Rajasthan JET Biology Sample Paper-10

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. In C_4 plants, the primary fixation of carbon dioxide (CO_2) by the enzyme PEP carboxylase takes place within the cytoplasm of the mesophyll cells. Where does the subsequent decarboxylation and secondary fixation via the Calvin cycle occur?

(A) Bundle sheath cells

(B) Epidermal cells

(C) Phloem parenchyma

(D) Xylem vessels

Q2. Conserving seeds of rare crop varieties in a long-term seed bank is best classified as:

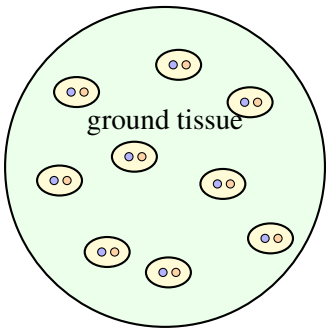
(A) in situ conservation inside the natural habitat

(B) sacred-grove conservation by local community

(C) ex situ conservation outside the natural habitat

(D) natural succession in an abandoned field

Q3. The diagram shows a stem transverse section with scattered vascular bundles. Each bundle is closed and lacks cambium. Which identification is most appropriate?



scattered closed vascular bundles

(A) Dicot root

(B) Dicot stem

(C) Monocot root

(D) Monocot stem

Q4. The molecular scissors used in recombinant DNA work cut DNA at specific recognition sites that often read the same on both strands in opposite directions. Such recognition sites are called:

(A) palindromic sequences

(B) telomeric caps

(C) exon-intron junctions only

(D) centromeric repeats only

Q5. In snapdragon, a cross between a true-breeding red-flowered plant and a true-breeding white-flowered plant gives pink flowers in F_1. When the F_1 plants are selfed, the expected phenotypic ratio is:

(A) 3 : 1

(B) 9 : 3 : 3 : 1

(C) 1 : 2 : 1

(D) 1 : 1

Q6. The commercially useful fibre of cotton is derived mainly from which plant part?

(A) seed coat epidermal hairs

(B) phloem fibres of the stem

(C) xylem vessels of the root

(D) latex ducts of the leaf

Q7. Pearl millet plants show downy fungal growth on the lower leaf surface and some earheads become leafy green structures instead of normal grain-bearing heads. The causal organism is most likely:

(A) *Tilletia indica*

(B) *Xanthomonas citri*

(C) *Alternaria solani*

(D) *Sclerospora graminicola*

Q8. In C_4 plants, the concentration of carbon dioxide around RuBisCO remains high inside bundle sheath cells. The immediate advantage of this arrangement is that it:

(A) stops all light absorption by chlorophyll

(B) reduces photorespiration by limiting oxygenase activity of RuBisCO

(C) prevents any movement of water through xylem

(D) converts glucose directly into proteins in chloroplasts

Q9. Excess nitrate and phosphate runoff enters a village pond after heavy fertilizer use. Soon the pond shows algal bloom followed by low dissolved oxygen and fish mortality. This sequence is best explained by:

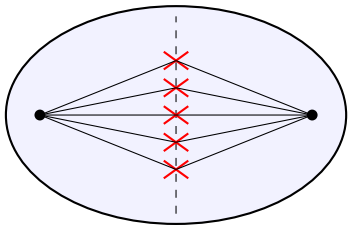
(A) biomagnification of carbon dioxide

(B) nitrogen fixation by fish

(C) eutrophication due to nutrient enrichment

(D) ozone depletion above water

Q10. The cell shown below has condensed chromosomes arranged at the equatorial plate and spindle fibres attached from opposite poles. Which mitotic stage is represented?



chromosomes at equator

(A) Metaphase

(B) Telophase

(C) Interphase

(D) Cytokinesis

Q11. In plant tissue culture, a callus is transferred to a medium with a relatively high cytokinin-to-auxin ratio. The most likely morphogenetic response is:

(A) only root initiation

(B) shoot initiation

(C) immediate seed formation

(D) loss of totipotency in all cells

Q12. The liquid endosperm of coconut represents a condition in which repeated nuclear divisions occur before extensive wall formation. This type of endosperm development is called:

(A) cellular endosperm

(B) helobial endosperm

(C) nuclear endosperm

(D) perisperm formation

Q13. In cumin, the spice used in food and trade consists mainly of the dried mature:

(A) root tubers

(B) schizocarpic fruits

(C) leaf buds

(D) petal lobes

Q14. When guard cells actively accumulate potassium ions, water enters them and the stomatal pore opens. The best explanation is that potassium ion accumulation:

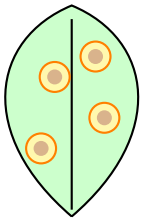
(A) lowers guard-cell water potential and draws water in osmotically

(B) destroys chlorophyll in guard cells immediately

(C) converts guard cells into xylem vessels

(D) blocks all carbon dioxide diffusion into the leaf

Q15. A citrus leaf develops raised corky lesions with yellow halos, as sketched below. Which causal agent is most likely involved?



citrus leaf

(A) *Puccinia graminis*

(B) *Sclerospora graminicola*

(C) *Xanthomonas citri*

(D) *Rhizobium leguminosarum*

Q16. In mangrove plants growing in waterlogged soil, many roots grow upward above the soil surface. Their main function is to:

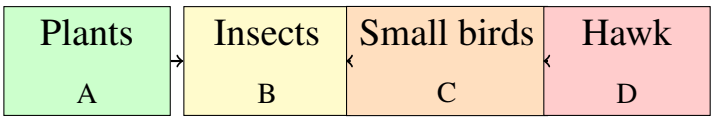
(A) store excess starch only

(B) absorb light for photosynthesis only

(C) produce flowers below ground

(D) facilitate gaseous exchange in poorly aerated soil

Q17. The diagram shows movement of a persistent pesticide through a food chain. At which level will its concentration generally be maximum?



pesticide concentration increases along the chain

(A) A

(B) B

(C) C

(D) D

Q18. An enzyme loses catalytic activity after being exposed to very high temperature because the heat mainly:

