

UPCATET Agriculture Zoology Sample Paper-6

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. Among the invertebrate phyla, members of Echinodermata possess a unique combination of radial symmetry as adults, bilateral symmetry larvae, and a distinctive water-vascular system. Which of the following statements accurately describes the phylogenetic significance of these characters in the context of deuterostome evolution?

- (A) Echinoderms are protostomes closely related to mollusks due to similar larval ciliary bands
- (B) Echinoderms are deuterostomes with secondary radial symmetry in adults, sharing embryonic bilateral ancestry with chordates, placing them within the deuterostome clade
- (C) Echinoderms lack coeloms entirely and are more primitive than cnidarians
- (D) Echinoderms possess a segmented body plan identical to annelids derived from a common trunk ancestor

Q2. The larval stages of parasitic *Ascaris lumbricoides* (human roundworm) migrate through the lungs before returning to the intestine. What is the physiological significance of this pulmonary migratory phase in the parasite's life cycle?

- (A) Larvae destroy lung tissue to obtain oxygen for aerobic respiration competence in intestinal adults



- (B) Complete waste of evolutionary resources with no adaptive significance whatsoever
- (C) Larvae undergo final molting and somatic growth necessary to reach species-specific size thresholds required for reproductive
- (D) Parasites intentionally damage hosts to prevent immune system development

Q3. The sugarcane top borer (*Chilo sacchariphagus*) causes severe damage by boring into young sugarcane shoots, creating characteristic dead heart symptoms in field crops. Under what ecological conditions does the population density of this pest reach economically damaging levels?

- (A) Monoculture sugarcane cultivation without crop rotation eliminates natural enemy habitats and permits unchecked pest population growth through reduced intraspecific competition for preferred host plants
- (B) In field conditions with high plant diversity and extensive natural enemy populations
- (C) Only during extreme cold temperatures preventing development
- (D) Exclusively in laboratory culture without any natural field occurrence

Q4. Myelin, the insulating sheath surrounding axons in vertebrate neurons, represents a specialized cell membrane modification. Which cellular process is fundamentally enhanced by myelin's electrical insulation properties?

- (A) Saltatory conduction, where action potentials jump between Nodes of Ranvier, dramatically accelerating nerve impulse conduction velocity compared to unmyelinated axons
- (B) Slowing of nerve impulse conduction to enable safer information processing
- (C) Protein synthesis exclusively in myelinated axons
- (D) Elimination of all ion channel activity in covered regions

Q5. The rice hispid beetle (*Dicladispa armigera*) inflicts serious damage on rice seedlings through adult feeding on leaf surfaces and larval boring in leaf tissues. What specific behavioral and physiological triggers regulate the population



transition from overwintering diapause to spring emergence and crop infestation?

- (A) Random emergence timing with no environmental determination
- (B) Temperature-mediated reactivation of metabolic processes coupled with photoperiod-triggered suppression of diapause hormone (prothoracicotropic hormone, PTTH) secretion, initiating ecdysone synthesis and termination of dormancy
- (C) Permanent immobility throughout the entire year independent of seasonal cues
- (D) Emergence exclusively during rainy seasons regardless of temperature

Q6. The circulatory system of mollusks (particularly in *Octopus vulgaris*, the octopus) differs fundamentally from the closed circulatory system of vertebrates. Which statement best characterizes molluscan circulatory physiology and its constraints on oxygen delivery?

- (A) Open circulatory system with hemolymph bathing tissues in sinuses; hemocyanin (copper-based oxygen carrier) provides lower oxygen-carrying capacity than vertebrate hemoglobin, limiting aerobic metabolic rates
- (B) Identical closed system with hemoglobin identical to all vertebrates
- (C) Complete absence of respiratory pigments relying purely on diffusion
- (D) Hemolymph circulating exclusively in the nervous system without nutrient delivery capability

Q7. The rice gall midge (*Orseolia oryzae*) causes characteristic stem gall formation through larval secretion of growth-regulating substances that induce abnormal plant cell proliferation. What is the molecular nature of the larval secretions triggering plant tissue remodeling?

- (A) Purely physical boring action without chemical signaling
- (B) Secretion of acids that melt plant tissues
- (C) Larval enzymes identical to plant enzymes with no modulatory effect



(D) Larval secretions containing plant hormone analogs (particularly auxin mimics and cytokinin-like compounds) that disrupt normal plant developmental signaling, triggering uncontrolled cell division and gall formation

Q8. Muscle tissue, classified histologically as a contractile tissue, demonstrates remarkable specialization across body regions. Which statement accurately characterizes the ultrastructural basis for differential contraction speeds across muscle fiber types?

(A) Slow-twitch muscle fibers possess higher myosin ATPase activity and larger glycolytic enzyme quantities; fast-twitch fibers show high oxidative capacity with abundant mitochondria enabling sustained aerobic metabolism

(B) All muscle fibers are identical ultrastructurally with contraction speed purely determined by neural input frequency

(C) Muscle fiber types are determined by absolute muscle size alone

(D) Contraction speed is inversely proportional to mitochondrial density

Q9. The cotton ball weevil (*Anthonomus grandis*) invades cotton bolls during fruit development, severely reducing yield through larval tissue destruction and secondary pathogen invasion. How does the female beetle locate host cotton plants from considerable distances, and what chemical signals guide her oviposition site selection?

(A) Random wandering with no directional host-seeking behavior

(B) Long-range olfactory attraction to cotton-specific volatile organic compounds (particularly aromatic alcohols and aldehydes) detected through antennal chemoreceptors; close-range tactile and gustatory assessment of boll susceptibility through mouthpart chemoreceptors guides precise oviposition site selection

(C) Attraction exclusively to cotton fiber color without chemical involvement

(D) Reliance on vertebrate animals to transport them to cotton plants

Q10. The circulatory hemolymph of insects (*Bombyx mori* larvae) contains multiple hemocyte types (plasmatocytes, granulocytes, oenocytoids) performing distinct



immune and metabolic functions. What is the primary physiological role of granulocytes in the context of parasite defense?

- (A) Nodulation: aggregation around parasites forming multilayered melanized capsules that encapsulate and isolate foreign organisms from internal tissues and prevent nutrient/oxygen diffusion to enclosed pathogens
- (B) Exclusive food digestion without immune involvement
- (C) Lipid storage exclusively for energy reserves
- (D) Oxygen transportation identical to vertebrate red blood cells

Q11. The potato leafhopper (*Empoasca fabae*) transmits aster yellows phytoplasma to hosts through salivary secretion during prolonged feeding. What aspect of this vector-pathogen interaction demonstrates the biological concept of *incompetence* when other leafhopper species fail to transmit the same pathogen?

