also possess underdeveloped reproductive organs (gonads), making them completely sterile until their final ecdysis into adulthood.

(e) The desert locust (*Schistocerca gregaria*) belongs to the order Orthoptera and exemplifies this direct, hemimetabolous developmental pathway.

(f) Both locust adults and nymphs possess heavy, mandate-type chewing mouthparts, enabling them to cause massive, rapid defoliation of farm vegetation.

Final Answer: Order Orthoptera, represented by Schistocerca gregaria

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept: Phylum-level classification in veterinary medicine relies heavily on key morphological blueprints. Differentiating parasitic flatworms from roundworms or segmented worms requires assessing body flattening, the nature of the internal body cavity, and specialized cellular machinery dedicated to metabolic waste clearance.

Solution:

(a) Flatworms belonging to the Phylum Platyhelminthes show a classic dorsoventrally flattened body organization, giving them a ribbon-like or leaf-like appearance.

(b) They are triploblastic, bilaterally symmetrical metazoans that are completely acoelomate, meaning they lack any fluid-filled body cavity between the gut and body wall.

(c) Instead of a cavity, the internal space surrounding their organs is filled with a solid, spongy embryonic tissue called parenchyma.

(d) For osmoregulation and excretion, they utilize unique, specialized ciliated cells known as flame cells (protonephridia) to regulate fluid balance.

(e) The liver fluke (*Fasciola hepatica*) is a notable platyhelminth parasite that infests the bile ducts and livers of farm cattle.

(f) This infestation causes liver rot, resulting in severe veterinary illness, reduced milk yield, and critical economic loss for livestock farmers.

Final Answer: Platyhelminthes

Answer: (D)

Go Back to Question 3

Q4.

Solution

Concept: Animal epithelial tissues undergo precise structural modifications at their apical surfaces to fulfill specific physiological tasks. These microvilli and cilia specializations maximize functional output based on location, directly facilitating efficient absorption or coordinating unidirectional fluid propulsion.

Solution:

(a) Simple epithelium consists of a single layer of cells tailored primarily for absorption, secretion, filtration, and transport dynamics.

(b) In the proximal convoluted tubule (PCT) of nephrons, the cuboidal epithelium is heavily modified with a dense brush border of microvilli.

(c) These microvilli are cytoplasmic extensions that expand the apical surface area exponentially, maximizing the reabsorption of water, glucose, and essential ions.

(d) Conversely, the lining of the respiratory tract consists of specialized ciliated epithelium containing prominent, hair-like motile projections called cilia.

(e) These cilia exhibit continuous, synchronized, wave-like beating patterns that mechanically move mucus, trapped dust particles, and invading microbes outward away from the lungs.

(f) Both configurations represent vital structural variations of simple epithelium tailored to optimize localized metabolic and mechanical transport needs.

Final Answer: They are structural variations of simple epithelial tissue designed to maximize surface area and facilitate directional fluid movement respectively.

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept: The desert locust (*Schistocerca gregaria*) exhibits phase polymorphism, shifting behaviorally and morphologically between solitary and gregarious states. This dynamic mechanism allows low-density populations to reorganize into dense, highly coordinated, destructive swarms that threaten regional agricultural security.

Solution:

(a) Solitary locusts are localized, reclusive pests that avoid conspecifics and cause minimal, localized damage to agricultural fields.

(b) When ecological triggers favor sudden, widespread breeding, massive populations converge on limited, shrinking green vegetation zones.

(c) This high-density crowding forces constant physical contact, inducing continuous mechanical stimulation of the mechanoreceptors located on their hind legs.

(d) The frequent tactile stimulation of the hind femora triggers rapid mechanosensory neural signaling to the insect's central nervous system.

(e) This neural input drives an immediate surge in systemic serotonin levels, initiating a dramatic physiological and behavioral transformation.

(f) The insects rapidly alter their coloration, aggregate closely, display hyperactive flight tendencies, and launch destructive swarms.

Final Answer: Mechanical stimulation of the hind legs due to high population density crowding

Answer: (B)

Go Back to Question 5

Q6.

Solution

Concept: The compound eye of the cockroach (*Periplaneta americana*) is a complex visual apparatus composed of roughly 2,000 individual ommatidia. This multi-unit structure shifts its physiological imaging mechanisms dynamically to adapt to changing ambient light conditions throughout the diurnal cycle.

