# Rajasthan JET Biology Sample Paper-8

**Duration: 40 Minutes** **Maximum Marks: 160**

## Instructions

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

**Q1.** The primary meristematic tissue responsible for the elongation of plant roots is located in:

(A) The root cap

(B) The transition zone between root cap and differentiation zone

(C) The zone of cell elongation

(D) The zone of differentiation

**Q2.** Which of the following is NOT a characteristic of gymnosperms?

(A) Presence of xylem and phloem

(B) Production of seeds

(C) Presence of flowers

(D) Presence of vascular tissue

**Q3.** The stage of meiosis during which homologous chromosomes separate is:

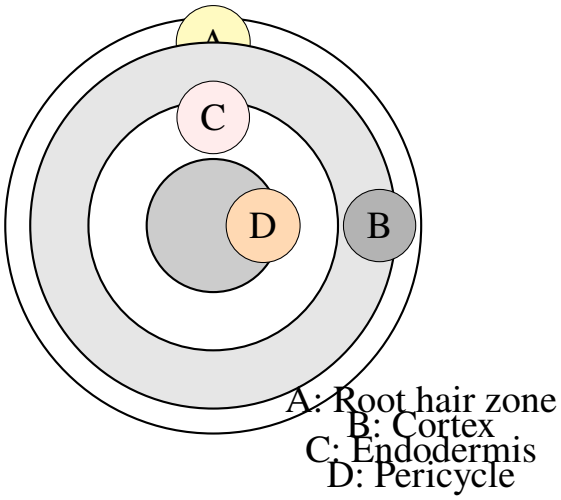
(A) Metaphase I

(B) Anaphase I

(C) Metaphase II

(D) Anaphase II

**Q4.** The detailed anatomy of a monocot root is shown in the diagram. Which tissue is primarily responsible for water absorption?




(A) Root hair zone (A)

(B) Cortex (B)

(C) Endodermis (C)

(D) Pericycle (D)

**Q5.** In a dihybrid cross (AaBb × AaBb), the probability of obtaining an offspring with at least one dominant allele for each gene is:

(A) $\frac{9}{16}$

(B) $\frac{12}{16}$

(C) $\frac{3}{4}$

(D) $\frac{15}{16}$

**Q6.** In the light reaction of photosynthesis, electrons extracted from water molecules are excited primarily at:

(A) Photosystem I

(B) Photosystem II

(C) The cytochrome b6f complex

(D) The ATP synthase complex

**Q7.** Turgor pressure in plant cells is maintained by the accumulation of:

(A) Glucose and fructose

(B) Sodium and potassium ions

(C) Solutes in the vacuole

(D) Proteins in the cytoplasm

**Q8.** The C4 photosynthetic pathway initially fixes $CO_2$ into a 4-carbon compound called:

(A) Ribulose-1,5-bisphosphate

(B) 3-phosphoglycerate

(C) Oxaloacetate

(D) Phosphoenolpyruvate

**Q9.** Which of the following plant hormones promotes the breakdown of starch into glucose during seed germination?

(A) Auxin

(B) Gibberellin

(C) Cytokinin

(D) Ethylene

**Q10.** The loss of water from the stomata of a leaf in gaseous form is known as:

(A) Guttation

(B) Transpiration

(C) Imbibition

(D) Photosynthesis

**Q11.** The process by which nutrient elements move from the soil into the root cells against the concentration gradient is:

(A) Osmosis

(B) Diffusion

(C) Active transport

(D) Plasmolysis

**Q12.** During the process of fertilization in angiosperms, one pollen nucleus:

(A) Fuses with the egg nucleus only

(B) Fuses with the polar nuclei to form the endosperm

(C) Remains as a vegetative nucleus

(D) Degenerates immediately after pollination

**Q13.** The type of fruit produced by the dissociation of carpels is called:

(A) Drupe

(B) Follicle

(C) Schizocarp

(D) Legume

**Q14.** In ecological succession, pioneer species like lichens function primarily to:

(A) Increase soil fertility and prepare habitat for other species

(B) Compete with later species for resources

(C) Prevent colonization by other organisms

(D) Reduce light availability for other plants

**Q15.** Which of the following metabolic processes occurs entirely in the mitochondrial matrix?

(A) Glycolysis

(B) Krebs cycle

(C) Electron transport

(D) Pentose phosphate pathway

**Q16.** The phenomenon of self-incompatibility in plants prevents:

(A) Cross-pollination between different species

(B) Pollination by insects

(C) Self-fertilization through incompatible gamete recognition

(D) Seed dispersal after fertilization

**Q17.** The biome characterized by low precipitation, extreme temperature variations, and sparse vegetation is:

(A) Tropical rainforest

(B) Temperate grassland

(C) Desert

(D) Tundra

**Q18.** According to the theory of evolution by natural selection, organisms with favorable traits are more likely to:

(A) Acquire new mutations

(B) Reproduce and pass genes to offspring

(C) Develop complex organs

(D) Migrate to new environments

**Q19.** Which of the following is an example of a transgenic crop developed through recombinant DNA technology?

(A) Polyploid wheat

(B) Bt cotton resistant to Lepidoptera

(C) Hybrid maize

(D) Mutagenized rice varieties

**Q20.** The fungal disease that causes severe damage to pearl millet crops in Rajasthan by inducing smut infection is:

(A) Rust

(B) Blast

(C) Downy mildew

(D) Loose smut

**Q21.** The insecticidal protein produced by Bacillus thuringiensis for pest control works by:

(A) Disrupting the nervous system of insects

(B) Creating pores in the midgut epithelium of insects

(C) Preventing molting in insects

(D) Inhibiting reproductive hormones

**Q22.** The most economically important oil-yielding crop cultivated during the rabi season in Rajasthan is:

(A) Sunflower

(B) Mustard

(C) Safflower

(D) Castor

**Q23.** The process of breaking seed dormancy through exposure to cold temperatures is called:

(A) Vernalization

(B) Stratification

(C) Photoperiodism

(D) Scarification

**Q24.** Which soil organism is responsible for the conversion of atmospheric nitrogen into available forms for plant uptake?

(A) Decomposer bacteria

(B) Nitrogen-fixing bacteria

(C) Parasitic fungi

(D) Plant pathogenic nematodes

**Q25.** The condition in which an organism displays multiple phenotypes from a single genotype due to environmental influence is called:

(A) Genetic drift

(B) Phenotypic plasticity

(C) Gene mutation

(D) Chromosomal aberration

**Q26.** The type of symmetry exhibited by most sessile animals such as sea anemones is:

(A) Bilateral symmetry

(B) Asymmetry

(C) Radial symmetry

(D) Spiral symmetry

**Q27.** The excretory organ found in terrestrial gastropod mollusks is:

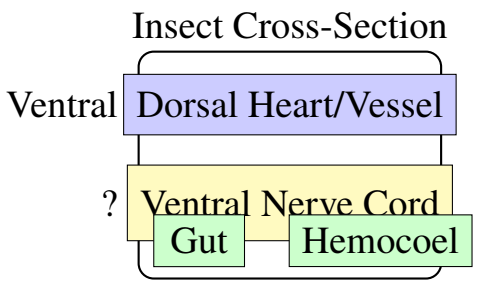
(A) A kidney

(B) A metanephridium

(C) An open heart

(D) A nephridium

**Q28.** The structure shown in the diagram represents a cross-section of an insect nervous system. Which component is the ventral nerve cord?



