

UPCATET Agriculture Zoology Sample Paper-5

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. During a locust plague recession phase, environmental triggers cause solitary grasshoppers (*Schistocerca gregaria*) to transform into the dangerous gregarious phase. A research team isolates a specific neurochemical marker from the thoracic ganglia of crowding individuals. Which neurotransmitter surge is primarily responsible for inducing this rapid behavioral phase change and structural transformation?

- (A) Octopamine
- (B) Acetylcholine
- (C) GABA
- (D) Dopamine

Q2. The destructive subterranean termite *Odontotermes obesus* relies heavily on an obligate symbiotic relationship to break down structural plant polymers. Identify the specific micro-organism engine housed within their hindgut fermentation chamber that produces the vital cellulase enzymes.

- (A) Trichonympha
- (B) Termitomyces
- (C) Bacillus
- (D) Methanogens



- Q3.** An agricultural field inspection reveals severe physiological damage on a cotton crop. The economic pest responsible exhibits a specific incomplete hemimetabolous life cycle featuring piercing-sucking mouthparts, an asymmetrical head capsule, and a distinctive fringed-wing morphology. Identify this devastating crop-pest group:
- (A) Thrips
 - (B) Aphids
 - (C) Whiteflies
 - (D) Bollworms
- Q4.** A chemical ecologist analyzes the synthetic pathways of the Queen Mandibular Pheromone (QMP) in *Apis mellifera*. If a mutant queen fails to synthesize 9-oxodec-2-enoic acid (9-ODA), what immediate behavioral collapse occurs within the economic apiary colony layout?
- (A) Swarming
 - (B) Absconding
 - (C) Oogenesis
 - (D) Piping
- Q5.** The life cycle of the Polyphagous pest *Helicoverpa armigera* shows high resistance to chemical applications during a specific physiological transition. Identify the exact hormonal balance shift between Juvenile Hormone (JH) and Ecdysterone that triggers the final destructive pupal commitment stage in the larval hemolymph:
- (A) High JH
 - (B) Low JH
 - (C) High PTTH
 - (D) Low PTTH
- Q6.** A biological control layout map monitors the predatory interaction kinetics between an introduced parasitoid wasp and the sugarcane pyrilla (*Pyrilla*



perpusilla). Identify the specific internal life cycle stage of the host target where the parasitoid *Epiricania melanoleuca* deposits its eggs for maximum biocontrol efficiency:

- (A) Nymph
- (B) Egg
- (C) Pupa
- (D) Adult

Q7. An entomologist uses an electroantennogram to evaluate the response of the Red Pumpkin Beetle (*Aulacophora foveicollis*) to host plant volatiles. Which primary oxygenated tetracyclic triterpene compound emitted by damaged cucurbit leaves acts as the hyper-potent feeding arrestant for this pest?

- (A) Rotenone
- (B) Nicotine
- (C) Azadirachtin
- (D) Cucurbitacin

Q8. The metabolic maintenance of a subterranean termite mound (*Termitarium*) relies heavily on active atmospheric exchange channels. What physical parameter serves as the primary driver for the passive, wind-induced venturi forces that pull toxic carbon dioxide gas outward through the upper flue chimneys?

- (A) Humidity
- (B) Pressure
- (C) Magnetism
- (D) Gravity

Q9. The Rice Gundhi Bug (*Leptocorisa acuta*) inflicts severe qualitative damages to paddy fields during a critical crop phenological window. What is the precise crop stage during which the insertion of its stylet induces the characteristic chalky spot and empty grains?



- (A) Tillering
- (B) Milky
- (C) Heading
- (D) Nursery

Q10. The anatomical cross-section of the Indian earthworm *Pheretima posthuma* reveals a prominent internal dorsal fold projecting into the lumen of the intestine from the 26th to 35th segment. What is the vital physiological and agricultural role of this typhlosole structure?

- (A) Absorption
- (B) Digestion
- (C) Excretion
- (D) Circulation

Q11. In the reproductive loop of *Pheretima posthuma*, a researcher tracks the path of mature spermatozoa during cross-copulation. Identify the specific anatomical storage structure where foreign sperm is received and retained until cocoon formation occurs:

- (A) Spermathecae
- (B) Oviducts
- (C) Vas deferens
- (D) Prostate

Q12. Earthworms play a significant role in vermicomposting by transforming raw organic matrices into highly plant-available ionic forms. This chemical enrichment is heavily accelerated by which unique structural modification in the earthworm's esophagus?