(A) increases the number of active sites permanently

(B) alters the three-dimensional shape of the protein and active site

(C) converts every substrate into inhibitor

(D) changes the enzyme into a carbohydrate polymer

Q19. In a plant transformation experiment, only cells that have taken up the vector survive on a medium containing an antibiotic. The gene that allows this selection is called a:

(A) selectable marker

(B) origin of replication inhibitor

(C) promoterless intron

(D) telomerase poison

Q20. A plant with genotype $AaBb$ is test-crossed with $aabb$. If the two genes assort independently, the expected phenotypic ratio among progeny is:

(A) 9 : 3 : 3 : 1

(B) 3 : 1

(C) 1 : 1 : 1 : 1

(D) 1 : 2 : 1

Q21. Safflower is cultivated as an oilseed crop. The edible oil is obtained mainly from its:

(A) petals

(B) seeds

(C) fibrous bark

(D) aerial roots

Q22. Wheat grains from an infected field show partial bunt, black powdery masses, and a fishy smell. The disease is most likely caused by:

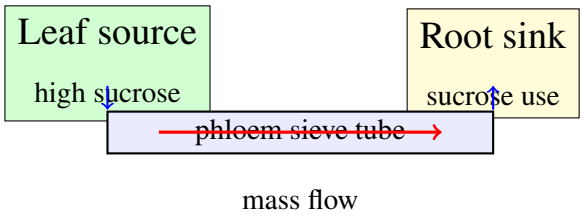
(A) *Tilletia indica*

(B) *Claviceps fusiformis*

(C) *Fusarium oxysporum*

(D) *Xanthomonas oryzae*

Q23. In the pressure-flow model shown below, sucrose loading at the source causes water entry into phloem and creates high pressure. The bulk flow of sap is mainly from:



(A) low-pressure sink to high-pressure source

(B) high-pressure source to low-pressure sink

(C) xylem vessel to cork cambium only

(D) epidermis to stomatal pore only

Q24. In arid grazing lands, removal of protective plant cover by excessive grazing most directly accelerates desertification because it:

(A) increases soil erosion and reduces organic matter input

(B) converts sand particles into clay minerals overnight

(C) prevents wind movement completely

(D) increases permanent forest cover immediately

Q25. In germinating barley seeds, gibberellin released from the embryo stimulates the aleurone layer to produce which enzyme for mobilizing starch reserves?

(A) Pepsin

(B) DNA ligase

(C) Cellulase only

(D) Alpha-amylase

Q26. An adult marine animal has tube feet, a water vascular system, and pentaradial symmetry. It belongs to which phylum?

(A) Mollusca

(B) Arthropoda

(C) Echinodermata

(D) Nematoda

Q27. The larval stage of khapra beetle is especially damaging in stored grain because it:

(A) pollinates the crop during storage

(B) feeds on kernels and contaminates grain with cast skins and frass

(C) fixes nitrogen inside wheat bags

(D) protects grain from fungal infection

Q28. A student has body mass 70 kg and height 1.75 m. Using the BMI formula shown in the diagram, what is the approximate BMI?

$$BMI = \frac{\text{body mass in kg}}{(\text{height in m})^2}$$
nutritional assessment index

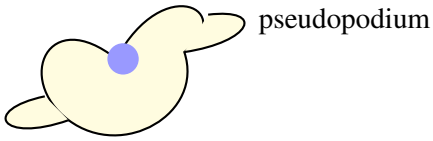
(A) 22.9

(B) 28.6

(C) 35.0

(D) 17.5

Q29. The diagram shows an *Amoeba* extending temporary cytoplasmic projections. These structures are mainly used for:



Amoeba

(A) forming a permanent shell only

(B) pumping blood through vessels

(C) producing eggs inside testes

(D) locomotion and engulfing food particles

Q30. In integrated pest management, the economic threshold level refers to the pest population density at which:

(A) all natural enemies must be killed immediately

(B) the crop must be harvested regardless of maturity

(C) control action should begin to prevent economic loss

(D) pests become permanently extinct in the field

Q31. The vitamin that promotes calcium absorption and whose deficiency in children may lead to rickets is:

(A) Vitamin C

(B) Vitamin D

(C) Vitamin B_1

(D) Vitamin K

Q32. In earthworm, the internal fold of the intestinal wall called typhlosole is important because it:

(A) increases the absorptive surface area of the intestine

(B) acts as the main reproductive organ

(C) produces the clitellum externally

(D) blocks food movement permanently

Q33. The desert locust becomes a serious agricultural pest mainly because under favourable conditions it can:

(A) change into a plant pathogen bacterium

(B) feed only on stored pulses in closed bins

(C) lose all wings and stop movement

(D) form large migratory swarms that consume green vegetation

Q34. During short-term fasting, liver glycogen is broken down to help maintain blood glucose. This process is called:

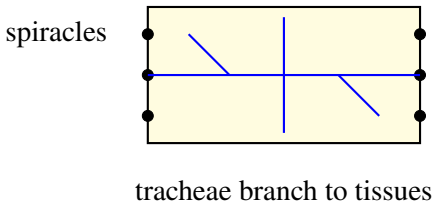
(A) glycogenesis

(B) glycogenolysis

(C) lipogenesis

(D) deamination

Q35. The simplified insect tracheal system below shows air entering through spiracles and branching tubes reaching tissues. Which statement is correct?



(A) Oxygen is carried mainly by red blood cells

(B) Air first enters the lungs and then the gills

(C) Oxygen reaches tissues directly through tracheal tubes

(D) Tracheae are used only for excretion

Q36. A pesticide recommendation is 2 L formulation per hectare. A sprayer applies 500 L water per hectare. How much formulation is needed for a 15 L tank?

(A) 15 mL

(B) 30 mL

(C) 60 mL

(D) 120 mL

Q37. Which one of the following is an essential fatty acid required in the human diet?