Solution:

(a) Each ommatidium acts as an independent sensory unit, capturing a minute fragment of the insect's surrounding visual field.

(b) During nocturnal hours or low-intensity illumination, the dark screening pigment granules within the iris and retinal cells migrate proximally.

(c) This pigment retraction uncovers the adjacent ommatidia, allowing light rays entering at oblique angles to cross over and stimulate neighboring rhabdomes.

(d) The resulting overlap of light rays creates a specialized compound image known biologically as a superposition image.

(e) This mechanism provides high light sensitivity, allowing the nocturnal insect to detect movement in dim environments.

(f) However, because light rays overlap heavily across units, the resulting mosaic image suffers from low clarity and poor resolution.

Final Answer: Superposition image, providing high sensitivity and low resolution

Answer: (C)

Go Back to Question 6

Q7.

Solution

Concept: Connective tissues are classified based on the nature of their extracellular matrix and the distribution of specialized cellular elements. Cartilage is a tough, specialized skeletal tissue designed to provide structural flexibility and smooth surfaces at articulating skeletal joints.

Solution:

(a) Cartilage features a firm, solid, yet resiliently pliable extracellular matrix dominated by complex chondroitin sulfate proteoglycan complexes.

(b) The specialized mature cells of this tissue, called chondrocytes, reside grouped within small fluid-filled cavities termed lacunae.

(c) Cartilage stands out because it lacks direct blood vessels, intrinsic nerve loops, or internal lymphatic drainage systems.

(d) Nutrition, oxygenation, and metabolic waste removal rely on passive diffusion through the surrounding fibrous connective sheath called the perichondrium.

(e) Hyaline cartilage is the most abundant type, characterized by a smooth, glassy matrix containing fine, unbundled collagen fibrils.

(f) It forms critical structural frameworks in the larynx, trachea, bronchial rings, and caps the articulating surfaces of long bones.

Final Answer: Hyaline cartilage

Answer: (B)

Go Back to Question 7

Q8.

Solution

Concept: The yellow stem borer (*Scirpophaga incertulas*) is a destructive monophagous pest of paddy crops. Managing this pest requires matching its characteristic field symptoms—such as "dead hearts" or "white ears"—with its specific larval feeding habits and life cycle stages.

Solution:

(a) The yellow stem borer undergoes complete, holometabolous metamorphosis involving four distinct stages: egg, larva, pupa, and adult moth.

(b) The adult female moth deposits her eggs in clusters on the apical leaf tips of young rice plants.

(c) Upon hatching, the young, highly active caterpillar larvae move down the plant and bore directly into the inner stem tissue.

(d) Inside the stem, the larvae feed continuously on the vascular bundles, completely severing the plant's internal nutrient and water transport lines.

(e) If this boring occurs during the reproductive stage, the panicles dry out completely, producing empty grain heads called "white ears."

(f) This larval boring behavior hidden inside the stem protects the pest from predators and complicates topical chemical pesticide applications.

Final Answer: Scirpophaga incertulas, showing holometabolous development

Answer: (A)

Go Back to Question 8

Q9.

Solution

Concept: Phylum Nematoda consists of unsegmented, unbranched pseudocoelomate roundworms that occupy diverse aquatic, terrestrial, and parasitic niches. Understanding their unique body plan helps researchers develop targeted pest control strategies for destructive root-knot nematodes in agricultural soils.

Solution:

(a) Nematodes are triploblastic, bilaterally symmetrical, elongated cylindrical worms that are completely devoid of true metameric segmentation.

(b) They possess a distinct body cavity termed a pseudocoelom, which develops directly from the embryonic blastocoel rather than the mesoderm.

(c) This pseudocoelom is filled with pressurized fluid that acts as a hydrostatic skeleton, supporting their characteristic thrashing locomotion.

(d) Their digestive system forms a complete tube running from mouth to anus, creating a classic "tube-within-a-tube" body plan.

(e) Plant-parasitic variants, like *Meloidogyne incognita*, use specialized mouth stylets to puncture root cells, injecting secretions that induce giant cell formation.

(f) These structural adaptations allow them to thrive as persistent parasites, disrupting vascular functions and causing severe economic crop loss.

Final Answer: Triploblastic body organization with a fluid-filled pseudocoelom derived from the blastocoel

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept: Earthworms lack specialized respiratory organs like lungs or gills. To survive in soil environments, they rely entirely on cutaneous respiration, which requires a highly adapted, complex integration of their outermost integumentary layers and underlying blood vessels.