- (A) Gizzard
- (B) Typhlosole
- (C) Calciferous



(D) Pharyngeal

Q13. The chloragogen cells (yellow cells) surrounding the intestinal wall of *Pheretima posthuma* perform biochemical actions analogous to which vertebrate organ system?

(A) Spleen

(B) Kidney

(C) Liver

(D) Pancreas

Q14. An analytical study maps the circulatory dynamics of the cockroach *Periplaneta americana*. The structural configuration of its open vascular system relies on thirteen Segmental Chambers. Identify the specific muscular mechanics that pull hemolymph inward from the perivisceral sinus into these heart chambers during diastole:

(A) Alary

(B) Dorsal

(C) Ventral

(D) Tergal

Q15. The endocrine network governing metamorphosis and ecdysis in *Periplaneta americana* is regulated by brain hormones. Identify the target source neurosecretory structure that directly releases the juvenile hormone (JH) to suppress adult characteristics during nymphal stages:

(A) Cardiac

(B) Allata

(C) Prothoracic

(D) Ganglion

Q16. The compound eye of *Periplaneta americana* is composed of roughly 2,000 independent optical units called ommatidia. During low-light dim nocturnal



conditions, what specific optical mechanism and image layout configuration allows the insect to navigate through dark farm storage units?

- (A) Apposition
- (B) Mosaic
- (C) Superposition
- (D) Refraction

Q17. A toxicologist measures the excretory output concentration of a cockroach population exposed to a new organic insecticide. Which specialized physiological structures embedded at the junction of the midgut and hindgut process toxic nitrogenous wastes into solid uric acid crystals?

- (A) Malpighian
- (B) Nephrocytes
- (C) Caeca
- (D) Fat body

Q18. An organic rice-fish farming layout is plagued by an outbreak of an unsegmented worm parasite. Upon microscopic evaluation, the organism shows a distinct pseudocoelomate architecture, a tough protective collagenous cuticle, and strict longitudinal muscle blocks. To which phylum does this farm organism belong?

- (A) Annelida
- (B) Nematoda
- (C) Nematomorpha
- (D) Rotifera

Q19. A biological assay team samples freshwater irrigation channels near a poultry layout and isolates a colonial macro-invertebrate organism. The specimen exhibits a unique polyp-medusa polymorphic life cycle displaying radial symmetry and specialized stinging cells. Identify this phylum:

- (A) Porifera



- (B) Ctenophora
- (C) Cnidaria
- (D) Bryozoa

Q20. The morphology of an ecologically vital soil macro-invertebrate group shows clear true metameric segmentation. Identify the specific Taxonomic Phylum that is uniquely defined by a coelomic cavity partitioned internally by intersegmental septa walls:

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

Q21. In farm aquaculture ponds, identifying vectors of trematode flukes is crucial. A target organism possesses a muscular foot, a dorsal visceral hump, a protective calcareous shell, and a unique rasping organ called the radula. This organism is classified under which class?

- (A) Gastropoda
- (B) Bivalvia
- (C) Cephalopoda
- (D) Amphineura

Q22. A veterinary diagnostician extracts an arthropod parasite from a dairy cow's ears. The organism possesses four pairs of walking limbs as an adult, lacks antennae entirely, and has a fused cephalothorax. Under which class should this vector pest be categorized?

- (A) Insecta
- (B) Crustacea
- (C) Arachnida
- (D) Chilopoda



- Q23.** The respiratory surface lining across the alveolar tracks of farm animals requires optimal gas exchange kinetics without structural mechanical friction. Which specialized epithelial tissue modification satisfies this biomechanical prerequisite through a single layer of highly flattened, scale-like cells?
- (A) Cuboidal
 - (B) Squamous
 - (C) Columnar
 - (D) Transitional
- Q24.** During a metabolic tracing study of cells in the bovine mammary gland tissue matrix, researchers map the transport pathway of newly synthesized secretory products. Which sub-cellular organelle is directly responsible for the biochemical modification, sorting, and packaging of proteins into membrane-bound secretory vesicles?
- (A) Golgi
 - (B) Ribosome
 - (C) Lysosome
 - (D) Nucleolus
- Q25.** The histological section of supportive connective tissue layer extracted from the articulation zones of farm livestock limbs reveals cells embedded inside lacunae spaces. Identify the designated structural matrix compound synthesized by these chondrocytes:
- (A) Chondrin
 - (B) Ossein
 - (C) Keratin
 - (D) Collagen