(A) Linoleic acid

(B) Palmitic acid only

(C) Stearic acid only

(D) Cholesterol

Q38. An unsegmented roundworm has a pseudocoelom and a complete digestive tract with separate mouth and anus. It belongs to:

(A) Platyhelminthes

(B) Nematoda

(C) Annelida

(D) Cnidaria

Q39. The ladybird beetle is useful in biological control mainly because it:

(A) transmits viral diseases to crop plants

(B) predates on aphids and other soft-bodied pests

(C) feeds only on stored wheat grains

(D) destroys all soil organic matter

Q40. A teenager has fatigue, pale conjunctiva, and low haemoglobin. If the main dietary deficiency is a mineral needed for haemoglobin formation, the deficient mineral is most likely:

(A) Iodine

(B) Calcium

(C) Iron

(D) Sodium

Detailed Solutions

Q1.

Solution

Concept:

The C_4 photosynthetic pathway is an evolutionary adaptation designed to minimize photorespiration and optimize carbon fixation efficiency in hot, arid environments. This mechanism physically separates initial carbon capture from the Calvin cycle across two distinct cell layers, establishing a concentrated carbon dioxide environment around the primary carboxylating enzyme, Rubisco.

Solution:

(a) Atmospheric carbon dioxide is first captured in the mesophyll cells, where it combines with phosphoenolpyruvate (PEP) via PEP carboxylase to form the four-carbon compound oxaloacetate. PEP carboxylase possesses a high affinity for carbon dioxide and no affinity for oxygen, effectively bypassing photorespiration.

(b) Oxaloacetate is rapidly converted into malate or aspartate, which is then actively transported through plasmodesmata into the adjacent, thick-walled bundle sheath cells that surround the vascular bundles.

(c) Inside the bundle sheath cells, these four-carbon organic acids undergo enzymatic decarboxylation, releasing a concentrated stream of carbon dioxide directly around Rubisco, while returning a three-carbon molecule to the mesophyll cells.

(d) This high local concentration of carbon dioxide allows Rubisco to function at maximum efficiency, driving the conventional Calvin cycle (C_3 cycle) to synthesize sugars while minimizing the wasteful oxygenase activity.

Final Answer: Bundle sheath cells.

Answer: (A)

Go Back to Question 1

Q2.

Solution

Concept:

Biodiversity can be conserved either in its natural habitat or outside it. In situ conservation protects organisms in their original ecosystems, such as national parks and sanctuaries. Ex situ conservation protects seeds, tissues, gametes, or organisms away from their natural habitat, as in seed banks, botanical gardens, and tissue culture repositories.

Solution:

(a) **Step 1:** The material being conserved is seed, not a whole natural ecosystem.

(b) **Step 2:** A seed bank stores seeds under controlled conditions away from the field where the plants normally grow.

(c) **Step 3:** Since conservation occurs outside the natural habitat, the method is ex situ conservation.

(d) **Step 4:** In situ conservation would mean conserving the plants in their actual habitat or agro-ecosystem.

(e) **Step 5:** Sacred groves are community-protected natural patches, and succession is an ecological process, not a seed-bank method.

Final Answer: Ex situ conservation

Answer: (C)

Go Back to Question 2

Q3.

Solution

Concept:

Stem anatomy differs in monocots and dicots. In dicot stems, vascular bundles are usually arranged in a ring and are open because cambium is present. In monocot stems, vascular bundles are scattered throughout the ground tissue and are closed because cambium is absent.

Solution:

(a) **Step 1:** The diagram shows vascular bundles scattered throughout the section instead of forming a ring.

(b) **Step 2:** The question states that the vascular bundles are closed, which means cambium is absent between xylem and phloem.

(c) **Step 3:** Scattered closed vascular bundles are characteristic of a monocot stem.

(d) **Step 4:** A dicot stem usually has a ring of open vascular bundles, while roots show radial arrangement of xylem and phloem rather than scattered collateral bundles.

(e) **Step 5:** Therefore, the section is best identified as a monocot stem.

Final Answer: Monocot stem

Answer: (D)

Go Back to Question 3

Q4.

Solution

Concept:

Restriction endonucleases are enzymes used in recombinant DNA technology. They recognize specific short DNA sequences and cut the DNA at or near those sites. Many restriction enzyme recognition sequences are palindromic, meaning the sequence reads the same in the $5' \rightarrow 3'$ direction on both complementary strands.

Solution:

(a) **Step 1:** The question describes enzymes that cut DNA at specific sites, so the topic is restriction endonucleases.

(b) **Step 2:** Their recognition sequences are often symmetrical when read on complementary strands.

(c) **Step 3:** Such DNA sequences are called palindromic sequences.

(d) **Step 4:** Telomeres are chromosome ends, exon-intron junctions are gene structural boundaries, and centromeric repeats are chromosome regions for spindle attachment.

(e) **Step 5:** These alternatives do not describe the usual recognition sites of restriction enzymes.

Final Answer: Palindromic sequences

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept:

Incomplete dominance occurs when the heterozygote shows an intermediate phenotype instead of resembling only one parent. In snapdragon, red and white alleles show incomplete dominance, so the heterozygote is pink. In such cases, the genotypic and phenotypic ratios in the F_2 generation are both $1 : 2 : 1$.

Solution:

(a) **Step 1:** Let the red allele be R and the white allele be r.

(b) **Step 2:** The parental cross is $RR \times rr$, so all F_1 plants are Rr.

(c) **Step 3:** Because dominance is incomplete, the heterozygous Rr plants are pink.

(d) **Step 4:** Selfing F_1 gives $Rr \times Rr$.

(e) **Step 5:** The genotypes produced are RR, Rr, Rr, and rr, giving a $1 : 2 : 1$ ratio.

(f) **Step 6:** Since each genotype has a distinct phenotype, the phenotypic ratio is also red:pink:white = $1 : 2 : 1$.

Final Answer: $\boxed{1 : 2 : 1}$

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept:

Economic botany identifies the plant parts that provide useful products. Cotton fibre is not a stem fibre like jute. It is a unicellular hair that develops from the epidermal cells of the seed coat. These long hairs are collected and processed as cotton lint.

Solution:

(a) **Step 1:** Cotton fibre is associated with the seed of *Gossypium*.