Solution:

(a) The outer body wall of *Pheretima posthuma* is covered by a thin, non-cellular, highly permeable, transparent cuticle layer.

(b) Numerous epidermal mucous glands continuously secrete mucus onto this surface, keeping the skin wet, slimy, and glistening.

(c) Directly beneath this epidermis lies a rich, extensive network of microscopic sub-epidermal blood capillaries filled with hemoglobin-rich blood.

(d) Atmospheric oxygen dissolves readily into the external moisture film on the skin and diffuses inward across the thin cuticle.

(e) Once inside, the oxygen binds with hemoglobin dissolved in the plasma, while carbon dioxide diffuses outward down its concentration gradient.

(f) If the earthworm's skin dries out due to low soil moisture, gas exchange stops entirely, leading to rapid asphyxiation and death.

Final Answer: A thin, moist cuticle maintained by epidermal mucous glands, running parallel to an extensive network of sub-epidermal blood capillaries

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept: Termites are eusocial insects categorized under a rigid caste structure that governs colony operations. The creation of their macroscopic structures, known as mounds or termitaria, involves a highly specialized synthesis of environmental fragments and biological secretions processing through their digestive systems.

Solution:

(a) The subterranean termite (*Odontotermes obesus*) constructs structurally complex mounds engineered for ventilation and moisture regulation.

(b) This enormous construction task is performed exclusively by the sterile worker caste, which possesses optimized chewing mouthparts.

(c) Workers collect mineral soil particles, subsoil clay, and plant debris from their surrounding microenvironment.

(d) In their buccal cavities, they mix these soil elements with sticky saliva containing unique salivary proteins.

(e) This combination is further reinforced by pasting materials consisting of digested cellulose residues from their hindgut fluid.

(f) The resulting matrix dries into a resilient, mortar-like plaster that resists tropical rainfall and buffers internal temperature shifts.

Final Answer: Saliva-mixed excavated soil particles combined with their own fecal matter

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept: The digestive efficiency of an organism relies on maximizing internal surface areas where nutrient transport happens. The simple tube-like intestinal design of *Pheretima posthuma* implements a unique internal cellular modification to fulfill its intense metabolic demands without expanding body diameter.

Solution:

(a) The intestinal tract of the earthworm runs from segment 15 to the terminal anal opening as a relatively straight tube.

(b) Beginning at segment 26 and extending posteriorly up to the last 23 to 25 segments, a major anatomical modification occurs.

(c) The dorsal wall of the inner intestinal epithelium folds inward, forming a single, prominent median longitudinal ridge.

(d) This specific structural invagination is known as the typhlosole, which divides the luminal space of the digestive tract.

(e) Its presence significantly increases the effective internal surface area available for cellular secretion and nutrient absorption.

(f) This layout optimizes the extraction of scarce organic substances from the huge volume of mineral soil continuously moving through the gut.

Final Answer: It is an internal median fold of the dorsal wall of the intestine that significantly increases the effective area of absorption.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: Symbiotic interactions between micro-organisms and insects are fundamental to the field of economic entomology. Termites consume vast amounts of wood but cannot directly process complex plant structural proteins without specific mutualistic relationships established in their hindguts.

Solution:

(a) Termites swallow raw wood fragments containing heavy structures of cellulose and lignin that are highly resistant to standard animal enzymes.

(b) Their proctodaeal dilations harbor a massive population of specialized anaerobic flagellated protozoans like *Trichonympha*.

(c) These protozoans belong historically to the class Mastigophora, a grouping defined by one or more hair-like flagella.

(d) The flagellates engulf the wood particles via pseudopodia and secrete specialized cellulase and cellobiase enzymes.

(e) These enzymes break down the long-chain plant polymers into fermentable short-chain fatty acids that the insect can readily absorb.

(f) This obligate mutualism allows termites to act as premier nutrient recyclers in forest floors and major pests of wooden structures.

Final Answer: Mastigophora (Zooflagellates), such as Trichonympha

Answer: (A)

Go Back to Question 13

Q14.

Solution

Concept: The physiological activity of any specialized animal cell is directly supported by its underlying ultrastructural organelle composition. Secretory cells require high metabolic driving forces to synthesized products, package materials, and power active transport mechanisms across apical cell membranes.