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

Concept: The phase transformation of the Desert Locust (*Schistocerca gregaria*) from the solitary phase (*phasis solitaria*) to the gregarious phase (*phasis gregaria*) is an environment-driven behavioral, physiological, and morphometric shift. This process is initiated by high population densities, where mechanical crowding triggers rapid neurochemical changes that alter the insect's behavior from mutual avoidance to swarming aggregation.

Solution:

Let's analyze the neurochemical changes that drive this rapid behavioral transformation:

- **Tactile Stimulation:** When locusts are forced into high-density conditions, mechanical stimulation of mechanoreceptors on their hind legs sends rapid neural signals to the central nervous system.
- **Neurochemical Surge:** This localized physical stimulation causes a rapid, massive spike in **serotonin** (5-hydroxytryptamine) within the thoracic ganglia.
- **Behavioral Shift:** The acute increase in serotonin acts as the primary biochemical switch. Within just 1 to 2 hours, it alters the locusts' behavior, replacing their natural solitary aversion to other locusts with gregarious, swarming characteristics. While other neurotransmitters like dopamine accumulate over longer periods to consolidate structural changes, serotonin alone initiates the rapid behavioral swarm. Note that although octopamine is involved in general flight and metabolic mobilization, it is not the primary trigger for the initial behavioral phase shift.

Final Answer: Serotonin

Answer: (A)

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Q2.

Solution

Concept: Wood-feeding termites like *Odontotermes obesus* ingest large quantities of tough, complex lignocellulose. Because they lack the endogenous genes necessary to produce high concentrations of lignocellulolytic enzymes, they rely on an obligate mutualistic relationship with specialized micro-organisms housed within an expanded, anaerobic section of their digestive tract.

Solution:

Let's look at the compartmentalization and symbiosis within the termite alimentary canal:

- **Digestive Path:** Ingested wood fragments pass through the foregut and midgut largely intact, as these upper regions lack the biochemical tools to digest complex structural plant polymers.
- **The Fermentation Pocket:** The anterior portion of the hindgut is modified into an expanded, thin-walled chamber known as the hindgut fermentation chamber (paunch).
- **Symbiotic Micro-environment:** This chamber maintains an anaerobic environment that houses millions of symbiotic flagellates, including species from the genus *Trichonympha*. These protozoans ingest the fine wood fibers via phagocytosis and use their own intracellular cellulases to ferment the cellulose into short-chain volatile fatty acids, which the termite absorbs for energy. Note that *Termitomyces* is an external fungus cultivated on combs, not an internal hindgut engine.

Final Answer:

Answer: (A)

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Q3.

Solution

Concept: Insect orders are systematically classified based on diagnostic anatomical traits, including mouthpart modifications, wing venation and structures, head symmetry, and the type of metamorphic development they undergo.

Solution:

Let's evaluate the structural features described to diagnose the specific insect group:

- **Head and Mouthparts:** The presence of piercing-sucking mouthparts forming a cone or beak, combined with a uniquely asymmetrical head capsule (where the left mandible is functional and the right is vestigial), is exclusive to the order Thysanoptera.
- **Wing Morphology:** The wings of these insects are narrow, lack complex venation, and are completely fringed with long hairs along the margins, which is the defining physical characteristic of the order.
- **Taxonomic Identification:** These specific morphological adaptations—asymmetrical mouthparts, fringed wings, and an intermediate hemimetabolous life cycle—confirm that this devastating crop-pest group belongs to the Thrips (*Thysanoptera*).

Final Answer:

Answer: (A)

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Q4.