- (A) All leafhoppers are equally competent vectors by default
- (B) Non-vectors deliberately refuse to transmit known pathogens
- (C) Non-vector leafhopper species lack the specific salivary protein or receptor enabling phytoplasma acquisition from phloem or efficient salivary secretion into plant tissues during feeding, demonstrating host-pathogen incompatibility
- (D) Transmission competence is determined by plant species alone without insect involvement

Q12. In cnidarians like sea anemones (*Anemonia sulcata*), gastrodermal cells lining the coelenteron possess numerous symbiotic dinoflagellate zooxanthellae within intracellular vacuoles. What is the physiological advantage of this endosymbiotic arrangement for the host cnidarian?

- (A) Zooxanthellae photosynthetically produce carbohydrates and oxygen that are translocated to host tissues, supplementing heterotrophic nutrition and enabling survival in nutrient-poor tropical waters through autotrophic supplementation



- (B) Zooxanthellae exclusively consume nutrients without providing benefits
- (C) Chlorophyll in zooxanthellae poisons the anemone
- (D) Symbiosis occurs only in freshwater anemones not in marine species

Q13. The brinjal shootfly (*Ophiomyia phlogis*) larvae mine within brinjal stems during early growth stages, disrupting vascular transport and causing severe plant stunting. Which integrated pest management (IPM) strategy exploits the pest's specific life history and ecological requirements for sustainable suppression?

- (A) Exclusively relying on broad-spectrum organophosphate pesticides regardless of non-target effects
- (B) Deployment of resistant brinjal varieties preventing larval establishment, combined with crop sanitation removing infested plant debris harboring overwintering larvae, and release of parasitoid wasps (*Opius* species) attacking eggs and first-instar larvae
- (C) Allowing pest populations to reach maximum abundance before any control attempt
- (D) Monoculture intensification increasing pest pressure year-round

Q14. The cashew stem and root borer (*Hypocryphalus manihot*) is a serious wood-boring pest causing extensive internal damage while externally appearing normal. What physiological adaptation permits this boring beetle to survive within anoxic (oxygen-free) wood tissue for extended periods?

- (A) Anaerobic metabolic pathways (lactate fermentation, succinate production) coupled with associative symbiotic wood-degrading microbes providing fermentable sugars from cellulose; elevated catalase and alcohol dehydrogenase activity tolerating ethanol accumulation from fermentation
- (B) Pure aerobic respiration identical to non-boring insects
- (C) Photosynthetic capability enabling glucose synthesis from light
- (D) Bacterial symbiosis providing oxygen synthesis capability

Q15. The planarian flatworm (*Dugesia tigrina*) exhibits remarkable regenerative



capability, regrowing entire organisms from body fragments. What is the molecular mechanism enabling this extraordinary regenerative plasticity?

- (A) Complete inability to regenerate after any injury
- (B) Regeneration occurs exclusively through pure cell division without patterning mechanisms
- (C) External parasites drive regeneration without internal molecular mechanisms
- (D) Pluripotent neoblast stem cells throughout the body with Wnt/Notch signaling pathways determining positional identity; wounded tissue reactivates patterning genes establishing new body axis polarity and regenerating missing structures

Q16. The safflower aphid (*Dactynotus carthami*) exhibits cyclical parthenogenesis with seasonal alternation between asexual (clonal) and sexual reproductive stages. What environmental trigger switches reproduction from asexual to sexual production of overwintering eggs?

- (A) Declining photoperiod (shortened day length) triggers male production and sexual reproduction through suppression of juvenile hormone synthesis, enabling high fitness genetic recombination in eggs capable of surviving winter dormancy
- (B) Constant asexual reproduction throughout the entire year
- (C) Random switching between reproductive modes with no environmental determination
- (D) Exclusively sexual reproduction with no asexual phase

Q17. The zoological classification of Phylum Chordata includes not only vertebrates (Subphylum Vertebrata) but also simpler organisms like sea squirts (*Ascidia*) and amphioxus (**Branchiostoma**). What diagnostic feature unites these diverse members and defines their placement within Chordata?

- (A) Exclusive possession of backbones and jaws
- (B) Presence of four-chambered hearts in all members



- (C) Possession of a notochord (an axial stiffening rod), dorsal hollow nerve cord, pharyngeal gill slits, and post-anal tail at some developmental stage; the notochord is retained throughout life in protochordates but replaced by vertebrae in vertebrates
- (D) Exclusively aquatic habitat in all chordates

Q18. The cabbage butterfly caterpillar (*Pieris brassicae*) undergoes diapause as a chrysalis overwintering stage. The environmental signal terminating diapause involves both temperature and photoperiod perception. How does temperature influence diapause termination during overwinter?

- (A) Exposure to extended chilling (vernalization) at low temperatures activates cold-responsive transcription factors that reduce diapause hormone levels and increase ecdysone sensitivity, enabling spring emergence when temperatures warm above threshold temperatures
- (B) Temperature has no influence on diapause termination whatsoever
- (C) Continuous warmth maintains permanent diapause indefinitely
- (D) Diapause termination occurs exclusively in darkness without temperature involvement

Q19. The sweet potato weevil (*Cylas formicarius*) infests sweet potato tubers, transmitting bacterial pathogens and reducing storage shelf-life through larval tunneling. What combination of morphological and behavioral characters distinguishes this pest from related weevil species infesting different host plants?

- (A) Morphological specialization (elongated snout with pronounced sexual dimorphism; modified front legs with specialized sensory organs) coupled with strong behavioral host fidelity for *Ipomoea* species and avoidance of non-host plants through volatile-mediated olfactory discrimination
- (B) Complete morphological identity with all weevil species
- (C) Inability to discriminate between host and non-host plants
- (D) Exclusively parasitic lifestyle without any plant-feeding stage

Q20. Bone tissue in vertebrates undergoes continuous remodeling through coordinated



osteoblast-mediated bone synthesis and osteoclast-mediated resorption. Which regulatory molecule orchestrates the coupling of these opposed processes during skeletal homeostasis?