Solution:

(a) Salivary gland cells in active insects produce immense quantities of digestive enzymes, lubrication proteins, and fluid secretions.

(b) This high rate of cellular synthesis and transport demands a continuous, heavy supply of metabolic energy.

(c) Mitochondria are double-membrane bound organelles that specialize in generating systemic energy in the form of adenosine triphosphate.

(d) The outer membrane regulates molecular entry, while the inner membrane folds into prominent shelves called cristae to expand working areas.

(e) These cristae house the multi-subunit complexes of the electron transport chain and ATP synthase assemblies.

(f) Through oxidative phosphorylation, these structures produce the required ATP molecules that sustain active cellular transport and continuous glandular secretion.

Final Answer: Generation of adenosine triphosphate (ATP) via the electron transport chain and oxidative phosphorylation

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept: The structural configuration of insect mouthparts dictates their feeding habits and the specific damage symptoms visible on crops. Identifying these piercing-sucking or chewing variations allows agricultural inspectors to diagnose field infestations even when the adult pests are absent.

Solution:

(a) The Gundhi bug (*Leptocorisa varicornis*) belongs to the order Hemiptera, which is characterized by specialized sucking structures.

(b) Its mouthparts are modified into a long, needle-like probiscus consisting of piercing stylets enclosed in a protective labial sheath.

(c) The insect targets paddy crops precisely during the milky stage, when young grains are filled with soft, liquid starch.

(d) It punctures the delicate glumes with its stylets and pumps in saliva to dissolve internal plant fluids.

(e) The pest then sucks out the rich sap, causing the grains to shrivel and turn into empty, white husks known as chaff.

(f) This feeding behavior leads to massive yield losses and emits a characteristic pungent odor across infested fields.

Final Answer: Piercing and sucking mouthparts; sucking of sap from the developing grains during the milky stage, turning them into empty white chaff

Answer: (B)

Go Back to Question 15

Q16.

Solution

Concept: Comparing invertebrates with vertebrates highlights distinct evolutionary strategies for nutrient and gas transport. The structural architecture of the insect circulatory system relies on a decentralized, open system, which contrasts with the high-pressure closed loops of vertebrates.

Solution:

(a) *Periplaneta americana* possesses a classic open vascular network where blood and interstitial fluids combine into a uniform hemolymph fluid.

(b) The primary pumping organ is a long, multi-chambered dorsal tubular heart running along the mid-dorsal line of the thorax and abdomen.

(c) This specialized muscular tube contains 13 individual funnel-shaped chambers, with each chamber communicating via paired lateral openings called ostia.

(d) The heart resides inside a dorsal pericardial sinus and contracts rhythmically to propel hemolymph forward into the cephalic sinuses.

(e) The fluid washes directly over internal visceral organs located within the perivisceral and perineural cavities without passing through capillaries.

(f) This open setup functions independently of oxygen transport, as gas exchange in insects relies instead on a localized tracheal pipe network.

Final Answer: It has a 13-chambered dorsal tubular heart located in the pericardial sinus, operating within an open circulatory system where blood flows through hemocoelic sinuses.

Answer: (A)

Go Back to Question 16

Q17.

Solution

Concept: Earthworms act as primary bioturbators, physically altering soil profiles through feeding and burrowing. This mechanical activity, combined with their digestive outputs, modifies the structure and chemical availability of elements in agricultural ecosystems.

Solution:

(a) Earthworms move through agricultural fields by swallowing soil and organic matter, creating extensive networks of subsurface tunnels.

(b) This continuous burrowing action loosens packed soil profiles, increasing total porosity and enhancing internal aeration and gas exchange.

(c) These physical channels also double the rate of water infiltration, minimizing surface runoff and preventing soil erosion during heavy rains.

(d) Inside their digestive tracts, soil mixes with intestinal enzymes, humic compounds, and beneficial microbes before being excreted as castings.

(e) These vermicastings are rich in plant-available forms of nitrogen, exchangeable potassium, calcium ions, and soluble phosphorus compounds.

(f) By converting complex organic matter into accessible forms, earthworms act as natural bio-fertilizers that optimize plant growth.

Final Answer: They burrow deep into the soil, which increases aeration, enhances water infiltration, and deposits vermicastings rich in exchangeable plant nutrients.