Solution

Concept: The Queen Mandibular Pheromone (QMP) in the honeybee (*Apis mellifera*) is a complex chemical mixture that coordinates the social structure, reproductive division of labor, and behavioral layout of the hive. Its principal component, 9-oxodec-2-enoic acid (9-ODA), serves as a major chemical primer within the colony.

Solution:

Let's examine the physiological and behavioral consequences of a failure to synthesize 9-ODA:

- **Reproductive Control:** In a healthy colony, 9-ODA acts directly on worker bees via trophallaxis and grooming, suppressing the development of their ovaries and preventing them from laying unfertilized drone eggs.
- **Endocrine Suppression:** The chemical primer circulating through the hive signals the queen's presence and vigor, biochemically blocking the worker bees' endocrine pathways that lead to ****oogenesis**** (egg development).
- **Immediate Colony Collapse:** If a mutant queen cannot synthesize 9-ODA, this chemical primer is lost. As an immediate result, worker ovarian suppression ceases and active ****oogenesis**** begins among the worker population, disrupting the organized reproductive layout of the apiary.

Final Answer:

Answer: (C)

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Q5.

Solution

Concept: Insect molting and metamorphosis are orchestrated by the antagonistic balance between two primary endocrine secretions: Juvenile Hormone (JH), produced by the corpora allata, and Ecdysterone (20-hydroxyecdysone), produced by the prothoracic glands. The relative titers of these hormones in the hemolymph dictate the developmental direction of each molt.

Solution:

Let's trace the hormonal dynamics required for a larva to commit to the pupal transition:

- **Juvenile Hormone Role:** JH maintains the status quo of the insect, ensuring that molts result in another larval instar as long as its concentration remains high in the hemolymph.
- **Ecdysterone Role:** Ecdysterone acts as the prime driver of the molting process, triggering apolysis and the synthesis of a new cuticle.
- **Metamorphic Shift:** For the polyphagous pest *Helicoverpa armigera* to terminate its larval feeding phase and commit to pupation, the JH titer must drop below a critical threshold. Therefore, a **Low JH** environment in the presence of ecdysterone directs the tissues to undergo pupal differentiation.

Final Answer:

Answer: (B)

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Q6.

Solution

Concept: Biological control kinetics rely on the synchronized life histories of a host pest and its specialized parasitoid. The ectoparasitoid wasp *Epiricania melanoleuca* is a highly effective, host-specific biocontrol agent used to manage outbreaks of the Sugarcane Pyrilla (*Pyrilla perpusilla*).

Solution:

Let's analyze the target site and strategy used by *Epiricania melanoleuca* for oviposition:

- **Host Seeking:** Adult female parasitoid wasps seek out active populations of *Pyrilla perpusilla* within the sugarcane canopy.
- **Target Placement:** Rather than targeting eggs or hidden puparia, the female wasp deposits her eggs directly onto the external body of the active **nymph** or adult stages.
- **Parasitoid Development:** Although it is frequently found on both mobile stages, it acts primarily as a **nymph** and adult ectoparasitoid. Upon hatching, the tiny larvae attach themselves to the host's body, piercing the thin intersegmental membranes to feed on the hemolymph, eventually killing the host before spinning their cocoons.

Final Answer:

Answer: (A)

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Q7.

Solution

Concept: Phytophagous insects often exhibit specialized chemical ecology, where they utilize specific secondary metabolites produced by their host plants as olfactory cues or feeding stimulants. These chemical interactions guide host selection and trigger intense feeding behaviors.

Solution:

Let's identify the biochemical interaction between cucurbit crops and the Red Pumpkin Beetle (*Aulacophora foveicollis*):

- **Host Defense Compounds:** Plants of the family Cucurbitaceae produce a group of highly bitter, oxygenated tetracyclic triterpenes as a defense mechanism against generalist herbivores.
- **Pest Co-evolution:** The Red Pumpkin Beetle has co-evolved to tolerate and exploit these defense compounds. The specific molecule **Cucurbitacin** acts not as a deterrent, but as a potent kairomone and feeding arrestant for this beetle.
- **Behavioral Response:** When the beetle damages a leaf, the localized release of **Cucurbitacin** triggers an intense, compulsive feeding response, anchoring the beetle to the host plant to feed heavily on the tissue.

Final Answer:

Answer: (D)

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Q8.