- (A) Bone remodeling occurs without any molecular regulation
- (B) Osteoblasts and osteoclasts work independently without coordination
- (C) Receptor activator of nuclear factor kappa B ligand (RANKL) binds to RANK receptors on osteoclast precursors, promoting differentiation and activation; simultaneously, osteoblasts secrete osteoprotegerin (OPG) acting as a decoy RANKL receptor limiting osteoclastogenesis, maintaining bone mass balance
- (D) Growth hormone exclusively controls bone remodeling

Q21. The hessian fly (*Mayetiola destructor*) undergoes incomplete metamorphosis infesting wheat and barley crops throughout grain development. What is the specific developmental stage of the crop most vulnerable to hessian fly infestation, and what plant structures does the larva parasitize?

- (A) Mature grain stage exclusively without seedling vulnerability
- (B) Whorl stage: larvae feed within the innermost developing leaf whorl as endoparasites of leaf tissues, causing chlorosis and necrosis of growing tissues; subsequent larval-induced plant hormone disruption stunts shoot development creating characteristic stunting with dead tillers
- (C) Root tissues exclusively with no aerial part involvement
- (D) Infestation only occurs during flowering stage

Q22. Phylum Platyhelminthes includes parasitic species like *Opisthorchis viverrini* (liver fluke) alongside free-living planarians. What fundamental anatomical distinction reflects the dietary specialization and ecological role of parasitic versus free-living members?

- (A) Parasitic flukes possess suckers/hooks for host attachment, highly branched reproductive systems producing enormous gamete quantities, and reduced nervous/sensory systems reflecting simplified lifestyle within host tissues;



free-living planarians exhibit elaborate nervous systems with prominent eyes and extensive sensory specialization

- (B) Identical anatomy across all platyhelminth species
- (C) Free-living planarians possess more suckers than parasitic flukes
- (D) Parasites have larger brains than free-living species

Q23. The mealy bug (*Maconellicoccus hirsutus*) severely infests passion fruit vines through cryptic feeding on roots and aerial plant parts via its piercing-sucking mouthparts. What is the primary mechanism by which this soft-bodied insect evades natural predators while feeding exposed on plant surfaces?

- (A) Absence of any defensive mechanisms relying purely on speed for escape
- (B) Toxin production identical to plants without separate insect synthesis
- (C) Underground-exclusive existence preventing any predator encounter
- (D) Production of dense waxy coating (mealy covering) providing chemical and tactile deterrence to predators; coupled with secretion of sweet honeydew that attracts ant mutualists protecting the colony from predators through active defense behavior

Q24. The flea (*Xenopsylla cheopis*) exhibits extraordinary jumping capability (body lengths exceeding 50 times its body length) enabling it to locate hosts and transmit plague pathogens (*Yersinia pestis*). What ultrastructural modification of the exoskeleton enables this remarkable jumping performance?

- (A) Specialized pleural arch regions with resilin (elastic protein) undergoing rapid elastic recoil after muscular contraction, storing and releasing mechanical energy enabling explosive leg extension and propulsion exceeding normal muscular force output alone
- (B) Muscular strength identical to non-jumping insects
- (C) Hollow legs containing air sacs for buoyancy
- (D) Pneumatic systems providing thrust identical to bird wings

Q25. The armyworm complex (*Spodoptera* species) demonstrates facultative diapause phenotypes where individuals can either pupate immediately (subitaneous



development) or enter diapause (dormancy) depending on environmental cues. Which environmental factor is the primary predictor of diapause probability in laboratory populations?

- (A) Photoperiod length: short photoperiods trigger diapause hormone (diapause peptide hormone) secretion from neurosecretory cells via optic lobe photoreceptor pathways, suppressing juvenile hormone synthesis and permitting diapause entry independent of temperature
- (B) Temperature alone without photoperiod involvement
- (C) Random individual variation with no environmental determination
- (D) Larval food plant species determining all individuals identically



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

Concept: Evolutionary systematics classifies organisms based on shared ancestral characters. Echinoderms present an apparent paradox: radial adult symmetry coupled with bilateral larval organization. Understanding this requires examining embryological development and phylogenetic relationships.

Solution:

- (a) Echinoderms develop from bilateral embryos showing typical deuterostome characteristics: radial cleavage, blastopore becomes anus, enterocoelous coelom formation.
- (b) Adult echinoderms acquire radial symmetry through secondary reorganization from the bilateral larval body plan.
- (c) The water-vascular system is a unique hydraulic transport network using coelomic fluid for locomotion and feeding.
- (d) Larval ciliary bands and bilateral organization indicate ancient bilateral ancestry shared with chordates.
- (e) Molecular phylogenetic analysis confirms echinoderms and chordates share a recent common ancestor within Deuterostomia.
- (f) This secondary radial symmetry represents evolutionary specialization, not primitive simplicity.
- (g) The combination of deuterostome development, bilateral larval stages, and shared molecular characters unequivocally places echinoderms within Deuterostomia.

Final Answer: Echinoderms are deuterostomes with secondary radial symmetry in adults, sharing embryonic bilateral ancestry with chordates, placing them within the deuterostome clade

Answer: (B)

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Q2.

Solution

Concept: Parasitic nematodes undergo complex developmental migrations through multiple host organs. This life cycle organization reflects adaptive responses to host physiology and immune mechanisms.

Solution:

- (a) Infective *Ascaris* larvae are consumed with contaminated food, penetrate intestinal epithelium, and enter blood capillaries.
- (b) Larvae circulate through portal circulation to the liver, then through the right heart to lung capillaries.
- (c) In the lungs, larvae undergo their third and fourth molts (essential developmental stages) requiring approximately 1-2 weeks.
- (d) Lung migration permits growth to intermediate body sizes necessary for reproductive competence.
- (e) Larvae then break through alveolar walls into alveolar spaces, migrate up the trachea, and are swallowed.
- (f) They return to the small intestine where they mature into reproductively competent adults.
- (g) Without this pulmonary growth phase, larvae would remain too small for reproduction in intestinal adults.
- (h) This migration also permits the parasite to evade initial intestinal immune responses through temporal displacement.

Final Answer: Larvae undergo final molting and somatic growth necessary to reach species-specific size thresholds required for reproductive competence in intestinal adults

Answer: (C)

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Q3.

Solution

Concept: Pest population growth is regulated by availability of host plants and densities of natural enemies. Agricultural practices dramatically alter these ecological factors, favoring pest increase.