(A) The dorsal heart/vessel

(B) The ventral nerve cord (labeled)

(C) The hemocoel

(D) The gut

**Q29.** The type of blood pigment found in earthworms that binds oxygen is:

(A) Hemoglobin

(B) Chlorocruorein

(C) Hemocyanin

(D) Myoglobin

**Q30.** The larval form of the tapeworm that develops in the intermediate host is called a:

(A) Miracidium

(B) Cercaria

(C) Cysticercus

(D) Metacercaria

**Q31.** The hormone responsible for regulating blood glucose levels in vertebrates is secreted by:

(A) The thyroid gland

(B) The pancreas

(C) The adrenal gland

(D) The pituitary gland

**Q32.** The process by which the ureteric bud develops into the ureters and major calyces in vertebrate embryos is called:

(A) Pronephros development

(B) Mesonephros development

(C) Metanephros development

(D) Neonephros development

**Q33.** The phenomenon in which an organism can produce different types of gametes is called:

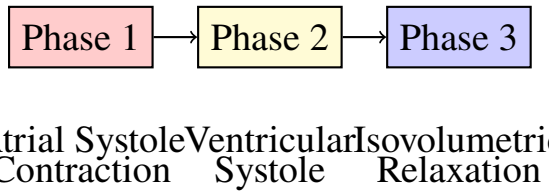
(A) Heterogamy

(B) Isogamy

(C) Oogamy

(D) Parthenogenesis

**Q34.** The cardiac cycle diagram shown represents different phases of heart contraction. Which phase represents ventricular filling?




(A) Phase 1 (Atrial Systole)

(B) Phase 2 (Ventricular Systole)

(C) Phase 3 (Isovolumetric Relaxation)

(D) Before Phase 1 (Ventricular Filling)

**Q35.** The type of reproduction where organisms produce offspring without the fusion of gametes is:

(A) Sexual reproduction

(B) Asexual reproduction

(C) Hermaphroditism

(D) Budding only

**Q36.** The hormone secreted by the posterior pituitary that promotes water reabsorption in the kidneys is:

(A) Thyroxine

(B) Antidiuretic hormone (ADH)

(C) Prolactin

(D) Oxytocin

**Q37.** In an arthropod, the exoskeleton is primarily composed of:

(A) Calcium carbonate

(B) Chitin and protein

(C) Cellulose

(D) Collagen fibers

**Q38.** The parasitic nematode that causes intestinal infection and is transmitted through contaminated food and water is:

(A) Wuchereria bancrofti

(B) Trichinella spiralis

(C) Ascaris lumbricoides

(D) Hookworm

**Q39.** The process by which the lens of the eye changes shape to focus light on the retina is called:

(A) Accommodation

(B) Convergence

(C) Refraction

(D) Reflection

**Q40.** The vertebrate stage that has a notochord in the embryo but it is replaced by the vertebral column in adults is the:

(A) Lamprey

(B) Teleost fish

(C) Salamander

(D) Mammal

## Detailed Solutions

# Q1.

## Solution

**Concept:**

Root growth occurs through the coordinated activity of meristematic tissues located at the root apex. The root tip is organized into distinct zones with specific developmental functions. Understanding the location and function of the primary meristematic tissue is crucial to plant developmental biology.

**Solution:**

(a) The root cap is a protective structure that covers the root apex and helps the root penetrate the soil, not the primary meristematic tissue.

(b) The primary meristematic tissue responsible for root elongation is the quiescent center and initial cells located in the transition zone between the root cap and the zone of elongation.

(c) This meristematic region divides to produce cells that differentiate into the various cell types of the root.

(d) The zone of cell elongation is where cells increase in size after being produced by the meristem, but this is not where meristematic division primarily occurs.

(e) The zone of differentiation is where cells mature and specialize, not where primary meristematic divisions occur.

(f) The transition zone contains the most active meristematic tissue, with rapid cell divisions and differentiation into the root's various tissues.

(g) Root growth is therefore sustained by the meristematic tissue in the transition zone between the root cap and zone of elongation.

**Final Answer:** The primary meristem is in the transition zone between root cap and differentiation zone.

**Answer: (B)**

Go Back to Question 1

## Q2.

### Solution

**Concept:**

Gymnosperms are seed plants that differ from flowering plants (angiosperms) in several ways. Understanding the characteristics that define and distinguish gymnosperm groups is essential for plant taxonomy and evolutionary understanding.

**Solution:**

(a) Gymnosperms possess both xylem and phloem (vascular tissue), which is a characteristic shared with angiosperms and most other land plants.

(b) Gymnosperms produce seeds, which is one of their defining characteristics as seed plants.

(c) Vascular tissue (xylem and phloem) is present in gymnosperms and is essential for transport and support in plants.

(d) Flowers are the defining reproductive structure of angiosperms (flowering plants), NOT gymnosperms.

(e) Gymnosperms produce cones (in conifers) or other naked seed structures, but not flowers with petals, sepals, and enclosed ovules.

(f) The term "gymnosperm" literally means "naked seed," indicating that seeds are not enclosed in a fruit as they are in angiosperms.

(g) This absence of flowers and enclosed seeds distinguishes gymnosperms from angiosperms.

(h) Therefore, the presence of flowers is NOT a characteristic of gymnosperms.

**Final Answer:** Presence of flowers is NOT a characteristic of gymnosperms.

**Answer: (C)**

Go Back to Question 2

## Q3.

### Solution

**Concept:**

Meiosis is a form of cell division that produces four haploid gametes from a diploid cell. The process involves two successive divisions, with specific events occurring in each stage. Understanding the timing of chromosome separation is crucial to understanding meiosis.

**Solution:**

(a) Metaphase I is the stage where homologous chromosome pairs (bivalents) align at the metaphase plate, but separation has not yet occurred.

(b) Anaphase I is the stage where homologous chromosomes separate and move toward opposite poles of the cell.

(c) This separation of homologous chromosomes in Anaphase I is the key event that reduces chromosome number from diploid to haploid.

(d) Metaphase II is the second meiotic division where individual chromosomes (consisting of two sister chromatids) align at the metaphase plate.

(e) Anaphase II is where sister chromatids separate, not homologous chromosomes.

(f) Therefore, the stage where homologous chromosomes separate is Anaphase I.

(g) This separation ensures that each gamete receives only one chromosome from each homologous pair.

**Final Answer:** Homologous chromosomes separate during Anaphase I.

**Answer: (B)**

Go Back to Question 3

## Q4.

### Solution

**Concept:**

The monocot root possesses specialized tissues arranged in a characteristic pattern. The root hair zone is particularly important for water absorption because of its specialized epidermal structures and high surface area. Understanding root anatomy is essential to understanding plant water uptake.

**Solution:**

(a) The root hair zone (also called the piliferous layer) is the region of the root where root hairs are produced from epidermal cells.

(b) Root hairs are elongations of epidermal cells that dramatically increase the absorptive surface area of the root.

(c) These root hairs are thin-walled, providing minimal resistance to water and mineral uptake.

(d) The increased surface area of root hairs allows for efficient absorption of water through osmosis and minerals through active transport.

(e) The cortex is the region of large parenchymatous cells located below the epidermis, primarily for storage and transport of absorbed water.

(f) The endodermis is a single layer of tightly packed cells that controls the passage of water and minerals into the stele through selective transport.

(g) The pericycle is the outermost layer of the stele that gives rise to lateral (branch) roots.

(h) While the endodermis is important in regulating water movement, the primary absorption occurs through the root hair zone.