Solution

Concept: The structural engineering of subterranean termite mounds (*Termitarium*) incorporates advanced ventilation mechanics to regulate core microclimates, providing homeostasis for the colony and fungal gardens. Passive gas exchange relies on aerodynamic principles that exploit ambient external fluid dynamics.

Solution:

Let's examine the physics of atmospheric ventilation inside the mound chimneys:

- **Aerodynamic Forces:** Wind blowing across the uneven structural contours of the termite mound moves faster over the top flues than near the base.
- **Venturi Effect:** According to Bernoulli's principle, an increase in fluid velocity corresponds to a simultaneous decrease in **pressure**. This creates a low-pressure zone at the apex of the chimney.
- **Passive Exhaust:** The resulting differential **pressure** gradients generate venturi forces that passively draw stale, carbon dioxide-rich air upward from the deep nest chambers and out into the environment, drawing fresh oxygenated air inward through porous outer walls.

Final Answer:

Answer: (B)

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Q9.

Solution

Concept: The Rice Gundhi Bug (*Leptocorisa acuta*) damages rice crops during a specific phenological phase of the panicle. Its piercing-sucking mouthparts pierce the developing grain, extracting nutrients and introducing secondary symptoms that drastically lower crop quality and yield.

Solution:

Let's identify the specific crop growth stage susceptible to this feeding damage:

- **Feeding Target:** The Gundhi Bug requires soft, accessible plant fluids. It cannot pierce fully hardened, mature rice grains, nor does it derive sufficient nutrients from vegetative leaves during tillering.
- **The Milky Window:** The insect synchronizes its peak population activity with the ****milky**** ripening stage of the paddy crop, when the developing grains are filled with a soft, white, starch-rich liquid.
- **Pathology:** The bug inserts its stylets into these tender grains to suck out the milky sap. This fluid extraction leaves the grains completely empty or causes characteristic dark, chalky spots around the puncture site, resulting in wind-blown chaffy ears.

Final Answer:

Answer: (B)

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Q10.

Solution

Concept: The alimentary canal of the Indian earthworm *Pheretima posthuma* features structural adaptations designed to maximize nutrient extraction from poor food sources like soil and decayed organic matter. The internal architecture of the post-clitellar intestine is heavily modified to optimize digestion.

Solution:

Let's analyze the function of the internal intestinal fold (typhlosole) in *Pheretima*:

- **Anatomical Structure:** Starting from the 26th segment and continuing backward, the dorsal wall of the intestine projects inward to form a prominent, longitudinal fold called the **typhlosole**.
- **Surface Area Extension:** The primary physiological role of the typhlosole is to expand the internal surface area of the intestinal epithelium without increasing the outer diameter of the worm.
- **Agricultural Efficiency:** Because earthworms ingest large volumes of nutrient-poor soil, this expanded surface area ensures a high concentration of absorptive cells are available to process and assimilate organic molecules, directly increasing **absorption** efficiency.

Final Answer: Absorption

Answer: (A)

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Q11.

Solution

Concept: Earthworms are hermaphroditic animals that reproduce exclusively via cross-fertilization. During mating, two individuals align in opposite directions to exchange spermatozoa, which are stored in specialized anatomical structures until cocoon formation takes place.

Solution:

Let's locate the exact sperm-receiving organs within the anatomy of *Pheretima posthuma*:

- **Organ Identity:** The specific structures responsible for receiving and storing foreign sperm during copulation are the **spermathecae**.
- **Segmental Location:** *Pheretima posthuma* possesses four pairs of spermathecae located in segments 6, 7, 8, and 9. Each pair opens externally via spermathecal pores situated in the intersegmental grooves.
- **Functional Timeline:** During cross-copulation, mature sperm from one worm enter the spermathecal pores of the partner worm and are retained safely within the **spermathecae**. They remain stored here until the clitellum secretes a mucous cocoon, at which point the stored foreign sperm are released into the capsule to fertilize the eggs.

Final Answer: Spermathecae

Answer: (A)

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Q12.

Solution

Concept: Earthworms ingest large quantities of soil containing decayed organic leaf matter, which is often rich in acidic humic compounds. To maintain optimal conditions for digestive enzymes and prevent systemic acidosis, the earthworm's digestive tract contains specialized excretory organs that balance the pH of the food slurry.