Solution:

- (a) Monoculture sugarcane cultivation involves planting vast areas with a single crop genotype.
- (b) This eliminates flowering plants supporting parasitoid and predator populations.
- (c) Without alternate hosts, natural enemy populations collapse in the absence of sugarcane infestation.
- (d) Simultaneously, monoculture provides unlimited host plant availability, eliminating density-dependent resource competition.
- (e) Each female *Chilo* can oviposit on numerous sugarcane shoots without host plant limitation.
- (f) The combination of unlimited hosts plus minimal natural enemies creates conditions for exponential pest population growth.
- (g) Economic damage occurs when pest density exceeds the threshold where crop losses exceed pesticide costs.
- (h) Monoculture also eliminates spatial refugia where pest populations could be controlled by landscape heterogeneity.

Final Answer: Monoculture sugarcane cultivation without crop rotation eliminates natural enemy habitats and permits unchecked pest population growth through reduced intraspecific competition for preferred host plants

Answer: (A)

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Q4.

Solution

Concept: Myelin wraps around axons in a helical pattern, insulating the axon from surrounding extracellular space. This insulation has profound consequences for electrical signaling properties.

Solution:

- (a) Myelinated axons have action potentials confined to unmyelinated nodes (Nodes of Ranvier) spaced approximately 1 millimeter apart.
- (b) Between nodes, the myelin sheath prevents ion flow across the axonal membrane, eliminating local currents in myelinated regions.
- (c) This forces action potentials to propagate by jumping between nodes through internodal passive conduction.
- (d) Saltatory (jumping) conduction eliminates the time-consuming process of action potential regeneration along the entire axon length.
- (e) Conduction velocity increases approximately 100-fold in myelinated versus unmyelinated fibers of equivalent diameter.
- (f) This high conduction velocity enables rapid sensory perception and motor control essential for complex behaviors.
- (g) The energy expenditure for maintaining ion gradients is also reduced since active ion pump activity is concentrated at nodes.
- (h) This represents an elegant evolutionary solution trading local conduction for dramatic functional improvement.

Final Answer: Saltatory conduction, where action potentials jump between Nodes of Ranvier, dramatically accelerating nerve impulse conduction velocity compared to unmyelinated axons

Answer: (A)

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Q5.

Solution

Concept: Diapause in insects is a hormonally-controlled dormancy where metabolism is suppressed and development is arrested. Termination requires specific environmental signals overriding diapause hormone suppression.

Solution:

- (a) During diapause, neurosecretory cells in the brain suppress PTTH (prothoracicotropic hormone) release.
- (b) Without PTTH stimulation, the prothoracic glands cease ecdysone synthesis, permitting developmental arrest.
- (c) Spring temperature increase alone does not terminate diapause without photoperiod change.
- (d) As day length increases in spring, optic lobe photoreceptors detect the lengthening photoperiod.
- (e) Photoperiod information is integrated in clock neuron circuits, eventually suppressing diapause hormone synthesis.
- (f) As diapause hormone levels decline, PTTH secretion resumes from the pars intercerebralis.
- (g) Restored PTTH stimulates the prothoracic glands to synthesize ecdysone.
- (h) Ecdysone rising titers override diapause-maintaining mechanisms, initiating development and metamorphosis.
- (i) This temperature-photoperiod interaction ensures emergence timing matches spring conditions optimal for larval feeding.

Final Answer: Temperature-mediated reactivation of metabolic processes coupled with photoperiod-triggered suppression of diapause hormone (prothoracicotropic hormone, PTTH) secretion, initiating ecdysone synthesis and termination of dormancy

Answer: (B)

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Q6.

Solution

Concept: Open and closed circulatory systems represent distinct evolutionary solutions to oxygen delivery. The choice of respiratory pigment and circulatory organization profoundly affects metabolic capacity.

Solution:

- (a) Mollusks possess open circulatory systems where hemolymph flows from the heart into tissue sinuses without capillary networks.
- (b) Oxygen transport relies on hemocyanin, a copper-based protein with lower oxygen affinity and reduced oxygen-carrying capacity versus hemoglobin.
- (c) Hemocyanin carries approximately 0.5 millimoles O₂ per liter hemolymph versus 10 millimoles for hemoglobin.
- (d) Lower oxygen delivery rates limit aerobic metabolic rates in mollusks compared to vertebrates.
- (e) *Octopus* species exhibit high metabolic demands for rapid movement and cognition, partially compensated by branchial (gill) oxygen extraction efficiency.
- (f) The open system allows direct contact of hemolymph with tissues, enabling rapid diffusion of oxygen in exposed tissues.
- (g) However, low oxygen tension gradients necessitate efficient oxygen extraction by tissue respiration machinery.

Final Answer: Open circulatory system with hemolymph bathing tissues in sinuses; hemocyanin (copper-based oxygen carrier) provides lower oxygen-carrying capacity than vertebrate hemoglobin, limiting aerobic metabolic rates

Answer: (A)

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Q7.

Solution

Concept: Plant tissues normally maintain strict developmental programs controlling cell division and morphology. Parasitic insects disrupt these programs through secreted hormonal analogs.

Solution:

- (a) Rice gall midge larvae reside within plant tissue and secrete compounds into surrounding plant cells.
- (b) These secretions include auxin analogs (resembling indole-3-acetic acid) and cytokinin-like compounds.
- (c) Auxins normally suppress lateral bud growth; midge-secreted auxin analogs hyperactivate these pathways in localized tissues.
- (d) Simultaneously, cytokinin-like compounds promote cell division in targeted tissues.
- (e) The combined auxin/cytokinin distortion of the normal hormone balance triggers uncontrolled cell division.
- (f) This manifests as characteristic gall structures: abnormal swollen stem tissues with distorted internal anatomy.
- (g) The gall provides shelter, protection, and nutrition for developing midge larvae.
- (h) This represents a sophisticated hijacking of plant developmental signaling, enabling the parasite to create a "pathogen-induced" structure.

Final Answer: Larval secretions containing plant hormone analogs (particularly auxin mimics and cytokinin-like compounds) that disrupt normal plant developmental signaling, triggering uncontrolled cell division and gall formation

Answer: (D)

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Q8.

Solution

Concept: Muscle fibers display remarkable heterogeneity reflecting distinct physiological roles. This heterogeneity is fundamentally rooted in ultrastructural enzyme compositions and metabolic capabilities.