(b) **Step 2:** The fibre develops as an outgrowth of the seed coat epidermis.

(c) **Step 3:** Each cotton fibre is essentially an elongated seed hair.

(d) **Step 4:** Phloem fibres of the stem describe bast fibres such as jute, not cotton.

(e) **Step 5:** Xylem vessels and latex ducts do not produce commercial cotton lint.

Final Answer: Seed coat epidermal hairs

Answer: (A)

Go Back to Question 6

Q7.

Solution

Concept:

Plant diseases are identified by the host, symptoms, and pathogen. Downy mildew of pearl millet is caused by *Sclerospora graminicola*. It may produce downy growth on leaves and a characteristic green ear symptom in which floral structures are transformed into leafy structures.

Solution:

(a) **Step 1:** The host crop is pearl millet, a major dryland crop.

(b) **Step 2:** Downy growth on the lower leaf surface suggests a downy mildew disease.

(c) **Step 3:** The transformation of earheads into leafy green structures is called green ear, a well-known symptom in pearl millet downy mildew.

(d) **Step 4:** *Sclerospora graminicola* is the causal organism of this disease.

(e) **Step 5:** *Tilletia indica* causes Karnal bunt of wheat, *Xanthomonas citri* causes citrus canker, and *Alternaria solani* is linked with early blight.

Final Answer: *Sclerospora graminicola*

Answer: (D)

Go Back to Question 7

Q8.

Solution

Concept:

RuBisCO can act as a carboxylase or an oxygenase. When oxygen competes successfully with carbon dioxide, photorespiration increases and photosynthetic efficiency decreases. C_4 plants separate initial carbon dioxide fixation and the Calvin cycle, creating a high carbon dioxide concentration around RuBisCO in bundle sheath cells.

Solution:

(a) **Step 1:** In C_4 plants, mesophyll cells first fix carbon dioxide into four-carbon acids.

(b) **Step 2:** These acids move to bundle sheath cells and release carbon dioxide there.

(c) **Step 3:** The released carbon dioxide accumulates near RuBisCO.

(d) **Step 4:** High carbon dioxide concentration favours the carboxylase activity of RuBisCO over its oxygenase activity.

(e) **Step 5:** This reduces photorespiration and improves photosynthetic efficiency, especially in hot and dry conditions.

(f) **Step 6:** The other options do not describe the role of the C_4 carbon dioxide-concentrating mechanism.

Final Answer: Reduction of photorespiration

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept:

Eutrophication is the enrichment of a water body with nutrients such as nitrates and phosphates. These nutrients stimulate rapid algal growth. When algae die, decomposers use oxygen while breaking down organic matter, causing a fall in dissolved oxygen and harming aquatic animals.

Solution:

(a) **Step 1:** The pond receives excess nitrate and phosphate from fertilizer runoff.

(b) **Step 2:** These nutrients stimulate rapid multiplication of algae, forming an algal bloom.

(c) **Step 3:** After the bloom declines, dead algal matter is decomposed by microbes.

(d) **Step 4:** Microbial decomposition consumes dissolved oxygen from the water.

(e) **Step 5:** Low dissolved oxygen can suffocate fish and other aquatic organisms.

(f) **Step 6:** Therefore, the sequence is eutrophication.

Final Answer: Eutrophication

Answer: (C)

Go Back to Question 9

Q10.

Solution

Concept:

Mitosis has characteristic stages. During metaphase, chromosomes are maximally condensed and align at the equatorial plate. Spindle fibres from opposite poles attach to the kinetochores. This arrangement ensures equal separation of sister chromatids during the next stage, anaphase.

Solution:

(a) **Step 1:** The diagram shows condensed chromosomes, so the cell is not in interphase.

(b) **Step 2:** The chromosomes are arranged along the equatorial plate.

(c) **Step 3:** Spindle fibres are shown extending from opposite poles to the chromosomes.

(d) **Step 4:** This combination of equatorial alignment and spindle attachment is the defining feature of metaphase.

(e) **Step 5:** In telophase, chromosomes would reach the poles and nuclear envelopes would re-form. In cytokinesis, cytoplasmic division would be prominent.

(f) **Step 6:** Therefore, the stage shown is metaphase.

Final Answer: Metaphase

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept:

Plant tissue culture depends strongly on the balance of growth regulators. Auxins and cytokinins influence organogenesis. A relatively high auxin level favours root formation, while a relatively high cytokinin level favours shoot formation. A balanced level often maintains callus proliferation.

Solution:

(a) **Step 1:** The starting material is callus, a mass of undifferentiated plant cells.

(b) **Step 2:** The medium has a high cytokinin-to-auxin ratio.

(c) **Step 3:** Cytokinins promote cell division and shoot bud initiation when present at a relatively higher level than auxin.

(d) **Step 4:** If auxin were dominant, root initiation would be expected instead.

(e) **Step 5:** Seed formation is not a direct response of callus to this hormone ratio, and plant cells do not necessarily lose totipotency.

(f) **Step 6:** Therefore, shoot initiation is the most likely response.

Final Answer: Shoot initiation

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept:

Endosperm development in angiosperms may be nuclear, cellular, or helobial. In nuclear endosperm development, the primary endosperm nucleus divides repeatedly without immediate cell wall formation. Coconut water is a familiar example of free-nuclear endosperm.

Solution:

(a) **Step 1:** The question states that nuclear divisions occur before extensive wall formation.

(b) **Step 2:** This means many nuclei are initially present in a common cytoplasm.

(c) **Step 3:** Such development is called nuclear endosperm development.

(d) **Step 4:** Coconut liquid endosperm contains free nuclei in early stages, which is why it is used as a standard example.

(e) **Step 5:** Cellular endosperm would form walls after each nuclear division, and perisperm is persistent nucellus, not endosperm.

Final Answer: Nuclear endosperm

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept:

Many spices are specific plant parts. Cumin, obtained from *Cuminum cyminum*, belongs to Apiaceae. The commercial spice consists of dried fruits, commonly described as schizocarpic fruits, which split into one-seeded mericarps when mature.