(i) Therefore, the root hair zone (A) is primarily responsible for water absorption.

**Final Answer:** The root hair zone (A) is primarily responsible for water absorption.

**Answer: (A)**

Go Back to Question 4

## Q5.

### Solution

**Concept:**

Dihybrid crosses involve the simultaneous inheritance of two genes. The probability calculations for specific phenotypic combinations require understanding independent assortment and the application of multiplication rules for probability.

**Solution:**

(a) In a dihybrid cross (AaBb × AaBb), each gene segregates independently according to Mendelian principles.

(b) For each gene independently: The probability of at least one dominant allele $(A_)is3/4(AAorAa), andtheprobabilityofatleastonedominantallele(B_)isalso3/4.$

(b) The probability of having at least one dominant allele for BOTH genes is: (3/4) × (3/4) = 9/16.

(c) Alternatively, we can calculate the probability by identifying the one genotype that lacks dominant alleles: aabb, which occurs with probability (1/4) × (1/4) = 1/16.

(d) Therefore, the probability of at least one dominant allele for each gene is: 1 - 1/16 = 15/16.

(e) The correct calculation is 9/16 if the question asks for both genes showing dominance $(A_{B_}), whichgivestheclassic9:3:3:1ratiocomponent.$

(e) However, "at least one dominant allele for each gene" means $A_ANDB, whichis(3/4)(3/4) = 9/16.$

(e) The answer 9/16 represents the proportion of offspring with at least one dominant allele for each of the two genes.

**Final Answer:** The probability is 9/16.

**Answer: (A)**

Go Back to Question 5

## Q6.

### Solution

**Concept:**

The light-dependent reactions of photosynthesis involve two photosystems working in series to transfer electrons and generate ATP and NADPH. Water serves as the ultimate electron donor, and the electrons are initially excited at a specific photosystem where the oxygen-evolving complex is located.

**Solution:**

(a) In the Z-scheme model of photosynthesis, electrons are excited at two different photosystems in a sequential manner.

(b) Water splitting (photolysis) occurs at Photosystem II (PSII), where the oxygen-evolving complex containing manganese ions catalyzes the reaction: $2H_2O \rightarrow O_2 + 4H_+ + 4e$.

(c) The reaction center of PSII is P680, a chlorophyll molecule that absorbs light and becomes excited.

(d) This excited P680 transfers electrons to the first electron acceptor, pheophytin, initiating the electron transport chain.

(e) Electrons from water replace those lost by P680, creating a continuous supply of electrons from water splitting.

(f) Photosystem I (PSI) is downstream in the electron flow and accepts electrons from the electron transport chain, not directly from water.

(g) The cytochrome b6f complex transfers electrons between PSII and PSI but does not split water.

(h) ATP synthase uses the proton gradient to make ATP but is not involved in water splitting or electron excitation.

**Final Answer:** Electrons from water are excited primarily at Photosystem II.

**Answer: (B)**

Go Back to Question 6

## Q7.

### Solution

**Concept:**

Turgor pressure is the pressure exerted by the vacuolar contents against the cell wall, maintaining cell rigidity and plant structure. This pressure is maintained by the accumulation of solutes in the vacuole, creating an osmotic gradient that draws water into the cell.

**Solution:**

(a) Turgor pressure is the hydrostatic pressure within plant cells created by the influx of water.

(b) Water enters the cell through osmosis because the vacuole contains dissolved substances (solutes) at higher concentration than the surrounding medium.

(c) The primary solutes responsible for maintaining turgor pressure are organic compounds such as sugars, amino acids, and ions.

(d) Glucose and fructose are sugars that can accumulate in the vacuole, but these are not the only or even primary solutes.

(e) Sodium and potassium ions are important for many cellular processes but are not the primary osmotically active substances in plant vacuoles.

(f) Proteins in the cytoplasm contribute to osmotic potential but are not the primary solutes in the vacuole.

(g) The accumulation of various solutes in the vacuole lowers the water potential, causing water to enter the cell by osmosis.

(h) This influx of water creates turgor pressure, which keeps the plant rigid and turgid.

(i) Loss of turgor pressure (through water loss) results in wilting.

**Final Answer:** Turgor pressure is maintained by the accumulation of solutes in the vacuole.

**Answer: (C)**

Go Back to Question 7

## Q8.

### Solution

**Concept:**

C4 photosynthesis is an alternative to the more common C3 pathway, representing an adaptation to high light and temperature conditions. The initial fixation step in C4 photosynthesis involves a specific enzyme and produces a different initial product than in C3 plants.

**Solution:**

(a) In C4 photosynthesis, the enzyme phosphoenolpyruvate carboxylase (PEP carboxylase) catalyzes the initial $CO_2$ fixation.

(b) This enzyme combines $CO_2$ with phosphoenolpyruvate (PEP), a 3-carbon compound, to produce oxaloacetate, a 4-carbon compound.

(c) Oxaloacetate is subsequently reduced to malate, which is transported to the bundle sheath cells where $CO_2$ is released for the Calvin cycle.

(d) Ribulose-1,5-bisphosphate is the $CO_2$ acceptor in C3 photosynthesis, not C4 photosynthesis.

(e) 3-phosphoglycerate is an intermediate in the Calvin cycle, not the initial $CO_2$ fixation product.

(f) Phosphoenolpyruvate is the $CO_2$ acceptor in C4 photosynthesis, but the initial product is oxaloacetate, not phosphoenolpyruvate itself.

(g) The 4-carbon compound (oxaloacetate) that is initially formed is why this is called "C4" photosynthesis.

**Final Answer:** $CO_2$ is initially fixed into oxaloacetate.

**Answer: (C)**

Go Back to Question 8

## Q9.

### Solution

**Concept:**

Plant hormones regulate various developmental and physiological processes. During seed germination, specific hormones promote the mobilization of stored reserves, allowing the embryo to grow. Understanding the role of different hormones in seed germination is crucial to plant development.

**Solution:**

(a) Gibberellins (GA) are the primary hormones that promote seed germination and the mobilization of stored reserves.

(b) Gibberellins stimulate the production of hydrolytic enzymes in the aleurone layer of cereal grains.

(c) These enzymes (such as amylase and protease) break down starch and proteins in the endosperm, producing glucose and amino acids.

(d) The glucose and amino acids are then transported to the growing embryo, providing energy and building blocks for growth.

(e) Auxins are involved in cell elongation and apical dominance, not the breakdown of starch.

(f) Cytokinins promote cell division but do not directly stimulate the breakdown of starch.

(g) Ethylene promotes ripening and senescence, not starch breakdown during germination.

(h) Abscisic acid (ABA) actually inhibits seed germination, maintaining dormancy.

(i) Therefore, gibberellins are the hormones primarily responsible for promoting starch breakdown during seed germination.

**Final Answer:** Gibberellins promote starch breakdown during seed germination.

**Answer: (B)**

Go Back to Question 9

## Q10.

### Solution

**Concept:**

Water loss from plant leaves occurs through different mechanisms and has different names based on the form and location of loss. Understanding the terminology for different types of water loss is important in plant physiology.

**Solution:**

(a) Guttation is the loss of liquid water droplets from leaves, typically occurring at night when transpiration is minimal and root pressure is high.

(b) Transpiration is the loss of water from plant leaves in the form of water vapor through the stomata and, to a lesser extent, through the cuticle.

(c) The loss of water vapor (not liquid) through stomata is specifically called transpiration.

(d) This gaseous water loss is the primary form of water loss from leaves during the day when stomata are open for photosynthesis.