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept: Differentiating animal phyla requires examining diagnostic traits like body segmentation, locomotor structures, and excretory organs. A coelomate body plan with repeating internal and external structures is a defining hallmark of advanced segmented worms.

Solution:

(a) Phylum Annelida comprises triploblastic, bilaterally symmetrical invertebrates characterized by true metameric segmentation along their long axis.

(b) External rings called annuli align precisely with internal muscular septa, dividing the coelom into distinct repeating compartments.

(c) For movement, terrestrial annelids utilize specialized chitinous bristles known as setae, which are embedded in epidermal pits.

(d) Their vascular layout forms a high-pressure closed circulatory system where blood flows exclusively within specialized dorsal and ventral vessels.

(e) Excretion and fluid volume regulation are performed by metamerically repeated, coiled tubular structures called nephridia.

(f) These combined characteristics separate annelids from unsegmented roundworms or arthropods, which rely instead on a hard external exoskeleton.

Final Answer: Annelida

Answer: (C)

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Q19.

Solution

Concept: The red pumpkin beetle (*Aulacophora foveicollis*) is a destructive pest affecting agricultural crops in the family Cucurbitaceae. Effective pest management depends on identifying how its life stages feed on different parts of the host plant.

Solution:

(a) *Aulacophora foveicollis* undergoes a complete holometabolous life cycle featuring egg, larval grub, pupal, and adult beetle stages.

(b) The adult beetles feed on aerial parts of the crop, chewing holes in leaves and destroying young flowers.

(c) Meanwhile, the female beetle deposits her eggs in moist soil around the base of the host plant's stem.

(d) Upon hatching, the subterranean grubs live entirely in the soil and feed on underground plant structures.

(e) These grubs bore into roots and underground stems, disrupting vascular transport and causing the plant to wither and die.

(f) Since both the adult and larval stages feed aggressively on different parts of the plant, this pest causes severe damage to cucurbit fields.

Final Answer: Both adults and grubs cause damage; adults feed on the aerial leaves and flowers, while the subterranean grubs bore into roots and underground stems.

Answer: (B)

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Q20.

Solution

Concept: Excretory systems in terrestrial arthropods are adapted to conserve water while removing metabolic wastes. Malpighian tubules work closely with the hindgut to clear nitrogenous wastes without causing excessive fluid loss.

Solution:

(a) In *Periplaneta americana*, the Malpighian tubules form a cluster of about 100 to 150 fine, yellow, blind-ended threads.

(b) These structures are located at the junction where the midgut ends and the cuticular hindgut begins.

(c) The tubules float freely within the surrounding hemolymph, absorbing potassium urate, water, and metabolic wastes.

(d) Inside the tubule lumen, cells convert the absorbed potassium urate into water-insoluble uric acid crystals.

(e) This metabolic waste is then flushed directly into the hindgut alongside passing undigested food material.

(f) The rectal pads reabsorb remaining water and essential salts, allowing the insect to excrete dry uric acid and conserve water.

Final Answer: Located at the junction of the midgut and hindgut; they absorb nitrogenous wastes from the hemolymph and convert them into uric acid for excretion.

Answer: (B)

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Q21.

Solution

Concept: Functional physiology maps invertebrate cell groups to vertebrate organ complexes based on biochemical pathways. Metabolic storage, detoxification of integrated soil toxins, deamination of amino acids, and synthesis of urea or uric acid bridge equivalent processing pathways between distinct animal phyla.

Solution:

(a) Chloragogen cells, also known as y-cells, form a prominent yellow layer covering the outer intestinal wall and filling the coelom of *Pheretima posthuma*.

(b) These cells actively extract metabolic wastes from the coelomic fluid and blood, converting toxic ammonia into less harmful nitrogenous compounds.

(c) They break down proteins and deaminate amino acids, storing excess glycogen, lipids, and neutral fats inside their specialized cytoplasm.

(d) They synthesize urea from free metabolic derivatives and release it into the coelomic spaces for final excretion through the nephridia.

(e) Additionally, they absorb and isolate heavy metals, soil pesticides, and foreign chemical toxins to protect vital visceral organs.

(f) Because they manage intermediate metabolism, store nutrients, synthesize urea, and neutralize toxins, they function analogously to the vertebrate liver.

Final Answer: Liver

Answer: (B)

Go Back to Question 21

Q22.