Solution:

(a) **Step 1:** The question asks about the plant part used as cumin spice.

(b) **Step 2:** Cumin is not a root, leaf bud, or flower petal product.

(c) **Step 3:** The useful product is the dried mature fruit.

(d) **Step 4:** In Apiaceae, this fruit is a schizocarp that splits into mericarps.

(e) **Step 5:** Therefore, cumin spice consists mainly of dried schizocarpic fruits.

Final Answer: Schizocarpic fruits

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept:

Stomatal opening depends on guard-cell turgor. When guard cells accumulate solutes such as potassium ions, their water potential becomes lower than that of surrounding cells. Water then enters by osmosis, guard cells become turgid, and the stomatal pore opens.

Solution:

(a) **Step 1:** Potassium ions are solutes, so their accumulation increases the solute concentration inside guard cells.

(b) **Step 2:** Increased solute concentration lowers the water potential of the guard cells.

(c) **Step 3:** Water moves from higher water potential to lower water potential by osmosis.

(d) **Step 4:** Entry of water makes guard cells turgid.

(e) **Step 5:** Because of their unequal wall thickening, turgid guard cells curve and open the stomatal pore.

(f) **Step 6:** Potassium ions do not convert guard cells into xylem or destroy chlorophyll as part of normal opening.

Final Answer: Lowering of guard-cell water potential

Answer: (A)

Go Back to Question 14

Q15.

Solution

Concept:

Citrus canker is a bacterial disease of citrus plants. It produces raised corky lesions, often surrounded by yellow halos, on leaves, twigs, and fruits. The causal bacterium is commonly given as *Xanthomonas citri* or *Xanthomonas axonopodis* pathovar *citri*.

Solution:

(a) **Step 1:** The host is citrus, and the symptom is a raised corky lesion.

(b) **Step 2:** A yellow halo around the lesion is a characteristic symptom of citrus canker.

(c) **Step 3:** Citrus canker is caused by a bacterial pathogen.

(d) **Step 4:** Among the given options, *Xanthomonas citri* is the bacterial causal agent.

(e) **Step 5:** *Puccinia graminis* is a rust fungus, *Sclerospora graminicola* causes pearl millet downy mildew, and *Rhizobium* is a nitrogen-fixing bacterium.

Final Answer: *Xanthomonas citri*

Answer: (C)

Go Back to Question 15

Q16.

Solution

Concept:

Waterlogged soils have poor aeration because air spaces are filled with water. Mangrove plants develop special negatively geotropic roots called pneumatophores. These roots rise above the soil and have lenticels that help oxygen enter the root system.

Solution:

(a) **Step 1:** The plants are growing in waterlogged soil, where oxygen availability is low.

(b) **Step 2:** Ordinary roots in such soil cannot receive enough oxygen for respiration.

(c) **Step 3:** Mangroves produce upward-growing roots called pneumatophores.

(d) **Step 4:** These roots have openings that allow gaseous exchange with the atmosphere.

(e) **Step 5:** Their main role is aeration, not flower production or photosynthesis.

(f) **Step 6:** Therefore, they facilitate gaseous exchange in poorly aerated soil.

Final Answer: Gaseous exchange

Answer: (D)

Go Back to Question 16

Q17.

Solution

Concept:

Biomagnification is the increase in concentration of a non-biodegradable toxic substance at successive trophic levels. Persistent pesticides are not easily metabolized or excreted, so they accumulate in body tissues. Predators at higher trophic levels receive the toxin from many prey organisms and usually have the highest concentration.

Solution:

(a) **Step 1:** The pesticide is described as persistent, so it is likely to remain in organisms for a long time.

(b) **Step 2:** Plants take up or retain a small amount of pesticide.

(c) **Step 3:** Insects feeding on many plant parts accumulate more pesticide.

(d) **Step 4:** Small birds feeding on many insects accumulate still more pesticide.

(e) **Step 5:** The hawk is at the top of the shown food chain and feeds on lower-level organisms.

(f) **Step 6:** Therefore, the pesticide concentration is generally maximum in the hawk, labelled D.

Final Answer: D

Answer: (D)

Go Back to Question 17

Q18.

Solution

Concept:

Enzymes are mostly proteins whose activity depends on their precise three-dimensional structure. The active site must have the correct shape and chemical environment for substrate binding. High temperature can disrupt weak bonds maintaining protein structure, causing denaturation and loss of activity.

Solution:

(a) **Step 1:** The enzyme has been exposed to very high temperature.

(b) **Step 2:** Heat increases molecular motion and can disrupt hydrogen bonds, ionic interactions, and other weak forces.

(c) **Step 3:** These forces help maintain the tertiary structure of the enzyme protein.

(d) **Step 4:** When the tertiary structure changes, the active site no longer fits the substrate properly.

(e) **Step 5:** As a result, catalytic activity is lost.

(f) **Step 6:** The enzyme is not converted into a carbohydrate, and heat does not permanently increase useful active sites.

Final Answer: Alteration of protein shape and active site

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept:

A selectable marker is a gene that helps identify cells carrying a vector or introduced DNA. In transformation experiments, marker genes often confer resistance to an antibiotic or herbicide. Cells without the marker fail to grow under selection, while transformed cells survive.

Solution:

(a) **Step 1:** The medium contains an antibiotic, so only resistant cells can grow.

(b) **Step 2:** The cells that survive must have taken up a gene that provides antibiotic resistance.

(c) **Step 3:** Such a gene is used to distinguish transformed cells from non-transformed cells.

(d) **Step 4:** This type of gene is called a selectable marker.

(e) **Step 5:** An origin of replication is related to vector replication, and the other options do not describe selection of transformed cells.

Final Answer: Selectable marker

Answer: (A)

Go Back to Question 19

Q20.

Solution

Concept:

A test cross involves crossing an individual with a homozygous recessive individual. For a dihybrid $AaBb$, independent assortment produces four types of gametes in equal proportion: AB, Ab, aB, and ab. Crossing with $aabb$ reveals these gametes directly in the progeny phenotypes.