(e) Imbibition is the absorption of water by dry seeds or plant tissues, not the loss of water.

(f) Photosynthesis is the process of converting light energy into chemical energy, not related to water loss.

(g) The question specifically asks about water loss in gaseous form, which is transpiration, not guttation.

**Final Answer:** Water loss from stomata in gaseous form is transpiration.

**Answer: (B)**

Go Back to Question 10

## Q11.

### Solution

**Concept:**

Nutrients are generally present in the soil at lower concentrations than in plant cells. Plants have evolved mechanisms to transport nutrients from the soil into root cells, often against the concentration gradient. This process requires energy and is a fundamental aspect of plant nutrition.

**Solution:**

(a) Active transport is the movement of substances against a concentration gradient (from lower to higher concentration) using ATP energy.

(b) Plant roots selectively absorb essential mineral nutrients from the soil through active transport mechanisms.

(c) Root cells use ATP to pump nutrient ions against the concentration gradient into the vacuole and cytoplasm.

(d) Osmosis is the movement of water across a semi-permeable membrane in response to solute concentration differences.

(e) Diffusion is the movement of substances from higher to lower concentration, which is passive and does not move substances against the gradient.

(f) Plasmolysis is the separation of the protoplast from the cell wall in hypertonic solutions, not a nutrient transport mechanism.

(g) Active transport is the only mechanism that allows plants to accumulate nutrients from dilute soil solutions.

(h) This process is energetically expensive but necessary for plant growth and development.

**Final Answer:** Active transport moves nutrients against the concentration gradient.

**Answer: (C)**

Go Back to Question 11

## Q12.

### Solution

**Concept:**

Double fertilization in angiosperms involves two distinct fertilization events within the embryo sac. These events produce different structures essential for seed development. Understanding the fates of the sperm nuclei is crucial to understanding angiosperm reproduction.

**Solution:**

(a) During double fertilization, two sperm nuclei are released from the pollen tube into the embryo sac.

(b) One sperm nucleus fuses with the egg nucleus to form the zygote, which develops into the embryo.

(c) The other sperm nucleus fuses with the central cell nucleus (formed by the fusion of the two polar nuclei) to form the endosperm.

(d) The endosperm is a triploid tissue (3n) that develops to provide nutrients for the developing embryo.

(e) Both sperm nuclei play essential roles: one in forming the embryo (through fusion with egg) and the other in forming the endosperm (through fusion with polar nuclei).

(f) Neither sperm nucleus remains as a vegetative nucleus or degenerates.

(g) The fusion of one pollen nucleus with polar nuclei produces the endosperm, not just any tissue.

(h) Therefore, one pollen nucleus fuses with the polar nuclei to form the endosperm.

**Final Answer:** One pollen nucleus fuses with polar nuclei to form the endosperm.

**Answer: (B)**

Go Back to Question 12

## Q13.

### Solution

**Concept:**

Fruits develop from ovaries after fertilization and exhibit diverse forms depending on the plant species. Different fruit types are classified based on their development, the tissues involved, and the number of carpels that fuse. Understanding fruit classification is important in plant taxonomy.

**Solution:**

(a) A drupe is a type of fruit with a hard, woody endocarp and a soft mesocarp (examples: peaches, cherries, mangoes).

(b) A follicle is a fruit that develops from a single carpel and splits along one suture (examples: milkweed, columbine).

(c) A schizocarp is a fruit that develops from multiple fused carpels but dissociates (breaks apart) into individual one-seeded units called mericarps.

(d) The schizocarp is produced by the separation of carpels that were fused during development.

(e) Examples of schizocarps include the fruits of umbelliferous plants (carrots, coriander) where the fruit splits into two mericarps.

(f) A legume is a fruit that develops from a single carpel and typically opens along two sutures (examples: peas, beans).

(g) The question specifically asks about fruits produced by the dissociation (separation) of carpels, which is the definition of a schizocarp.

(h) Therefore, a schizocarp is the correct answer.

**Final Answer:** The fruit is called a schizocarp.

**Answer: (C)**

Go Back to Question 13

## Q14.

### Solution

**Concept:**

Ecological succession is the process by which communities change over time. Pioneer species are the first organisms to colonize bare areas, and they play crucial roles in ecosystem development. Understanding the functions of pioneer species is essential to understanding succession.

**Solution:**

(a) Pioneer species like lichens are among the first organisms to colonize bare rock or newly exposed substrate.

(b) Lichens are symbiotic associations between fungi and algae or cyanobacteria.

(c) Lichens produce organic acids that chemically break down rock, initiating the weathering process.

(d) As lichens and other pioneer species break down rock and accumulate organic matter, they create conditions suitable for soil formation.

(e) This newly formed soil provides nutrients and a substrate for later colonizers.

(f) Pioneer species increase soil fertility by adding organic matter from their decay.

(g) By preparing the habitat, pioneer species facilitate the colonization by other species, which is why they are called "facilitators."

(h) Pioneer species do not compete with later species; in fact, later species eventually outcompete and replace pioneer species.

(i) Pioneer species do not prevent colonization by other organisms; they enable it.

(j) Therefore, pioneer species function to increase soil fertility and prepare the habitat for other species.

**Final Answer:** Pioneer species increase soil fertility and prepare habitat for others.

**Answer: (A)**

Go Back to Question 14

## Q15.

### Solution

**Concept:**

Cellular respiration involves multiple stages occurring in different cellular compartments. Understanding the specific locations of metabolic processes is crucial to understanding how cells generate ATP and manage metabolic intermediates.

**Solution:**

(a) Glycolysis occurs in the cytoplasm and produces pyruvate, ATP, and NADH.

(b) The Krebs cycle (citric acid cycle) occurs in the mitochondrial matrix and generates $CO_2$, ATP (or GTP), NADH, and $FADH_2$.

(c) Both the reactions of glycolysis and the Krebs cycle produce the reducing equivalents (NADH and $FADH_2$) that are subsequently oxidized.

(d) The electron transport chain occurs on the inner mitochondrial membrane, not in the matrix.

(e) The pentose phosphate pathway occurs in the cytoplasm and generates NADPH and five-carbon sugars.

(f) The Krebs cycle is the only metabolic pathway that occurs entirely within a single compartment: the mitochondrial matrix.

(g) All enzymes of the Krebs cycle (citrate synthase, isocitrate dehydrogenase, etc.) are located in the mitochondrial matrix.

(h) Therefore, the Krebs cycle is the metabolic process that occurs entirely in the mitochondrial matrix.

**Final Answer:** The Krebs cycle occurs entirely in the mitochondrial matrix.

**Answer: (B)**

Go Back to Question 15

## Q16.

### Solution

**Concept:**

Self-incompatibility is a genetic mechanism that prevents self-fertilization in certain plant species. This system involves molecular recognition between pollen and pistil, ensuring that compatible pollen grains can fertilize the flower while self-pollen is rejected.

**Solution:**

(a) Self-incompatibility is a genetic mechanism found in many plant species that prevents or reduces self-fertilization.

(b) The system involves specific proteins (S-alleles) present on both pollen and stigma that recognize self versus non-self pollen.

(c) When pollen from the same plant (or genetically identical plants) attempts to fertilize the flower, the stigma recognizes this "self" pollen.

(d) The recognition triggers a response (in some systems, calcium influx and callose deposition) that prevents pollen tube growth.

(e) This prevents self-fertilization, ensuring genetic outcrossing and promoting genetic diversity.