Solution:

- (a) Slow-twitch (Type I) fibers contain low myosin ATPase activity, producing slow but powerful contractions.
- (b) Fast-twitch (Type II) fibers contain high myosin ATPase activity, producing rapid weak contractions.
- (c) However, this characterization is incomplete without considering oxidative capacity.
- (d) Fast-twitch oxidative fibers contain abundant mitochondria with high concentrations of cytochrome oxidase and other oxidative enzymes.
- (e) These fibers maintain aerobic metabolism during sustained activity, relying on fatty acid oxidation.
- (f) Fast-twitch glycolytic fibers contain few mitochondria and high concentrations of glycolytic enzymes (phosphofructokinase, lactate dehydrogenase).
- (g) These fibers rapidly generate ATP through anaerobic glycolysis, producing lactate under intense activity.
- (h) Slow-twitch oxidative fibers contain abundant mitochondria and high myoglobin concentrations, enabling sustained aerobic oxidation.
- (i) The ultrastructural enzyme content fundamentally determines contraction speed and metabolic capacity independent of neural control.

Final Answer: Fast-twitch muscle fibers possess higher myosin ATPase activity and larger glycolytic enzyme quantities; fast-twitch fibers show high oxidative capacity with abundant mitochondria enabling sustained aerobic metabolism

Answer: (A)

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Q9.

Solution

Concept: Insect herbivores employ multi-sensory systems for host location, utilizing volatile chemical cues at distance and contact chemicals at short range for precise oviposition.

Solution:

- (a) Cotton weevils detect cotton volatiles from considerable distances through antennal olfactory receptors.
- (b) Key attractive volatiles include benzaldehyde, phenylacetaldehyde, and various aromatic compounds characteristic of cotton buds.
- (c) These compounds diffuse through the atmosphere, providing directional cues via antennal detection gradients.
- (d) Females fly upwind following increasing concentration gradients toward cotton plants.
- (e) Upon plant contact, tactile stimulation of leg tarsi and antennae provides information about plant structure.
- (f) Mouthpart chemoreceptors (sensilla on the proboscis) taste plant surface chemistry, discriminating cotton from non-host plants.
- (g) Specific cotton seed maturation volatiles (particularly methyl esters and alcohols) are detected during close contact with developing bolls.
- (h) Females insert their rostrums between boll sepals, sampling internal chemistry before oviposition.
- (i) Internal boll chemistry (presence of specific sugars and amino acids) determines whether oviposition occurs.
- (j) This hierarchical sensory system (long-range olfaction → plant contact → chemical assessment) ensures efficient host-finding and precise oviposition.

Final Answer: Long-range olfactory attraction to cotton-specific volatile organic compounds (particularly aromatic alcohols and aldehydes) detected through antennal chemoreceptors; close-range tactile and gustatory assessment of boll susceptibility through mouthpart chemoreceptors guides precise oviposition site selection

Answer: (B)

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Q10.

Solution

Concept: Insect hemocytes represent an invertebrate immune system performing functions analogous to vertebrate leukocytes. Different hemocyte types specialize in distinct immune mechanisms.

Solution:

- (a) Granulocytes contain granular inclusions of antimicrobial peptides and phenoloxidase enzyme complexes.
- (b) Upon parasite detection, granulocytes aggregate around foreign organisms, binding to parasite surface molecules.
- (c) Multiple hemocytes cluster around the parasite, forming a spherical nodule.
- (d) This nodule is rapidly melanized through phenoloxidase-catalyzed conversion of tyrosine to melanin.
- (e) Melanization creates an impermeable, hardened capsule around the parasite.
- (f) This encapsulation prevents oxygen and nutrient diffusion to the enclosed organism.
- (g) The melanized capsule also prevents parasite secretion products from reaching host tissues.
- (h) Antimicrobial peptides concentrated within the nodule directly kill enclosed pathogens through membrane disruption.
- (i) The nodulation response is particularly effective against larger parasites (parasitoid wasp eggs, nematodes) that cannot be phagocytosed individually.
- (j) Granulocytes recognize parasite-associated molecular patterns through pattern recognition receptors, triggering cascading immune responses.

Final Answer: Nodulation: aggregation around parasites forming multilayered melanized capsules that encapsulate and isolate foreign organisms from internal tissues and prevent nutrient/oxygen diffusion to enclosed pathogens

Answer: (A)

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Q11.

Solution

Concept: Vector competence for disease transmission requires specific molecular interactions between vector and pathogen. Incompetence can arise from barriers to acquisition, replication, or transmission.

Solution:

- (a) Vector competence requires successful pathogen acquisition from phloem during feeding.
- (b) Phytoplasmas must traverse the leafhopper midgut epithelium and reach the salivary glands.
- (c) Non-vector leafhopper species may lack specific midgut receptors enabling phytoplasma binding and entry.
- (d) Without midgut receptor expression, phytoplasmas cannot penetrate the epithelium and reach internal tissues.
- (e) Additionally, non-vectors may lack specific salivary gland proteins enabling phytoplasma accumulation in saliva.
- (f) Competent vectors express specific salivary proteins (particularly fibronectin-like molecules) facilitating phytoplasma secretion.
- (g) Non-vectors may possess salivary antimicrobial factors inhibiting phytoplasma viability.
- (h) Some non-vectors possess genetic regions preventing phytoplasma multiplication inside the insect.
- (i) These molecular incompatibilities represent host-pathogen specificity at the cellular level.
- (j) Incompetence reflects the specific molecular evolution of pathogen-vector interactions.

Final Answer: Non-vector leafhopper species lack the specific salivary protein or receptor enabling phytoplasma acquisition from phloem or efficient salivary secretion into plant tissues during feeding, demonstrating host-pathogen incompatibility

Answer: (C)

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Q12.

Solution

Concept: Endosymbiotic relationships exploit symbiotic partner capabilities to enable growth in otherwise inhospitable environments. Algal symbiosis provides photosynthetic capacity to heterotrophic hosts.

Solution:

- (a) Tropical coral reef environments are paradoxically nutrient-poor despite high productivity.
- (b) Anemones feeding exclusively through predation cannot obtain sufficient nitrogen and phosphorus from sparse zooplankton.
- (c) Symbiotic zooxanthellae (dinoflagellate algae) photosynthetically produce organic compounds from CO₂.
- (d) These carbohydrates are translocated to host anemone tissues, supplementing heterotrophic nutrition.
- (e) Photosynthetic oxygen production by zooxanthellae enables higher respiration rates in the host.
- (f) The algae benefit by residing within host tissues, receiving protection from grazers.
- (g) The host provides nitrogen and phosphorus obtained through predatory feeding, supporting algal growth.
- (h) This mutualistic arrangement enables anemone survival in nutrient-poor tropical waters.
- (i) The partnership is so obligate that anemones bleach (lose symbiont algae) and die when temperature exceeds optimal ranges.

Final Answer: Zooxanthellae photosynthetically produce carbohydrates and oxygen that are translocated to host tissues, supplementing heterotrophic nutrition and enabling survival in nutrient-poor tropical waters through autotrophic supplementation

Answer: (A)

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Q13.