Solution:

(a) **Step 1:** The heterozygous parent is $AaBb$.

(b) **Step 2:** Under independent assortment, it produces four gamete types: AB, Ab, aB, and ab.

(c) **Step 3:** Each gamete type is produced in equal frequency.

(d) **Step 4:** The tester parent $aabb$ can produce only ab gametes.

(e) **Step 5:** The progeny genotypes are $AaBb$, $Aabb$, $aaBb$, and $aabb$ in equal numbers.

(f) **Step 6:** Therefore, the phenotypic ratio is $1 : 1 : 1 : 1$.

Final Answer: $1 : 1 : 1 : 1$

Answer: (C)

Go Back to Question 20

Q21.

Solution

Concept:

Oilseed crops are cultivated for oil-rich seeds or fruits. Safflower is an important oilseed crop, and its seeds contain edible oil. Although safflower flowers may also have uses as a dye source, the commercial edible oil is extracted from seeds.

Solution:

(a) **Step 1:** The question identifies safflower as an oilseed crop.

(b) **Step 2:** In oilseed crops, the main storage oil is generally present in seeds.

(c) **Step 3:** Safflower seeds are crushed or processed to extract edible oil.

(d) **Step 4:** Petals may be used for colouring purposes, but they are not the main source of edible oil.

(e) **Step 5:** Fibrous bark and aerial roots do not represent safflower oil sources.

Final Answer: Seeds

Answer: (B)

Go Back to Question 21

Q22.

Solution

Concept:

Karnal bunt is an important disease of wheat. It affects grains and produces black powdery spores in portions of the kernel, often with an unpleasant fishy odour. The causal fungus is *Tilletia indica*. Recognizing the host and the grain symptom is essential in plant pathology questions.

Solution:

(a) **Step 1:** The host is wheat and the symptom is bunt of grains.

(b) **Step 2:** Black powdery masses in grains indicate a smut or bunt-type fungal disease.

(c) **Step 3:** The fishy smell is a characteristic clue for Karnal bunt.

(d) **Step 4:** Karnal bunt of wheat is caused by *Tilletia indica*.

(e) **Step 5:** *Claviceps fusiformis* causes ergot of pearl millet, *Fusarium oxysporum* causes wilt diseases, and *Xanthomonas oryzae* is bacterial.

Final Answer: *Tilletia indica*

Answer: (A)

Go Back to Question 22

Q23.

Solution

Concept:

The pressure-flow hypothesis explains phloem translocation. At the source, sucrose is loaded into sieve tubes, lowering water potential and causing water to enter from xylem. This creates high turgor pressure. At the sink, sucrose is unloaded and pressure becomes lower. Phloem sap moves by bulk flow from high pressure to low pressure.

Solution:

(a) **Step 1:** The source leaf loads sucrose into the phloem.

(b) **Step 2:** Sucrose loading lowers water potential inside the sieve tube at the source.

(c) **Step 3:** Water enters the sieve tube, increasing turgor pressure at the source end.

(d) **Step 4:** At the sink, sucrose is removed for storage or metabolism, so pressure becomes relatively lower.

(e) **Step 5:** The pressure gradient drives mass flow of phloem sap from source to sink.

(f) **Step 6:** Therefore, movement is from the high-pressure source to the low-pressure sink.

Final Answer: High-pressure source to low-pressure sink

Answer: (B)

Go Back to Question 23

Q24.

Solution

Concept:

Desertification is land degradation in dry regions. Vegetation protects soil from wind and water erosion, adds organic matter, and helps maintain soil structure. Overgrazing removes plant cover and exposes soil, making erosion and loss of fertility more likely.

Solution:

(a) **Step 1:** The land described is arid grazing land, where plant cover is already limited.

(b) **Step 2:** Excessive grazing removes grasses and other protective vegetation.

(c) **Step 3:** Bare soil is more easily eroded by wind and occasional rain.

(d) **Step 4:** Less vegetation also means less litter and organic matter return to the soil.

(e) **Step 5:** Soil structure and fertility decline, promoting desertification.

(f) **Step 6:** The other options are physically or ecologically incorrect.

Final Answer: More erosion and less organic matter

Answer: (A)

Go Back to Question 24

Q25.

Solution

Concept:

Gibberellins are plant hormones involved in seed germination. In cereal grains such as barley, gibberellin from the embryo acts on the aleurone layer. The aleurone produces hydrolytic enzymes, especially alpha-amylase, which breaks starch into sugars for the growing embryo.

Solution:

(a) **Step 1:** The seed mentioned is barley, a cereal grain rich in starch.

(b) **Step 2:** During germination, the embryo needs soluble sugars for respiration and growth.

(c) **Step 3:** Gibberellin signals the aleurone layer to synthesize and secrete enzymes.

(d) **Step 4:** Alpha-amylase hydrolyses starch into smaller sugars such as maltose.

(e) **Step 5:** Pepsin is an animal digestive enzyme, DNA ligase joins DNA fragments, and cellulase does not specifically describe the classic barley aleurone response.

(f) **Step 6:** Hence, the enzyme is alpha-amylase.

Final Answer: Alpha-amylase

Answer: (D)

Go Back to Question 25

Q26.

Solution

Concept:

Echinoderms are marine animals such as starfish, sea urchins, and sea cucumbers. Adult echinoderms usually show pentaradial symmetry and possess a water vascular system with tube feet. These features are diagnostic for phylum Echinodermata.

Solution:

(a) **Step 1:** The animal is marine, which is consistent with echinoderms.

(b) **Step 2:** Tube feet are mentioned. Tube feet are extensions of the water vascular system.

(c) **Step 3:** A water vascular system is a unique identifying feature of Echinodermata.

(d) **Step 4:** Pentaradial symmetry in the adult further confirms the identification.

(e) **Step 5:** Molluscs have a muscular foot and mantle, arthropods have jointed appendages, and nematodes are roundworms.

(f) **Step 6:** Therefore, the animal belongs to Echinodermata.

Final Answer: Echinodermata

Answer: (C)

Go Back to Question 26

Q27.