(f) Self-incompatibility does not prevent cross-pollination between different species or between different varieties of the same species.

(g) Self-incompatibility does not prevent insect pollination; rather, it ensures that insect-mediated cross-pollination is necessary for seed set.

(h) Self-incompatibility does not prevent seed dispersal; it prevents self-fertilization, which would reduce genetic diversity.

(i) Therefore, self-incompatibility prevents self-fertilization through incompatible gamete recognition.

**Final Answer:** Self-incompatibility prevents self-fertilization through incompatible gamete recognition.

**Answer: (C)**

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## Q17.

### Solution

**Concept:**

Biomes are large ecological regions characterized by specific climatic conditions, vegetation types, and animal communities. Each biome is adapted to its particular climate and environmental constraints. Understanding biome characteristics is essential to understanding global ecology.

**Solution:**

(a) Tropical rainforests are characterized by high precipitation, high temperatures year-round, and dense vegetation.

(b) Temperate grasslands have moderate precipitation, seasonal temperature variations, and herbaceous vegetation.

(c) Deserts are characterized by very low precipitation (less than 250 mm per year), extreme temperature variations (hot days, cold nights), and sparse vegetation adapted to xeric conditions.

(d) Tundra is characterized by very low temperatures, low precipitation, and sparse vegetation consisting mainly of grasses, lichens, and dwarf shrubs.

(e) The biome described (low precipitation, extreme temperature variations, sparse vegetation) matches the characteristics of deserts.

(f) Deserts experience extreme temperature variations because the lack of cloud cover allows rapid cooling at night and rapid heating during the day.

(g) Deserts are found in both subtropical and temperate regions, including the Sahara, Arabian, Kalahari, Australian deserts, and others.

(h) Vegetation in deserts is adapted to minimize water loss and survive long periods without rainfall.

**Final Answer:** This biome is the desert.

**Answer: (C)**

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## Q18.

### Solution

**Concept:**

Natural selection is the mechanism of evolution proposed by Darwin. This process occurs when organisms with heritable traits that enhance survival and reproduction become more common in populations over time. Understanding the mechanism of natural selection is fundamental to understanding evolution.

**Solution:**

(a) Natural selection operates on heritable variation that already exists in populations, not by acquiring new mutations during an organism's lifetime.

(b) Organisms with favorable traits are more likely to survive in their environment and reach reproductive age.

(c) These surviving organisms are more likely to mate and produce offspring.

(d) By reproducing successfully, organisms with favorable traits pass these genes to their offspring, increasing the frequency of favorable alleles in the population.

(e) Over many generations, the accumulation of favorable traits through this process leads to evolutionary change.

(f) Acquiring new mutations and developing complex organs are consequences of natural selection over long periods, not direct mechanisms of selection.

(g) Migration is one of several factors affecting allele frequencies (along with natural selection, genetic drift, and mutation), but it is not the primary outcome of natural selection.

(h) The fundamental outcome of natural selection is differential reproduction based on heritable trait differences.

**Final Answer:** Organisms with favorable traits reproduce and pass genes to offspring.

**Answer: (B)**

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## Q19.

### Solution

**Concept:**

Recombinant DNA technology has revolutionized agriculture by enabling the creation of crops with enhanced traits. These transgenic crops have specific advantageous characteristics that would be difficult or impossible to achieve through traditional breeding methods.

**Solution:**

(a) Bt cotton is a transgenic crop developed by inserting the Cry1Ac gene from Bacillus thuringiensis into cotton.

(b) This gene encodes a protein that is toxic to Lepidopteran insects (butterflies and moths) including the pink bollworm and American bollworm.

(c) The Bt protein disrupts the midgut epithelium of susceptible insects, causing death.

(d) Bt cotton is resistant to major insect pests through this genetically engineered trait, reducing the need for chemical insecticides.

(e) Polyploid wheat is created through chemical induction of polyploidy, not through recombinant DNA technology.

(f) Hybrid maize is created through traditional cross-breeding methods, producing heterozygous plants with hybrid vigor, not through genetic engineering.

(g) Mutagenized rice varieties are created by exposure to mutagens, inducing random mutations, not by recombinant DNA technology.

(h) Bt cotton exemplifies the successful application of recombinant DNA technology in creating transgenic crops with enhanced insect resistance.

(i) This technology has significantly reduced pesticide use in cotton cultivation in many countries.

**Final Answer:** Bt cotton is a transgenic crop created through recombinant DNA technology.

**Answer: (B)**

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## Q20.

### Solution

**Concept:**

Plant diseases caused by fungal pathogens are significant constraints to crop production in Rajasthan. Different crops are susceptible to different fungal diseases, and understanding the major pathogens is important for developing management strategies.

**Solution:**

(a) Pearl millet (bajra) is an important millet crop grown in Rajasthan, particularly in arid and semi-arid regions.

(b) Pearl millet is susceptible to various diseases, with loose smut being a particularly devastating fungal disease.

(c) Loose smut of pearl millet is caused by Tolyposporium penicillariae (formerly known as Ustilago destruens).

(d) This disease replaces the grain with dark, powdery spore masses that are released into the air at harvest.

(e) Loose smut reduces yield and grain quality, making it economically important.

(f) Rust is a fungal disease that affects various crops but is particularly problematic in wheat and barley.

(g) Blast is a fungal disease that affects rice and other cereals.

(h) Downy mildew affects various crops including maize and pearl millet under specific conditions.

(i) Loose smut is the disease most characteristically associated with pearl millet damage in Rajasthan.

**Final Answer:** Loose smut is the fungal disease that causes smut infection in pearl millet.

**Answer: (D)**

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## Q21.

### Solution

**Concept:**

Bacillus thuringiensis (Bt) is a soil-dwelling bacterium that produces insecticidal proteins used extensively in pest management. Understanding how these proteins work is crucial to appreciating the mechanism of Bt-based bioinsecticides and transgenic crops.

**Solution:**

(a) Bacillus thuringiensis produces crystalline proteins (Cry proteins) during sporulation that have insecticidal properties.

(b) The Cry proteins are inactive protoxins that must be activated in the insect's midgut.

(c) In the alkaline midgut environment of susceptible insects, the protoxins are cleaved by proteases to produce active toxins.

(d) The active Cry toxins bind to specific receptors on the midgut epithelial cells of susceptible insects.

(e) Upon binding, the toxin inserts into the cell membrane, creating pores that allow the leakage of cellular contents.

(f) The formation of pores in the midgut epithelium disrupts the barrier function and leads to cell lysis and insect death.

(g) The nervous system disruption occurs secondarily due to the breakdown of the midgut barrier and septicemia.

(h) Cry proteins do not directly affect molting (which is controlled by hormones) or reproductive hormones.

(i) The mechanism of Cry toxins is specific to lepidopteran insects with appropriate midgut receptors, making Bt crops selective pesticides.

**Final Answer:** Bt protein creates pores in the midgut epithelium of susceptible insects.

**Answer: (B)**

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## Q22.

### Solution

**Concept:**

Rajasthan has diverse agricultural systems with crops suited to its arid and semi-arid climate. Rabi crops are grown during the winter season (October to March), and certain oil crops are particularly important to the state's agriculture.

**Solution:**

(a) Sunflower is an important oil crop but is primarily grown during the kharif season in Rajasthan, not the rabi season.

(b) Mustard (rapeseed-mustard) is the most economically important oil-yielding crop cultivated during the rabi season in Rajasthan.

(c) Mustard thrives in the cool, dry conditions of winter and requires relatively low rainfall, making it ideal for Rajasthan's rabi season.