Solution

Concept: Integrated pest management (IPM) combines multiple control tactics exploiting pest life history and ecology. Success requires detailed knowledge of pest development, host preferences, and natural enemies.

Solution:

- (a) Brinjal shoot fly larvae mine within developing leaves during the seedling stage.
- (b) Host plant resistance in certain brinjal varieties prevents larval establishment through constitutive chemical defenses.
- (c) Resistant varieties reduce pest population growth rates, decreasing overall infestation pressure.
- (d) Crop sanitation removes infested plant debris harboring overwintering pupae.
- (e) Without overwintering refuge, pest populations decline significantly each season.
- (f) Parasitoid wasps (*Opius* species) attack eggs and first-instar larvae before they enter protected leaf tissue.
- (g) Parasitoid release programs supplement natural biological control.
- (h) The combination of varietal resistance + sanitation + parasitoids creates multi-layered suppression.
- (i) This IPM approach reduces pesticide applications, lowering costs and environmental contamination.
- (j) Sustainable yield suppression results from synergistic interaction of multiple tactics.

Final Answer: Deployment of resistant brinjal varieties preventing larval establishment, combined with crop sanitation removing infested plant debris harboring overwintering larvae, and release of parasitoid wasps (*Opius* species) attacking eggs and first-instar larvae

Answer: (B)

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Q14.

Solution

Concept: Wood is a complex, nutrient-poor substrate resistant to decomposition. Boring insects accessing internal wood tissues face severe oxygen limitation and require specialized metabolic adaptations.

Solution:

- (a) Wood tissues within beetle galleries become anoxic (oxygen-free) due to limited diffusion of atmospheric oxygen.
- (b) Normal aerobic respiration is impossible in anoxic environments.
- (c) Boring beetles maintain anaerobic metabolic pathways enabling ATP synthesis without oxygen.
- (d) Lactate fermentation and ethanol fermentation produce limited ATP from glucose.
- (e) Succinate production provides an alternative anaerobic pathway yielding ATP via succinate dehydrogenase.
- (f) The beetle's associated wood-degrading bacterial and fungal symbionts provide essential nutrients.
- (g) These microbes produce cellulases breaking down wood cellulose into fermentable glucose.
- (h) Elevated catalase and alcohol dehydrogenase activity protects the beetle from ethanol accumulation (toxic at high concentrations).
- (i) The combination of anaerobic metabolism + microbial support enables survival in wood tissue.
- (j) Some boring beetle species possess hemocyanin-like compounds improving limited oxygen capture.

Final Answer: Anaerobic metabolic pathways (lactate fermentation, succinate production) coupled with associative symbiotic wood-degrading microbes providing fermentable sugars from cellulose; elevated catalase and alcohol dehydrogenase activity tolerating ethanol accumulation from fermentation

Answer: (A)

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Q15.

Solution

Concept: Planarians exemplify extraordinary regenerative capacity, regrowing entire organisms from small fragments. This capability reflects a sophisticated developmental patterning system guided by molecular gradients.

Solution:

- (a) Planarians maintain populations of pluripotent neoblast stem cells distributed throughout body tissues.
- (b) These cells can differentiate into any cell type (neurons, muscle, pharynx, etc.).
- (c) Wnt signaling pathway genes express differentially along the anterior-posterior axis.
- (d) Wnt ligands establish morphogenetic gradients: high Wnt at posterior; low Wnt at anterior.
- (e) Wnt signaling suppresses anterior-specific genes (like *head*) through beta-catenin inhibition at the posterior.
- (f) Notch signaling reciprocally suppresses posterior-specific genes at the anterior.
- (g) When a planarian is cut transversely, wound-induced signaling resets the Wnt/Notch gradients in remaining fragments.
- (h) Neoblasts sense these gradients and differentiate appropriately for the fragment's position.
- (i) Anterior wounds lose Wnt signal, permitting anterior genes to activate, forming a new head.
- (j) Posterior wounds lose Notch signal, permitting posterior genes to activate, forming a new tail.
- (k) This elegant system ensures body axis polarity is restored in regenerating fragments.

Final Answer: Pluripotent neoblast stem cells throughout the body with Wnt/Notch signaling pathways determining positional identity; wounded tissue reactivates patterning genes establishing new body axis polarity and regenerating missing structures

Answer: (D)

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Q16.

Solution

Concept: Cyclical parthenogenesis permits rapid population growth under favorable conditions while preserving genetic diversity through periodic sexual reproduction. Environmental signals switch reproduction strategy.

Solution:

- (a) Under long-day photoperiods (summer), aphids reproduce asexually through parthenogenesis.
- (b) Clonal reproduction produces genetically identical daughters, enabling rapid population expansion.
- (c) Each female can produce 5-12 clonal daughters daily without mate investment.
- (d) As photoperiod shortens in autumn, neurosecretory cells detect the declining day length through optic lobe circuits.
- (e) Short-day photoperiod signals trigger suppression of juvenile hormone (JH) synthesis.
- (f) JH suppression permits ecdysone signaling to proceed, triggering sex determination in developing embryos.
- (g) Males appear for the first time in the season, alongside sexual females.
- (h) Sexual females and males mate, producing fertilized eggs.
- (i) These overwintering eggs are resistant to freezing and desiccation, surviving harsh winter conditions.
- (j) Upon spring warming and photoperiod lengthening, these eggs hatch into asexual females, restarting the cycle.
- (k) This strategy maximizes reproductive output during favorable seasons while ensuring survival during harsh winters.

Final Answer: Declining photoperiod (shortened day length) triggers male production and sexual reproduction through suppression of juvenile hormone synthesis, enabling high fitness genetic recombination in eggs capable of surviving winter dormancy

Answer: (A)

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Q17.

Solution

Concept: Phylum Chordata encompasses vast diversity from microscopic lancelets to enormous whales. Despite this diversity, all chordates share fundamental developmental characters defining the phylum.

Solution:

- (a) The notochord is a rod-like elastic structure composed of turgid notochordal cells arranged longitudinally.
- (b) It provides structural support without being as rigid as bone.
- (c) In protochordates (amphioxus, sea squirts), the notochord persists throughout life.
- (d) In vertebrates, the notochord becomes partially incorporated into the nucleus pulposus (central portion of intervertebral discs) and is replaced by vertebrae.
- (e) The dorsal hollow nerve cord lies dorsal to the notochord, derived from ectoderm.
- (f) Pharyngeal gill slits represent openings from the pharynx to the exterior, used in filter feeding.
- (g) In fish, these slits house gills for respiratory water exchange.
- (h) In land vertebrates, gill slits appear embryonically but are modified into non-respiratory structures.
- (i) The post-anal tail is a muscular extension posterior to the anus, used for propulsion.
- (j) These four characters unite all chordates and distinguish them from non-chordates.