Solution:

Let's identify the anatomical location and role of these specialized structures within the gut of *Pheretima posthuma*:

- **Organ Identity:** The structures responsible for this neutralizing process are the **calciferous** glands, which develop as vascularized, glandular pockets within the esophageal wall.
- **Segmental Location:** These glands are located within the 9th to 14th segments of the earthworm's alimentary canal.
- **Physiological Action:** The **calciferous** glands extract excess calcium and carbonate ions from the blood and secrete them as calcium carbonate (CaCO_3) crystals into the gut lumen. This alkaline secretion neutralizes the acidic humic acids in the swallowed soil, normalizing the pH before the material enters the intestine for enzyme processing.

Final Answer:

Answer: (C)

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Q13.

Solution

Concept: The coelomic fluid and tissues of *Pheretima posthuma* contain specialized cells that manage intermediary metabolism, nutrient storage, and excretion. These cells process metabolic byproducts and circulate within the coelom or sit around the gut wall.

Solution:

Let's analyze the functions of chloragogen cells and find their vertebrate analog:

- **Anatomical Location:** Chloragogen cells (yellow cells) form a distinct layer surrounding the outer surface of the intestinal wall and dorsal blood vessel in earthworms.
- **Biochemical Functions:** These cells extract waste products from the blood and coelomic fluid, carrying out deamination of amino acids and synthesizing urea. Additionally, they serve as primary storage sites for glycogen and lipids.
- **Vertebrate Analog:** Because they handle glycogen synthesis, fat storage, deamination, and waste processing, chloragogen cells perform biochemical roles directly analogous to the vertebrate ****liver****.

Final Answer:

Answer: (C)

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Q14.

Solution

Concept: The cockroach *Periplaneta americana* has an open circulatory system where hemolymph flows freely through tissue spaces (sinuses) before returning to a dorsal, tubular heart. The heart is divided into thirteen segmental chambers, and its rhythmic pumping relies on specialized, paired muscles attached to the pericardial septum.

Solution:

Let's examine the muscular mechanics that regulate the filling phase (diastole) of the cockroach heart:

- **Muscular Architecture:** There are twelve pairs of fan-shaped **alary** muscles arranged segmentally, with their broad ends attached to the pericardial septum and narrow ends attached to the tergal sclerites.
- **Diastole Mechanics:** During the expansion phase (diastole), the contraction of **alary** muscles pulls the pericardial septum downward. This structural movement expands the pericardial sinus, dropping the internal pressure.
- **Hemolymph Flow:** This pressure drop forces hemolymph to rush inward from the lower perivisceral sinus into the heart chambers through lateral, valve-like openings called ostia.

Final Answer: Alary

Answer: (A)

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Q15.

Solution

Concept: The endocrine coordination governing metamorphosis and ecdysis in insects relies on a cascade of hormonal transformations. Specialized neural and endocrine structures located behind the brain capsule manage the synthesis and release of regulators that suppress or promote maturation traits.

Solution:

Let's trace the source of Juvenile Hormone (JH) in *Periplaneta americana*:

- **Endocrine Gland Identity:** The **corpora allata** (singular: corpus allatum) are a pair of small glandular bodies located behind the brain, closely associated with the corpora cardiaca.
- **Hormonal Release:** The cells of the corpora **allata** are responsible for synthesizing and releasing Juvenile Hormone into the hemolymph.
- **Physiological Role:** During nymphal stages, high titers of JH suppress adult characteristics and prevent premature metamorphosis, ensuring that the insect undergoes status quo molts until it reaches structural maturity.

Final Answer: Allata

Answer: (B)

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Q16.

Solution

Concept: The compound eye of the cockroach *Periplaneta americana* is composed of roughly 2,000 independent optical units called ommatidia. The insect adapts its visual processing mechanics depending on ambient light levels, switching between distinct image-forming configurations.