(d) Rajasthan is the largest mustard-producing state in India, producing millions of tons annually.

(e) The mustard crop is cultivated across most districts of Rajasthan during the rabi season.

(f) Safflower is grown in Rajasthan but is less important economically than mustard.

(g) Castor is primarily grown as a kharif crop in India, not a rabi crop in Rajasthan.

(h) Mustard is used for oil extraction (mustard oil) and is also valuable for mustard seeds used in cooking and spices.

**Final Answer:** Mustard is the most economically important oil-yielding rabi crop in Rajasthan.

**Answer: (B)**

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## Q23.

### Solution

**Concept:**

Seed dormancy is a physiological state in which viable seeds do not germinate even when conditions appear favorable. Many seeds have dormancy mechanisms that prevent germination at inappropriate times. Understanding mechanisms that break dormancy is important in agriculture and horticulture.

**Solution:**

(a) Many seeds have dormancy mechanisms that prevent germination during unfavorable seasons.

(b) Vernalization is the breaking of dormancy through exposure to prolonged cold temperatures.

(c) This process is called "breaking dormancy by cold" or "cold stratification."

(d) Vernalization is required by many temperate plant species, particularly winter annuals and biennial plants.

(e) During winter cold exposure, biochemical changes occur in the seed that allow germination when warm temperatures return in spring.

(f) Stratification is similar to vernalization but more broadly refers to exposure to cold, moisture, and sometimes light to break dormancy.

(g) The terms vernalization and stratification are sometimes used interchangeably, with stratification being the more general term.

(h) Photoperiodism is the response to day length, not the breaking of seed dormancy by cold.

(i) Scarification is the mechanical breaking of seed coat to allow water and oxygen penetration, not cold-induced dormancy breaking.

(j) Vernalization is the specific term for breaking dormancy through cold exposure.

**Final Answer:** Breaking dormancy through cold exposure is called vernalization.

**Answer: (A)**

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## Q24.

### Solution

**Concept:**

Nitrogen is an essential macronutrient for plant growth and is a major component of proteins and nucleic acids. However, atmospheric nitrogen is in a form ($N_2$) that most plants cannot utilize directly. Nitrogen-fixing organisms convert atmospheric nitrogen into bioavailable forms.

**Solution:**

(a) Nitrogen-fixing bacteria have the enzyme nitrogenase that catalyzes the reduction of atmospheric nitrogen ($N_2$) to ammonia ($NH_3$).

(b) Free-living nitrogen-fixing bacteria (like Azotobacter and cyanobacteria) fix nitrogen in soil and aquatic environments.

(c) Symbiotic nitrogen-fixing bacteria (like Rhizobium) fix nitrogen in association with legume roots, forming nodules.

(d) The fixed nitrogen becomes bioavailable to plants as ammonium ($NH_4^+$) or nitrate ($NO_3$).

(e) Decomposer bacteria break down dead organic matter, releasing nitrogen from amino acids, but this is different from nitrogen fixation.

(f) Parasitic fungi and plant pathogenic nematodes do not fix nitrogen; they feed on plants and cause disease.

(g) Nitrogen fixation is essential for sustainable agriculture and is exploited in crop rotation systems using legumes.

(h) Nitrogen-fixing bacteria are crucial to the nitrogen cycle and global nitrogen availability.

**Final Answer:** Nitrogen-fixing bacteria convert atmospheric nitrogen into bioavailable forms.

**Answer: (B)**

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## Q25.

### Solution

**Concept:**

Genotypes determine the potential phenotype of an organism, but the environment significantly influences the actual phenotype expressed. The same genotype can produce different phenotypes under different environmental conditions, a phenomenon known as phenotypic plasticity.

**Solution:**

(a) Phenotypic plasticity (also called polyphenism) is the ability of a single genotype to produce multiple phenotypes in response to environmental conditions.

(b) A classic example is hydrangea flowers, which develop blue flowers in acidic soils and pink flowers in alkaline soils despite having the same genotype.

(c) Another example is the development of different forms in water fleas (Daphnia) in response to the presence or absence of predators.

(d) Environmental factors affecting phenotype include temperature, light, nutrients, pH, and social signals.

(e) Genetic drift is the random change in allele frequencies in populations, not related to phenotypic plasticity.

(f) Gene mutation is the change in DNA sequence, not the environmental influence on phenotype.

(g) Chromosomal aberration is a change in chromosome structure or number, not phenotypic plasticity.

(h) Phenotypic plasticity allows organisms to adjust their phenotype to match environmental conditions, increasing their fitness.

**Final Answer:** The phenomenon is called phenotypic plasticity.

**Answer: (B)**

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## Q26.

### Solution

**Concept:**

Animal body symmetry is a fundamental characteristic used in animal classification. Different symmetries reflect different body organizations and evolutionary relationships. Understanding symmetry types is essential to understanding animal phylogeny.

**Solution:**

(a) Bilateral symmetry occurs when an organism can be divided into left and right halves that are mirror images.

(b) Asymmetry occurs when an organism has no discernible pattern of symmetry.

(c) Radial symmetry occurs when an organism can be divided into multiple similar parts radiating from a central axis.

(d) Organisms with radial symmetry typically have no distinct head or tail and can move in any direction from their body.

(e) Sessile animals (non-moving) such as sea anemones, jellyfish, and corals exhibit radial symmetry.

(f) This radial symmetry is an adaptation to their sessile lifestyle, allowing them to detect and capture food approaching from any direction.

(g) Spiral symmetry is not a major category of animal symmetry.

(h) Bilateral symmetry is characteristic of mobile animals that have a defined head region (anterior) and tail region (posterior).

(i) Therefore, sessile animals like sea anemones exhibit radial symmetry.

**Final Answer:** Sea anemones exhibit radial symmetry.

**Answer: (C)**

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## Q27.

### Solution

**Concept:**

Excretion is the removal of metabolic wastes from the body. Different animals have evolved diverse excretory organs adapted to their environments and lifestyles. Understanding the excretory system is fundamental to comparative animal physiology.

**Solution:**

(a) Gastropod mollusks (snails and slugs) are terrestrial, marine, and freshwater animals with diverse body forms.

(b) In terrestrial gastropods, excretion occurs through a single kidney (nephridium).

(c) This nephridium is derived from the molluscan nephridium and functions to remove nitrogenous wastes.

(d) The nephridium filters the hemolymph (body fluid) and produces urine that is excreted through the nephridial duct.

(e) A kidney (in the mammalian sense) is a specific structure found in vertebrates, not mollusks.

(f) A metanephridium is the type of nephridium found in annelids, which differs from the single nephridium of gastropods.

(g) An open heart is a circulatory system feature, not an excretory structure.

(h) Most gastropods have a single kidney-like structure called a nephridium (sometimes called a kidney to reflect its function).

(i) Therefore, the excretory organ in terrestrial gastropods is a nephridium.

**Final Answer:** The excretory organ is a nephridium.

**Answer: (D)**

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## Q28.

### Solution

**Concept:**

The insect nervous system organization reflects its body organization and lifestyle. The principal nervous system element running along the body has specific structural features and functional importance. Understanding insect neurobiology is essential to understanding insect behavior and physiology.

**Solution:**

(a) The insect nervous system consists of a brain (in the head) and a ventral nerve cord running along the ventral (belly) side of the body.

(b) The ventral nerve cord contains segmental ganglia in each body segment, with neural connections allowing coordination of movements.