Solution

Concept:

Stored grain pests reduce both quantity and quality of grains. The khapra beetle, *Trogoderma granarium*, is a serious pest in warm dry storage conditions. Its larvae feed on stored kernels and contaminate the grain with cast skins, hair, and excreta.

Solution:

(a) **Step 1:** The question asks specifically about the damaging larval stage.

(b) **Step 2:** Khapra beetle larvae feed on stored grain kernels and broken grain pieces.

(c) **Step 3:** Their feeding reduces grain weight and quality.

(d) **Step 4:** They also contaminate grain with cast skins and frass, making the grain less acceptable.

(e) **Step 5:** The larvae do not pollinate stored grain or fix nitrogen.

(f) **Step 6:** Therefore, kernel feeding and contamination explain their damage.

Final Answer: Kernel feeding and contamination

Answer: (B)

Go Back to Question 27

Q28.

Solution

Concept:

Body Mass Index, or BMI, is calculated by dividing body mass in kilograms by the square of height in metres. It is a simple screening index used in nutritional assessment, although it does not directly measure body fat distribution.

Solution:

(a) **Step 1:** The given body mass is 70 kg.

(b) **Step 2:** The given height is 1.75 m.

(c) **Step 3:** Square the height: $(1.75)^2 = 3.0625$.

(d) **Step 4:** Apply the formula: $BMI = \dfrac{70}{3.0625}$.

(e) **Step 5:** Dividing gives approximately 22.86, which rounds to 22.9.

(f) **Step 6:** Therefore, the closest option is 22.9.

Final Answer: 22.9

Answer: (A)

Go Back to Question 28

Q29.

Solution

Concept:

Amoeba moves and feeds using pseudopodia. Pseudopodia are temporary extensions of cytoplasm. They help the organism crawl over surfaces and surround food particles during phagocytosis, forming food vacuoles.

Solution:

(a) **Step 1:** The projections shown are temporary and cytoplasmic.

(b) **Step 2:** Such projections in *Amoeba* are called pseudopodia, meaning false feet.

(c) **Step 3:** During locomotion, cytoplasm flows into a pseudopodium and the cell moves in that direction.

(d) **Step 4:** During feeding, pseudopodia surround a food particle and help form a food vacuole.

(e) **Step 5:** *Amoeba* does not have blood vessels or a permanent shell as part of this function.

(f) **Step 6:** Therefore, pseudopodia are used for locomotion and food capture.

Final Answer: Locomotion and engulfing food

Answer: (D)

Go Back to Question 29

Q30.

Solution

Concept:

Integrated pest management uses monitoring and decision-making rather than routine pesticide application. The economic threshold level is the pest density at which control measures should be started to prevent the pest population from reaching the economic injury level, where losses exceed control costs.

Solution:

(a) **Step 1:** The term belongs to pest monitoring and decision-making.

(b) **Step 2:** A few pests in a field do not always justify control measures.

(c) **Step 3:** When the pest population reaches the economic threshold, action is recommended.

(d) **Step 4:** The purpose is to prevent the population from reaching a level that causes economic injury.

(e) **Step 5:** IPM does not aim to kill all natural enemies or make every pest permanently extinct.

(f) **Step 6:** Therefore, the economic threshold is the action-starting level.

Final Answer: Control action should begin

Answer: (C)

Go Back to Question 30

Q31.

Solution

Concept:

Vitamin D helps maintain calcium and phosphate balance by promoting intestinal calcium absorption and supporting bone mineralization. In children, deficiency of vitamin D causes defective mineralization of growing bones, leading to rickets.

Solution:

(a) **Step 1:** The clue is calcium absorption and bone mineralization.

(b) **Step 2:** Vitamin D increases absorption of calcium from the intestine.

(c) **Step 3:** Adequate calcium and phosphate are required for proper hardening of bones.

(d) **Step 4:** In children, deficiency causes rickets, characterized by soft and deformed bones.

(e) **Step 5:** Vitamin C deficiency causes scurvy, vitamin B_1 deficiency causes beriberi, and vitamin K deficiency affects blood clotting.

(f) **Step 6:** Therefore, the correct vitamin is vitamin D.

Final Answer: Vitamin D

Answer: (B)

Go Back to Question 31

Q32.

Solution

Concept:

The earthworm intestine is adapted for absorption of digested food. Typhlosole is an internal fold of the dorsal intestinal wall. By projecting into the intestinal lumen, it increases surface area, improving absorption of nutrients.

Solution:

(a) **Step 1:** The structure named is typhlosole.

(b) **Step 2:** It is located in the intestine of earthworm.

(c) **Step 3:** A fold increases the surface area available for absorption.

(d) **Step 4:** Increased surface area helps absorb digested nutrients more efficiently.

(e) **Step 5:** It is not a reproductive organ and does not form the clitellum.

(f) **Step 6:** Therefore, its main function is to increase absorptive surface area.

Final Answer: Increased absorptive surface area

Answer: (A)

Go Back to Question 32

Q33.

Solution

Concept:

Locusts are grasshoppers capable of phase change. Under favourable breeding conditions and crowding, they shift from a solitary phase to a gregarious phase. Gregarious locusts form bands and swarms that migrate over long distances and feed heavily on crops and natural vegetation.

Solution:

(a) **Step 1:** Desert locust is known for sudden outbreaks after favourable rainfall and vegetation growth.

(b) **Step 2:** Crowding causes behavioural and physiological changes leading to gregarization.

(c) **Step 3:** Gregarious locusts can form huge swarms.

(d) **Step 4:** These swarms migrate and consume large quantities of green vegetation.

(e) **Step 5:** Locusts do not become bacteria and are not limited to stored pulses.

(f) **Step 6:** Therefore, their swarm-forming ability makes them dangerous agricultural pests.

Final Answer: Large migratory swarms

Answer: (D)

Go Back to Question 33

Q34.

Solution

Concept:

Carbohydrate metabolism includes synthesis and breakdown of glycogen. Glycogenesis is the synthesis of glycogen from glucose. Glycogenolysis is the breakdown of glycogen into glucose-1-phosphate and related products, allowing the liver to maintain blood glucose during fasting.