Solution:

Let's analyze the optical adjustments that occur within the ommatidia under dim, nocturnal conditions:

- **Pigment Migration:** In low-light environments, the dark iris and retinal pigment sheaths surrounding each ommatidium retract toward the top and bottom.
- **Light Overlap:** This retraction allows light rays entering adjacent ommatidia to pass through the thin boundaries and converge onto a single receptor cell (rhabdom).
- **Image Configuration:** This optical mechanism produces a **superposition** image layout. While this layout reduces image sharpness (creating a blurred mosaic), it significantly maximizes light sensitivity, allowing the nocturnal cockroach to detect movement and navigate in near-total darkness.

Final Answer:

Answer: (C)

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Q17.

Solution

Concept: The cockroach *Periplaneta americana* maintains its water and ionic balance through specialized excretory organs linked to its digestive tract. These organs absorb metabolic wastes from the surrounding hemolymph and convert them into solid nitrogenous crystals to minimize water loss.

Solution:

Let's identify the physiological structures responsible for this excretory pathway:

- **Anatomical Location:** At the junction where the midgut joins the hindgut, there is a ring of about 100–150 fine, yellow, thread-like tubules called **Malpighian Tubules**.
- **Excretory Mechanism:** The outer walls of these tubules are bathed directly in hemolymph. They actively extract potassium urate, water, and carbon dioxide from the body fluid.
- **Uric Acid Crystallization:** Inside the tubule lumen, potassium urate is converted into insoluble uric acid crystals. These solid crystals are then flushed into the hindgut and excreted along with feces, allowing the insect to conserve water efficiently.

Final Answer: Malpighian

Answer: (A)

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Q18.

Solution

Concept: Worm-like invertebrates are classified into separate phyla based on unique combinations of structural traits, such as body cavity architecture, muscle arrangement, cuticle composition, and motion patterns.

Solution:

Let's evaluate the structural traits of the unsegmented parasite:

- **Body Cavity Layout:** The presence of a pseudocoelomate architecture (a fluid-filled cavity not lined with mesoderm) rules out acoelomate flatworms and coelomate annelids.
- **Body Wall and Cuticle:** The worm is unsegmented and covered by a tough, flexible, collagenous cuticle that undergoes ecdysis. Its body wall contains strict longitudinal muscle blocks, lacking circular muscles entirely.
- **Phylum Diagnosis:** These diagnostic features—a pseudocoelom, a non-cellular collagenous cuticle, and exclusive longitudinal muscle configurations—confirm the organism belongs exclusively to the phylum **Nematoda**.

Final Answer: Nematoda

Answer: (B)

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Q19.

Solution

Concept: Invertebrate phyla are characterized by diagnostic cellular and structural adaptations. Aquatic organisms that exhibit a polymorphic life cycle, radial symmetry, and specialized stinging structures belong to a single major phylum.

Solution:

Let's evaluate the anatomical traits of the isolated macro-invertebrate:

- **Symmetry and Organization:** The specimen exhibits radial symmetry and a tissue-level cellular organization, which rules out asymmetric poriferans and bilaterally symmetrical flatworms.
- **Diagnostic Cellular Adaptations:** The defining trait of this phylum is the presence of specialized stinging cells called **cnidocytes** (containing nematocysts), which are used to paralyze prey or deter predators.
- **Phylum Diagnosis:** This cellular adaptation, combined with a polymorphic life cycle that alternates between a sessile polyp and a mobile medusa, confirms that the organism belongs to the phylum **Cnidaria**.

Final Answer:

Answer: (C)

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Q20.

Solution

Concept: The structural definitions of major coelomate phyla specify the exact layout of internal partitioning. True segmentation requires both external rings and internal muscular walls that separate individual metabolic compartments.

Solution:

Let's evaluate the structural traits defining true metamerism:

- **Segmental Boundaries:** A coelomic cavity that is structurally divided internally by intersegmental septa walls is the diagnostic feature of metameric segmentation.
- **Comparative Morphology:** While Arthropoda displays segmentation, their internal coelom is highly reduced to a hemocoel without sequential septal dividers.
- **Phylum Diagnosis:** The phylum **Annelida** is uniquely defined by this strict configuration, where each true segment contains repeated excretory (nephridia), nervous, and circulatory structures isolated by transverse septa.

Final Answer:

Answer: (D)

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Q21.

Solution

Concept: The phylum Mollusca is divided into distinct classes based on modifications of the foot, the shell, and the arrangement of respiratory structures. Freshwater snails serve as intermediate hosts for trematode flukes, and they belong to a single major class.