(c) The ventral nerve cord is the main processing and coordination center for the insect, integrating sensory information and controlling motor output.

(d) The dorsal heart/vessel (labeled A in the diagram) is a tubular heart running along the dorsal side, not the ventral nerve cord.

(e) The hemocoel is the body cavity where hemolymph circulates, not a nervous structure.

(f) The gut is the digestive system, not a nervous structure.

(g) The question asks about the ventral nerve cord, which is already labeled as structure B in the diagram.

(h) The ventral nerve cord is the primary nervous system element coordinating insect activities.

**Final Answer:** The ventral nerve cord is structure B (labeled in the diagram).

**Answer: (B)**

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## Q29.

### Solution

**Concept:**

Oxygen transport in blood is accomplished through various mechanisms, with different blood pigments serving this function in different animal groups. Understanding blood pigments is important to understanding oxygen delivery and respiration in different organisms.

**Solution:**

(a) Hemoglobin is the iron-containing blood pigment found in vertebrates (and some invertebrates) that binds oxygen.

(b) Chlorocruorein is a blood pigment found in some marine worms and bivalves, containing iron and chlorophyll-like structures.

(c) Hemocyanin is a copper-containing blood pigment found in many arthropods and mollusks (such as crustaceans and cephalopod mollusks).

(d) Myoglobin is a protein found in muscle tissue that binds and stores oxygen, not a blood pigment.

(e) Earthworms, being annelids, have a closed circulatory system but lack true hemoglobin dissolved in blood.

(f) Instead, earthworms have hemoglobin (or a similar iron-containing pigment) that is bound to proteins in their blood plasma.

(g) This hemoglobin-like compound in earthworms binds oxygen and transports it through the closed circulatory system.

(h) The blood pigment that binds oxygen in earthworms is hemoglobin (or a hemoglobin-like compound).

**Final Answer:** The blood pigment in earthworms is hemoglobin.

**Answer: (A)**

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## Q30.

### Solution

**Concept:**

Parasitic flatworms (trematodes) have complex life cycles involving multiple hosts and larval stages. Understanding the terminology for different larval forms is important to understanding parasite biology and transmission.

**Solution:**

(a) A miracidium is the free-swimming larval stage of some trematodes that infects the intermediate host.

(b) A cercaria is a later larval stage of trematodes that develops in the intermediate host and is released to infect the definitive host.

(c) A cysticercus is the larval stage of tapeworms (cestodes) that develops in the intermediate host as an encysted larva.

(d) A metacercaria is an encysted larval stage of some trematodes found in the intermediate host or in environmental sources.

(e) The tapeworm life cycle involves the adult in the definitive host producing eggs that are released in feces.

(f) These eggs develop in the environment and are ingested by the intermediate host (often a small herbivore or copepod).

(g) In the intermediate host, the larval form (cysticercus in tapeworms or other forms in trematodes) develops.

(h) When the intermediate host is consumed by the definitive host, infection is transmitted.

(i) The larval form in the intermediate host of a tapeworm is specifically called a cysticercus.

**Final Answer:** The larval form in the intermediate host is a cysticercus.

**Answer: (C)**

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## Q31.

### Solution

**Concept:**

Glucose homeostasis is critical for normal animal physiology, particularly for maintaining energy availability in the brain and muscles. Several hormones are involved in regulating blood glucose levels, with specific hormones having opposing effects.

**Solution:**

(a) Blood glucose levels must be maintained within a narrow range (approximately 70-100 mg/dL in humans) for optimal function.

(b) The pancreas is an endocrine gland that secretes hormones responsible for regulating blood glucose.

(c) Insulin is secreted by beta cells of the pancreatic islets (islets of Langerhans) in response to high blood glucose.

(d) Insulin lowers blood glucose by promoting glucose uptake by cells and conversion to glycogen or fat for storage.

(e) Glucagon is secreted by alpha cells of the pancreatic islets in response to low blood glucose.

(f) Glucagon raises blood glucose by promoting glycogen breakdown (glycogenolysis) and glucose synthesis (gluconeogenesis).

(g) The thyroid gland secretes thyroxine, which affects metabolic rate but does not directly regulate blood glucose.

(h) The adrenal gland secretes epinephrine and cortisol, which can affect blood glucose but are not the primary glucose regulators.

(i) The pituitary gland secretes growth hormone and other hormones but does not directly regulate blood glucose.

**Final Answer:** The pancreas secretes hormones that regulate blood glucose.

**Answer: (B)**

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## Q32.

### Solution

**Concept:**

The kidney develops through a series of developmental stages, with different kidneys functioning at different developmental stages in amniote vertebrates. Understanding kidney development is important to understanding urogenital system formation.

**Solution:**

(a) The pronephros is the earliest kidney to develop, functioning briefly in early embryonic development, particularly in aquatic vertebrates.

(b) The mesonephros develops after the pronephros and serves as the functional kidney during middle embryonic development.

(c) The metanephros is the definitive kidney that develops last and becomes the functional kidney in adult amniotes (reptiles, birds, mammals).

(d) The ureteric bud (also called the ureteric diverticulum) is an outgrowth of the mesonephric duct that develops into the ureter.

(e) The ureteric bud elongates and branches to form the ureters (which carry urine to the bladder) and the major and minor calyces (which collect urine from the kidney).

(f) The process of ureteric bud development and branching into these structures is part of metanephros development.

(g) The term for this developmental process is metanephros development (or nephrogenesis).

(h) This is distinct from pronephros and mesonephros development, which are earlier stages.

**Final Answer:** This is metanephros development.

**Answer: (C)**

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## Q33.

### Solution

**Concept:**

Reproduction in animals occurs through various mechanisms, with different organisms producing different types of gametes. The terminology for different reproductive strategies reflects the types of gametes and sexual dimorphism present.

**Solution:**

(a) Heterogamy is the production of two different types of gametes by one individual or by the two sexes.

(b) In most animals with sexual reproduction, one sex (usually males) produces many small gametes (sperm), while the other sex (usually females) produces fewer large gametes (eggs).

(c) This difference in gamete size and number is the definition of heterogamy.

(d) Isogamy is the production of similar or identical gametes, as seen in some algae and fungi where both sexes produce similar-sized gametes.

(e) Oogamy is a specific type of heterogamy where there is extreme size dimorphism between large eggs and small sperm.

(f) Parthenogenesis is asexual reproduction from an unfertilized egg, not a type of gamete production.

(g) Heterogamy describes the phenomenon of different gamete types, making it the correct answer.

**Final Answer:** The phenomenon is called heterogamy.

**Answer: (A)**

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## Q34.

### Solution

**Concept:**

The cardiac cycle describes the sequence of events during one heartbeat. Different phases of the cycle involve different chambers contracting and different valves opening and closing. Understanding the phases is essential to understanding cardiac physiology.

**Solution:**

(a) The cardiac cycle consists of atrial and ventricular systole (contraction) and diastole (relaxation).

(b) Phase 1: Atrial systole occurs when the atria contract, forcing blood into the relaxed ventricles.

(c) Phase 2: Ventricular systole occurs when the ventricles contract, forcing blood into the arteries and closing the atrioventricular valves.

(d) Phase 3: Isovolumetric relaxation is the brief period when the ventricles relax but the semilunar valves have closed, so ventricular volume is constant.

(e) Ventricular filling occurs during ventricular diastole (when ventricles are relaxed), which includes both passive filling and active filling during atrial systole.

(f) The period labeled as "before Phase 1" or during the preceding diastole is when ventricular filling occurs.