Solution

Concept: Taxonomic diagnostics categorize farm pests based on structural innovations that support survival. A non-expanding outer covering paired with segmentally arranged structural appendages allows these animals to spread across diverse agricultural ecosystems.

Solution:

(a) Phylum Arthropoda represents the largest assemblage in the animal kingdom, containing critical agricultural vectors, crop pests, and soil organisms.

(b) The defining characteristic of this phylum is a dense, rigid outer exoskeleton composed of polymerized chitin cross-linked with structural proteins.

(c) This skeletal layer provides physical defense against field predators and acts as an impermeable barrier that prevents lethal dehydration.

(d) Because the rigid exoskeleton restricts continuous growth, animals must periodically shed and rebuild this layer through hormonal ecdysis.

(e) Their body plan features pairs of jointed appendages modified into specialized walking legs, sensory antennae, or feeding mouthparts.

(f) These structural traits allow arthropods to inhabit diverse agricultural niches, from deep field soil layers to open crop canopies.

Final Answer: Arthropoda

Answer: (C)

Go Back to Question 22

Q23.

Solution

Concept: Economic entomology classifies polyphagous field pests by tracking their life cycle stages and typical crop damage patterns. High metabolic needs during specific growth phases drive targeted damage to high-value reproductive parts of food crops.

Solution:

(a) The gram pod borer (*Helicoverpa armigera*) is a highly destructive polyphagous pest that targets pulses, cotton, cereals, and vegetable crops.

(b) This insect belongs to the order Lepidoptera, a group characterized by scale-covered wings in adults and complete holometabolous development.

(c) While the adult stage is a nocturnal moth that feeds on nectar, it causes no direct structural damage to farm crops.

(d) The damage is caused entirely by the active, chewing caterpillar larva after it hatches from eggs laid on foliage. The larva feeds on young leaves before boring into developing pods, seeds, or fruits to consume the internal tissues.

(e) It typically keeps its body outside while inserting its head into the bored hole, destroying multiple seed pods and causing massive yield losses.

Final Answer: Order Lepidoptera; damaging stage is the caterpillar larva

Answer: (B)

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Q24.

Solution

Concept: Reproductive biology in hermaphroditic annelids depends on specialized epidermal modifications that protect gametes during external fertilization. This process requires precise coordination between glandular secretions and the physical alignment of mating individuals.

Solution:

(a) In sexually mature specimens of *Pheretima posthuma*, the body wall forms a prominent, thick, dark-colored girdle of glandular tissue.

(b) This continuous structural modification is called the clitellum and covers segments 14, 15, and 16, obscuring external segmentation.

(c) The clitellar glands contain specialized cells that secrete nutrients and structural proteins during the earthworm's reproductive cycle.

(d) During mating, these glands produce a gelatinous fluid that hardens upon exposure to air, forming a flexible tube around the clitellum.

(e) As the earthworm slips backward out of this ring, it deposits its own mature eggs and stored foreign spermatozoa into the tube.

(f) The ends of the discarded tube elasticly seal to form a cocoon, protecting the developing embryos in the soil.

Final Answer: Segments 14, 15, and 16; responsible for secreting the cocoon matrix that encloses eggs and sperm for external fertilization

Answer: (B)

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Q25.

Solution

Concept: Insect reproductive adaptations include specialized mechanisms to protect fragile embryos from environmental stress and fungal pathogens. Glandular secretions work together to build protective structures that shield developing eggs over extended periods.

Solution:

(a) The female reproductive system of *Periplaneta americana* includes a pair of highly branched structures called collateral glands behind the ovaries.

(b) These glands secrete different structural proteins and phenolic compounds directly into the vestigial genital chamber.

(c) As fertilized eggs pass into the chamber, the secretions mix and undergo a chemical tanning process called sclerotization.

(d) This reaction forms a tough, dark reddish-brown, purse-shaped capsule called an ootheca around the eggs.

(e) The ootheca typically contains 16 individual eggs arranged vertically in two parallel rows of eight within the chamber walls.

(f) The female carries this capsule using her abdominal plates before cementing it in a warm, humid, hidden crevice near food sources.

Final Answer: Ootheca

Answer: (C)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	D	4	A	5	B
6	C	7	B	8	A	9	B	10	B
11	C	12	B	13	A	14	B	15	B
16	A	17	B	18	C	19	B	20	B
21	B	22	C	23	B	24	B	25	C