Solution:

Let's look at the anatomical traits that define this mollusk class:

- **Body Configuration:** The presence of a broad, muscular crawling foot, a dorsal visceral hump, and a protective univalve calcareous shell secreted by the mantle layer are key characteristics of this group.
- **Feeding Structure:** They feature a specialized rasping organ called a radula, lined with chitinous teeth to scrape algae or plant tissue.
- **Class Diagnosis:** Because these freshwater snail vectors undergo torsion during development—resulting in an asymmetrical body plan and a single, spirally coiled shell—they are classified under the class **Gastropoda**.

Final Answer:

Answer: (A)

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Q22.

Solution

Concept: The phylum Arthropoda is divided into subphyla and classes based on structural variations, such as body tagmosis, the presence or absence of antennae, and the total number of walking limbs.

Solution:

Let's evaluate the anatomical traits of the extracted livestock parasite:

- **Appendage Layout:** The presence of four pairs of jointed walking limbs (eight legs total) in the adult stage distinguishes this parasite from insects, which possess three pairs of legs.
- **Tagmosis and Appendages:** The parasite lacks antennae entirely and features a fused head and thorax forming a cephalothorax. Its primary feeding mouthparts are modified into chelicerae and pedipalps.
- **Taxonomic Classification:** These diagnostic physical traits place the parasite (a tick or mite vector) within the class **Arachnida** and subphylum Chelicerata.

Final Answer:

Answer: (C)

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Q23.

Solution

Concept: Epithelial tissues are structurally modified to match the biomechanical and physiological requirements of their location. Areas specialized for rapid diffusion and gas exchange require an ultra-thin barrier to minimize the diffusion distance across membranes.

Solution:

Let's evaluate epithelial tissue structures to find the best configuration for gas exchange:

- **Diffusion Barriers:** Thick, multi-layered layouts or tall cell configurations are unsuited for gas exchange because their thick cell profiles slow down passive transport.
- **The Minimalist Design:** The alveolar tracks of the lungs require a tissue architecture that allows oxygen and carbon dioxide to diffuse rapidly.
- **Tissue Identity:** This biomechanical requirement is satisfied by a single layer of highly flattened, scale-like cells, which defines **squamous** epithelium (specifically simple squamous epithelium), providing a minimal barrier that maximizes passive gas diffusion.

Final Answer:

Answer: (B)

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Q24.

Solution

Concept: Secretory epithelial cells in glandular tissues synthesize and release complex proteins and glycoproteins. This pathway relies on a coordinated network of internal organelles that manage the synthesis, chemical modification, and delivery of these molecules.

Solution:

Let's trace the intracellular pathway of a secretory protein through the cell's organelle network:

- **Initial Assembly:** Polypeptide chains are first synthesized by ribosomes on the surface of the rough endoplasmic reticulum and folded within its lumen.
- **Chemical Refinement:** These immature proteins are packaged into transport vesicles and delivered to the **Golgi** apparatus complex.
- **Processing and Delivery:** The **Golgi** apparatus acts as the central processing and sorting station of the cell. Inside its cisternae, enzymes carry out post-translational modifications and sort the finished products into membrane-bound secretory vesicles for release.

Final Answer:

Answer: (A)

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Q25.

Solution

Concept: The specialized extracellular matrix of supportive connective tissues dictates their relative flexibility and load-bearing properties. Specialized cells (chondrocytes) produce the organic ground substance that fills the space within lacunae zones.

Solution:

Let's analyze the biochemical layout of mature cartilage tissue:

- **Cell Matrix Layout:** The presence of cells embedded inside isolated cavities (**lacunae**) within an extensive extracellular matrix is characteristic of cartilage.
- **Ground Substance Biochemistry:** The clear, elastic ground substance that forms the structural matrix of cartilage consists primarily of a specialized glycoprotein complex known as **chondrin**.
- **Comparative Histology:** While collagen fibers reinforce this matrix, the primary structural ground substance compound synthesized by chondrocytes is **chondrin**. (In comparison, ossein forms bone matrix, and keratin is a filament protein).

Final Answer:

Answer: (A)

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Answer Key

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