(g) Ventricular filling is not represented in the phases shown (1, 2, 3) if we consider only the active phases of contraction.

(h) However, if the diagram shows the complete cycle, the diastolic period before Phase 1 would represent ventricular filling.

**Final Answer:** Ventricular filling occurs before Phase 1 (during ventricular diastole).

**Answer: (D)**

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## Q35.

### Solution

**Concept:**

Reproduction can occur through two fundamentally different mechanisms: sexual reproduction involving gamete fusion and asexual reproduction without gamete involvement. Understanding these two major reproductive strategies is fundamental to biology.

**Solution:**

(a) Sexual reproduction involves the fusion of two gametes (sperm and egg) to produce offspring with genetic material from both parents.

(b) Asexual reproduction produces offspring without the fusion of gametes, resulting in genetically identical clones of the parent.

(c) Examples of asexual reproduction include budding (growth of new individuals from parent tissue), fission (splitting of parent into two), and fragmentation (breaking of parent into multiple pieces).

(d) Hermaphroditism is a condition where an individual possesses both male and female reproductive organs, not a type of reproduction per se.

(e) Budding is one example of asexual reproduction, but the term "asexual reproduction" encompasses all reproductive mechanisms without gamete fusion.

(f) The broader category that includes budding, fission, fragmentation, and other non-sexual modes is asexual reproduction.

(g) Therefore, the term for reproduction without gamete fusion is asexual reproduction.

**Final Answer:** Reproduction without gamete fusion is asexual reproduction.

**Answer: (B)**

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## Q36.

### Solution

**Concept:**

The pituitary gland is divided into anterior and posterior lobes with distinct hormonal products and functions. The posterior pituitary stores and releases hormones produced by the hypothalamus, while the anterior pituitary synthesizes and releases its own hormones.

**Solution:**

(a) The posterior pituitary (neurohypophysis) stores and releases two hormones: antidiuretic hormone (ADH) and oxytocin.

(b) ADH (also called vasopressin) is produced by the hypothalamus and stored in the posterior pituitary.

(c) ADH acts on the collecting ducts of the kidney, promoting the reabsorption of water and the production of concentrated urine.

(d) This mechanism allows the body to conserve water during dehydration or high solute concentrations.

(e) Oxytocin is the other posterior pituitary hormone, involved in contraction of the uterus during labor and milk letdown during nursing.

(f) Thyroxine is secreted by the thyroid gland, not the pituitary.

(g) Prolactin is secreted by the anterior pituitary, not the posterior pituitary.

(h) The anterior pituitary secretes growth hormone, ACTH, TSH, LH, and FSH, but not ADH.

(i) Therefore, ADH is the hormone secreted by the posterior pituitary that promotes water reabsorption.

**Final Answer:** ADH is the hormone promoting water reabsorption.

**Answer: (B)**

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## Q37.

### Solution

**Concept:**

The exoskeleton is the external skeletal structure of arthropods, providing protection and support while also serving as a surface for muscle attachment. Understanding exoskeleton composition is important to understanding arthropod structure and function.

**Solution:**

(a) The arthropod exoskeleton is a non-living, rigid outer covering composed primarily of chitin and protein.

(b) Chitin is a polysaccharide that provides structural rigidity and water resistance.

(c) Protein (particularly resilin and other structural proteins) provides flexibility and strength to the exoskeleton.

(d) The exoskeleton is secreted by the underlying epidermis and is periodically shed (molted) to allow growth.

(e) Calcium carbonate is the primary component of shells in mollusks and some crustaceans, but not the typical arthropod exoskeleton.

(f) Cellulose is a plant cell wall component, not a component of animal exoskeletons.

(g) Collagen fibers are found in vertebrate connective tissues and skin, not in arthropod exoskeletons.

(h) The chitin-protein exoskeleton provides flexibility at joints while maintaining rigidity in the body wall.

(i) This structure is lightweight, strong, and waterproof, making it ideal for terrestrial arthropods.

**Final Answer:** The exoskeleton is primarily composed of chitin and protein.

**Answer: (B)**

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## Q38.

### Solution

**Concept:**

Parasitic nematodes cause significant morbidity and mortality in human populations worldwide. Different nematodes have different transmission routes and affect different body systems. Understanding nematode transmission is important for disease prevention.

**Solution:**

(a) Wuchereria bancrofti is transmitted by mosquitoes (not contaminated food/water) and causes lymphatic filariasis.

(b) Trichinella spiralis is transmitted through consumption of undercooked meat, not contaminated food and water.

(c) Ascaris lumbricoides is transmitted through ingestion of contaminated food and water containing embryonated eggs.

(d) This nematode infects the small intestine, causing malnutrition, intestinal obstruction, and other complications.

(e) Ascaris is one of the most common helminthic infections worldwide, particularly in areas with poor sanitation.

(f) Hookworm (Necator americanus and Ancylostoma duodenale) is transmitted through larval penetration of the skin (usually the feet), not through contaminated food/water.

(g) The key feature of Ascaris transmission is ingestion of contaminated food or water, not another transmission route.

(h) Therefore, Ascaris lumbricoides is the parasitic nematode transmitted through contaminated food and water.

**Final Answer:** Ascaris lumbricoides is transmitted through contaminated food and water.

**Answer: (C)**

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## Q39.

### Solution

**Concept:**

The eye is a complex optical instrument that must focus light precisely on the retina for clear vision. The lens plays a crucial role in this focusing process, with its shape changing to accommodate objects at different distances.

**Solution:**

(a) Accommodation is the process by which the lens changes shape to focus light on the retina.

(b) This process involves contraction of the ciliary muscle, which relieves tension on the suspensory ligaments holding the lens.

(c) When the ciliary muscle contracts, the lens becomes thicker and more curved, increasing its refractive power.

(d) This increased refractive power allows the eye to focus on near objects.

(e) When the ciliary muscle relaxes, the lens flattens, reducing its refractive power and allowing focus on distant objects.

(f) Convergence is the inward movement of the eyes to direct gaze toward a single point.

(g) Refraction is the bending of light as it passes through different media (including the lens).

(h) Reflection is the bouncing of light off a surface.

(i) Accommodation is the specific term for the lens shape-changing mechanism for focusing.

**Final Answer:** The process is called accommodation.

**Answer: (A)**

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## Q40.

### Solution

**Concept:**

The notochord is an embryonic structure that appears in all chordates at some stage of development. In some chordates, the notochord persists into adulthood, while in others, it is replaced by other structures during development.

**Solution:**

(a) The notochord is a flexible, rod-like structure composed of a core of vacuolated cells surrounded by a sheath.

(b) It appears in the embryo of all chordates and serves as an initial skeletal support.

(c) In lampreys (jawless fish), the notochord persists throughout life as the main supporting structure.

(d) In teleost fish (most fish with true vertebrae), the notochord is largely replaced by the vertebral column during development, though remnants may persist.

(e) In salamanders and other amphibians, the notochord is also replaced by the vertebral column.

(f) In mammals (including humans), the notochord is mostly replaced by the vertebral column, though a small remnant persists as the nucleus pulposus of intervertebral discs.

(g) Therefore, the vertebrate stage that has a notochord in the embryo that is replaced by the vertebral column in adults is the mammal (and other vertebrates with true backbones).

(h) Lampreys retain the notochord throughout life, unlike other vertebrates.

**Final Answer:** The mammal is the vertebrate stage with notochord replaced by the vertebral column.

**Answer: (D)**

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# Answer Key

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