Final Answer: Possession of a notochord (an axial stiffening rod), dorsal hollow nerve cord, pharyngeal gill slits, and post-anal tail at some developmental stage; the notochord is retained throughout life in protochordates but replaced by vertebrae in vertebrates

Answer: (C)

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Q18.

Solution

Concept: Diapause termination requires integration of multiple environmental signals. Temperature and photoperiod interact to permit diapause exit when conditions favor emergence.

Solution:

- (a) Cabbage butterfly pupae enter diapause in autumn as an overwintering strategy.
- (b) Diapause involves suppression of PTTH synthesis, preventing ecdysone production.
- (c) Winter temperatures (near 0°C) provide extended chilling (vernalization) critical for diapause termination.
- (d) Cold exposure activates cold-responsive transcription factors in neurosecretory cells.
- (e) These transcription factors reduce expression of diapause hormone genes, permitting PTTH synthesis to resume.
- (f) However, temperature alone is insufficient; simultaneously, spring photoperiod lengthening occurs.
- (g) Extended daylight duration is detected through optic lobe circuits.
- (h) Photoperiod-sensing clock neurons further suppress diapause hormone production, amplifying PTTH signaling.
- (i) This photoperiod+temperature integration ensures emergence only when both spring signals are present.
- (j) A warm day in winter without photoperiod lengthening does not trigger emergence.
- (k) Only when both temperature warms AND photoperiod lengthens does consistent diapause termination occur.
- (l) This ensures emergence timing matches spring conditions optimal for caterpillar feeding on young cabbage leaves.

Final Answer: Exposure to extended chilling (vernalization) at low temperatures activates cold-responsive transcription factors that reduce diapause hormone levels and increase ecdysone sensitivity, enabling spring emergence when temperatures warm above threshold temperatures

Answer: (A)

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Q19.

Solution

Concept: Host specificity in herbivorous insects reflects both morphological and behavioral evolution. Sensory system specialization enables discrimination between host and non-host plants.

Solution:

- (a) Sweet potato weevils possess an elongated snout (rostrum) specialized for accessing small cavities in tubers.
- (b) Sexual dimorphism includes females with longer, more precisely-tapered rostrums enabling tuber insertion.
- (c) Front legs possess modified adhesive pads and sensory hairs detecting sweet potato tuber surface chemistry.
- (d) These legs are substantially modified from those of related weevil species.
- (e) Antennal receptor diversity differs from non-host-specific weevils, with specialized receptors for Ipomoea-specific volatiles.
- (f) Host plant detection begins with long-range olfactory attraction to Ipomoea-specific volatile blends.
- (g) Key attractive volatiles include compounds specific to sweet potato storage root tissues and decaying tubers.
- (h) Non-host weevils fail to respond to these volatiles due to absent or low-affinity olfactory receptors.
- (i) Upon contact with potential hosts, females use labial and maxillary palp chemoreceptors for surface chemistry discrimination.
- (j) Sweet potato tubers contain specific alkaloids and secondary metabolites recognized only by sweet potato weevil chemoreceptors.
- (k) This morphological and behavioral specialization ensures host-specific colonization.

Final Answer: Morphological specialization (elongated snout with pronounced sexual dimorphism; modified front legs with specialized sensory organs) coupled with strong behavioral host fidelity for Ipomoea species and avoidance of non-host plants through volatile-mediated olfactory discrimination

Answer: (A)

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Q20.

Solution

Concept: Bone remodeling is a coordinated process where bone resorption and synthesis are tightly coupled. This coordination is mediated by paracrine signaling between osteoblasts and osteoclasts.

Solution:

- (a) RANKL (receptor activator of nuclear factor kappa B ligand) is secreted by osteoblasts.
- (b) RANKL binds to RANK receptors on osteoclast precursor cells.
- (c) RANK-RANKL binding initiates osteoclast differentiation from monocyte/macrophage precursors.
- (d) Activated osteoclasts attach to bone surfaces and create a sealed compartment (resorption lacuna).
- (e) Within this sealed space, osteoclasts secrete hydrogen ions and protease enzymes dissolving mineral and organic bone matrix.
- (f) Simultaneously, osteoblasts secrete osteoprotegerin (OPG), a decoy receptor for RANKL.
- (g) OPG binds circulating RANKL, preventing RANK-RANKL interactions and limiting osteoclast differentiation.
- (h) The OPG/RANKL ratio determines the rate of osteoclastogenesis and bone resorption.
- (i) High OPG levels suppress osteoclast formation; high RANKL levels promote osteoclast formation.
- (j) This RANKL-RANK-OPG system maintains bone mass balance by coupling resorption to formation.
- (k) Hormones (parathyroid hormone, estrogen) regulate this system, explaining age-related osteoporosis upon estrogen decline.

Final Answer: Receptor activator of nuclear factor kappa B ligand (RANKL) binds to RANK receptors on osteoclast precursors, promoting differentiation and activation; simultaneously, osteoblasts secrete osteoprotegerin (OPG) acting as a decoy RANKL receptor limiting osteoclastogenesis, maintaining bone mass balance

Answer: (C)

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Q21.

Solution

Concept: The hessian fly infests developing grain crops with maximum damage at specific growth stages. Larval feeding habits and plant tissue susceptibility determine optimal infestation timing.

Solution:

- (a) The whorl stage occurs in grains when 4-5 leaves remain folded within the developing bud.
- (b) This stage is approximately 7-10 days post-germination in favorable conditions.
- (c) Hessian fly females oviposit on leaf surfaces during this vulnerable growth phase.
- (d) Hatching larvae migrate into the leaf whorl, burrowing into the innermost developing leaf tissues.
- (e) Larvae function as endoparasites, feeding on leaf parenchyma and vascular tissues from within.
- (f) Their feeding causes severe chlorosis (yellowing) and necrosis of developing leaf tissue.
- (g) Larval salivary secretions contain plant growth inhibitors that disrupt normal development.
- (h) Stunted plants result from destruction of apical meristem tissues.
- (i) Secondary shoots fail to develop (dead tillers), reducing grain yield per plant.
- (j) Later growth stages show reduced hessian fly susceptibility due to leaf maturation and development of thicker protective epidermis.
- (k) This temporal matching of pest life stage to plant vulnerability stage results in maximum damage.