Solution:

(a) **Step 1:** The question states that liver glycogen is being broken down.

(b) **Step 2:** The suffix lysis means breakdown.

(c) **Step 3:** Therefore, breakdown of glycogen is glycogenolysis.

(d) **Step 4:** Glycogenesis would be the opposite process, synthesis of glycogen.

(e) **Step 5:** Lipogenesis is fat synthesis, and deamination is removal of amino groups from amino acids.

(f) **Step 6:** Hence, the correct process is glycogenolysis.

Final Answer: Glycogenolysis

Answer: (B)

Go Back to Question 34

Q35.

Solution

Concept:

Insects respire through a tracheal system. Air enters through spiracles and passes through tracheae and tracheoles. These tubes deliver oxygen directly to tissues, so insect hemolymph is not the main oxygen carrier as blood is in vertebrates.

Solution:

(a) **Step 1:** The diagram shows spiracles on the body surface.

(b) **Step 2:** Spiracles open into tracheal tubes.

(c) **Step 3:** Tracheae branch repeatedly into smaller tracheoles that reach tissues.

(d) **Step 4:** Oxygen diffuses from these tubes directly into body cells.

(e) **Step 5:** Insects do not use red blood cells to transport most oxygen, and they do not have both lungs and gills in this system.

(f) **Step 6:** Therefore, the correct statement is direct oxygen delivery through tracheal tubes.

Final Answer: Oxygen reaches tissues through tracheae

Answer: (C)

Go Back to Question 35

Q36.

Solution

Concept:

Sprayer calibration ensures that the correct pesticide dose is applied per unit area. If a recommended formulation dose and spray volume per hectare are known, the formulation concentration in the spray liquid can be calculated. This concentration is then multiplied by the tank volume.

Solution:

(a) **Step 1:** The recommended formulation is 2 L per 500 L spray water.

(b) **Step 2:** Convert 2 L to millilitres: $2\,\text{L} = 2000\,\text{mL}$.

(c) **Step 3:** Formulation per litre of spray water is $\dfrac{2000}{500} = 4\,\text{mL per L}$.

(d) **Step 4:** For a 15 L tank, formulation required is $4 \times 15 = 60\,\text{mL}$.

(e) **Step 5:** The unit is millilitres because the tank contains only 15 L, not a full hectare spray volume.

(f) **Step 6:** Therefore, the required formulation is 60 mL.

Final Answer: $\boxed{60\,\text{mL}}$

Answer: (C)

Go Back to Question 36

Q37.

Solution

Concept:

Essential fatty acids are fatty acids that humans cannot synthesize in sufficient amounts and therefore must obtain from food. Linoleic acid is an omega-6 essential fatty acid. It is needed for membrane structure and for synthesis of important signaling molecules.

Solution:

(a) **Step 1:** The question asks for a fatty acid that must be supplied through the diet.

(b) **Step 2:** Linoleic acid is a well-known essential fatty acid for humans.

(c) **Step 3:** Palmitic and stearic acids are saturated fatty acids that the body can synthesize.

(d) **Step 4:** Cholesterol is a sterol, not a fatty acid.

(e) **Step 5:** Therefore, linoleic acid is the correct dietary essential fatty acid.

Final Answer: Linoleic acid

Answer: (A)

Go Back to Question 37

Q38.

Solution

Concept:

Nematodes are unsegmented roundworms. They are pseudocoelomate animals and have a complete alimentary canal with separate mouth and anus. This distinguishes them from flatworms, which are usually acoelomate and often have incomplete or absent digestive tracts.

Solution:

(a) **Step 1:** The animal is described as an unsegmented roundworm.

(b) **Step 2:** It has a pseudocoelom, which is characteristic of nematodes.

(c) **Step 3:** It has a complete digestive tract with separate mouth and anus.

(d) **Step 4:** These features match phylum Nematoda.

(e) **Step 5:** Platyhelminthes are flatworms, Annelida are segmented worms, and Cnidaria includes diploblastic animals such as Hydra and jellyfish.

(f) **Step 6:** Therefore, the animal belongs to Nematoda.

Final Answer: Nematoda

Answer: (B)

Go Back to Question 38

Q39.

Solution

Concept:

Biological control uses natural enemies such as predators, parasitoids, and pathogens to reduce pest populations. Ladybird beetles are important predatory insects. Both adults and larvae commonly feed on aphids, scale insects, and other soft-bodied pests.

Solution:

(a) **Step 1:** The organism named is ladybird beetle.

(b) **Step 2:** Ladybird beetles are predators rather than plant pathogens.

(c) **Step 3:** Aphids are soft-bodied sucking pests that damage many crops.

(d) **Step 4:** Ladybird adults and larvae feed on aphids, helping reduce aphid populations.

(e) **Step 5:** They do not mainly feed on stored wheat grains or destroy soil organic matter.

(f) **Step 6:** Therefore, their biological control value is due to predation on soft-bodied pests.

Final Answer: Predation on aphids

Answer: (B)

Go Back to Question 39

Q40.

Solution

Concept:

Haemoglobin in red blood cells contains iron as part of the haem group. Iron deficiency reduces haemoglobin synthesis and can cause microcytic anaemia. Common symptoms include fatigue, pallor, weakness, and reduced exercise tolerance.

Solution:

(a) **Step 1:** The symptoms include fatigue, pale conjunctiva, and low haemoglobin, indicating anaemia.

(b) **Step 2:** The question asks for a mineral needed for haemoglobin formation.

(c) **Step 3:** Iron is a central component of haem, the oxygen-binding part of haemoglobin.

(d) **Step 4:** If iron intake or absorption is low, haemoglobin synthesis decreases.

(e) **Step 5:** Iodine is needed for thyroid hormones, calcium for bones and other functions, and sodium for fluid balance and nerve conduction.

(f) **Step 6:** Therefore, the deficient mineral is iron.

Final Answer: Iron

Answer: (C)

Go Back to Question 40

Answer Key

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