Final Answer: Whorl stage: larvae feed within the innermost developing leaf whorl as endoparasites of leaf tissues, causing chlorosis and necrosis of growing tissues; subsequent larval-induced plant hormone disruption stunts shoot development creating characteristic stunting with dead tillers

Answer: (B)

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Q22.

Solution

Concept: Parasitic and free-living flatworms diverged evolutionarily, acquiring distinct anatomical specializations reflecting their ecological niches. These specializations reflect fundamental differences in their life strategies.

Solution:

- (a) Parasitic flukes like *Opisthorchis* possess muscular suckers (oral sucker and ventral acetabulum) for firm host attachment.
- (b) Suckers enable the fluke to resist bile flow and peristaltic movements that would dislodge the parasite.
- (c) These parasites also possess hooks and spines for enhanced mechanical attachment.
- (d) Reproductive specialization includes enormously branched reproductive organs producing thousands of eggs daily.
- (e) This prolific egg production compensates for low survival probability of eggs and miracidia in the external environment.
- (f) Parasitic flukes possess extremely reduced nervous systems and sensory organs (no eyes, minimal ganglia).
- (g) Their simplified nervous system reflects the stable internal host environment requiring minimal external perception.
- (h) Conversely, free-living planarians possess elaborate nervous systems with prominent ganglia and nerve cords.
- (i) Planarians possess prominent photoreceptive structures (simple eyes) enabling directional light response.
- (j) They possess chemoreceptive cells throughout the body detecting food odors in the environment.
- (k) Their sensory specialization reflects the need to navigate complex external environments, find food, and respond to threats.

Final Answer: Parasitic flukes possess suckers/hooks for host attachment, highly branched reproductive systems producing enormous gamete quantities, and reduced nervous/sensory systems reflecting simplified lifestyle within host tissues; free-living planarians exhibit elaborate nervous systems with prominent eyes and extensive sensory specialization

Answer: (A)

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Q23.

Solution

Concept: Soft-bodied insects face acute predation pressure but possess multiple behavioral and chemical defenses. These defenses often involve mediating relationships with protective partners.

Solution:

- (a) Mealy bugs possess a dense waxy coating secreted by dermal wax glands.
- (b) This mealy covering provides physical deterrence to predator attack through its texture.
- (c) Additionally, the waxy coating contains chemical compounds distasteful to predators (alkanes, methylated ketones).
- (d) Simultaneously, mealy bugs secrete honeydew (liquid digestive byproduct) attractive to ants.
- (e) Ants are attracted to honeydew as a carbohydrate source and defend the mealy bug colony.
- (f) Ants actively patrol mealy bug aggregations, attacking predators attempting to feed on the soft-bodied insects.
- (g) This mutualistic relationship benefits both: ants obtain honeydew; mealy bugs obtain predator protection.
- (h) The combination of chemical deterrence (waxy coating) plus mutualistic protection (ants) creates effective predation defense.
- (i) Mealy bugs incapable of attracting ants show substantially higher predation rates.
- (j) This represents a sophisticated multi-layered defense strategy enabling soft-bodied insects to survive exposed on plant surfaces.

Final Answer: Production of dense waxy coating (mealy covering) providing chemical and tactile deterrence to predators; coupled with secretion of sweet honeydew that attracts ant mutualists protecting the colony from predators through active defense behavior

Answer: (D)

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Q24.

Solution

Concept: Jumping performance in insects depends on rapid energy storage and release. The cuticle itself can function as an energy storage structure through elastic protein properties.

Solution:

- (a) The flea's jumping apparatus involves hind leg muscles, but muscle contraction alone cannot produce the observed jump performance.
- (b) A specialized cuticle protein called resilin is uniquely positioned in the pleural arch (lateral thoracic region).
- (c) Resilin possesses elastic properties approximately 97% efficient at returning stored mechanical energy.
- (d) During muscle contraction, muscles compress the pleural arch, deforming the resilin-rich cuticle.
- (e) This deformation stores elastic energy in the resilin protein structure.
- (f) When muscles relax slightly, the resilin recoils elastically, rapidly extending the legs.
- (g) This elastic recoil amplifies muscular force output, accelerating leg extension velocity far beyond what muscle contraction alone could achieve.
- (h) The flea can achieve jump heights exceeding 200 times its body length.
- (i) This jumping ability enables the flea to leap from host to host, a critical feature for acquiring new blood meals and transmitting pathogens.
- (j) The resilin-cuticle system represents an evolutionary innovation enabling extraordinary jumping performance.

Final Answer: Specialized pleural arch regions with resilin (elastic protein) undergoing rapid elastic recoil after muscular contraction, storing and releasing mechanical energy enabling explosive leg extension and propulsion exceeding normal muscular force output alone

Answer: (A)

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Q25.

Solution

Concept: Photoperiod is the most reliable environmental cue predicting seasonal changes. Many insects evolved photoperiodic detection systems enabling anticipatory dormancy entry before winter conditions arrive.

Solution:

- (a) Armyworm populations in temperate regions must overwinter in a dormant state to survive freezing temperatures.
- (b) Entering diapause prematurely (before optimal overwintering stage) reduces survival; entering too late permits freezing during development.
- (c) Photoperiod (day length) is the most reliable predictor of seasonal change, remaining constant across years.
- (d) Temperature fluctuates unpredictably (warm days in autumn, cold snaps in spring) providing unreliable seasonal cues.
- (e) Optic lobes contain photoreceptive cells detecting daily light duration.
- (f) Information about photoperiod is processed through clock neuron circuits in the brain.
- (g) When photoperiod shortens below a critical threshold (approximately 13-14 hours for many *Spodoptera* species), diapause hormone synthesis is suppressed.
- (h) Suppression of diapause hormone permits PTTH secretion to resume.
- (i) The PTTH triggers ecdysone synthesis, initiating sexual development and preparation for overwintering.
- (j) Temperature modulates the intensity of photoperiodic response but does not determine diapause entry alone.
- (k) This sophisticated system ensures consistent, predictable diapause entry timing matching seasonal progression.

Final Answer: Photoperiod length: short photoperiods trigger diapause hormone (diapause peptide hormone) secretion from neurosecretory cells via optic lobe photoreceptor pathways, suppressing juvenile hormone synthesis and permitting diapause entry independent of temperature

Answer: (A)

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Answer Key

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

