JCECE Biology Sample Paper – 3

Duration: 60 Minutes **Maximum Marks: 50**

Instructions

- This paper contains **50** Multiple Choice Questions (Single Correct Answer), modelled on the Biology portion of **JCECE** entrance.
- Each correct answer carries **+1 mark**. There is -0.25 **mark** for each incorrect answer; unattempted questions get 0.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and Class 12 NCERT Biology (Jharkhand JAC / CBSE aligned) – Botany and Zoology.**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. Kingdom Protista, in Whittaker's five-kingdom scheme, is a group of organisms sharing one fundamental cellular feature. Members of kingdom Protista are best described as:

(A) prokaryotic and always multicellular

(B) prokaryotic with a cell wall of peptidoglycan

(C) eukaryotic and primarily single-celled (unicellular)

(D) non-cellular obligate intracellular parasites

Q2. According to the biological species concept widely used in taxonomy, a 'species' is best defined as a group of organisms that:

(A) merely look alike in external appearance

(B) live together in the same geographical area

(C) share the same number of chromosomes only

(D) can interbreed freely and produce fertile offspring

Q3. Pteridophytes (e.g. ferns, *Selaginella*) are regarded as the first true land plants because, unlike bryophytes, they are the earliest plants to possess:

(A) flowers and seeds enclosed in fruits

(B) well-developed vascular tissue (xylem and phloem)

(C) a dominant gametophyte and no sporophyte

(D) naked seeds borne on cones

Q4. The flatworms (phylum Platyhelminthes, e.g. *Planaria*, tapeworm) were the first animal group in evolution to show which level of body symmetry?

(A) bilateral symmetry

(B) radial symmetry

(C) complete absence of symmetry (asymmetry)

(D) biradial symmetry

Q5. In the xylem of a flowering plant, the chief water-conducting elements that are dead, lignified and lack end walls (forming continuous tubes) are the:

(A) sieve tube elements

(B) vessels (tracheary elements)

(C) companion cells

(D) xylem parenchyma

Q6. The muscle tissue that is striated, branched, involuntary and possesses intercalated discs, and is found only in the wall of the heart, is:

(A) smooth (unstriated) muscle

(B) skeletal (striped) muscle

(C) cardiac muscle

(D) areolar tissue

Q7. A leaf in which the veinlets form a network (mesh-like) between the larger veins shows 'reticulate venation'. This type of venation is characteristic of the leaves of:

(A) grasses and other monocotyledons

(B) ferns and mosses only

(C) all aquatic plants

(D) dicotyledonous plants

Q8. The heart of the frog (*Rana*) pumps blood through a circulatory pattern in which oxygenated and deoxygenated blood become slightly mixed in the single ventricle. The frog's heart is:

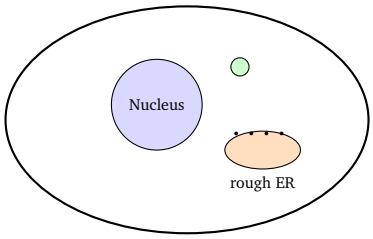
(A) two-chambered (one atrium, one ventricle)

(B) three-chambered (two atria, one ventricle)

(C) four-chambered with complete separation

(D) a single undivided muscular tube

Q9. In the cell shown below, the marked membranous network studded with ribosomes is the rough endoplasmic reticulum (RER). Its principal function is to:



(A) generate ATP by oxidative phosphorylation

(B) store and replicate the cell's DNA

(C) carry out photosynthesis in the cell

(D) synthesise and help transport secretory proteins

Q10. The net movement of *water* molecules across a selectively permeable membrane, from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), is called:

(A) osmosis

(B) active transport

(C) phagocytosis

(D) imbibition

Q11. Neutral fats (triglycerides), the most common storage lipids of cells, are chemically formed by the combination of:

(A) two amino acids joined by a peptide bond

(B) one glycerol with three fatty acid molecules

(C) many glucose units joined by glycosidic bonds

(D) a nitrogen base, a sugar and a phosphate

Q12. A non-protein *organic* molecule (often a vitamin derivative such as NAD^+ or FAD) that loosely associates with an enzyme and is essential for its catalytic activity is called a:

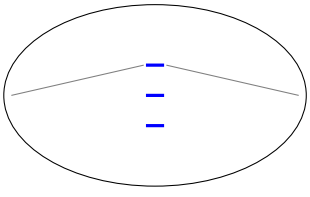
(A) substrate

(B) competitive inhibitor

(C) coenzyme

(D) zymogen (proenzyme)

Q13. The figure shows the stage of mitosis in which the chromosomes have just reached their position. The defining feature of this *metaphase* stage of mitosis is that:



(A) all the chromosomes line up at the equatorial plate with spindle fibres attached to their centromeres

(B) the sister chromatids separate and move to opposite poles

(C) the nuclear envelope and nucleolus reappear

(D) the chromatin first condenses into visible chromosomes

Q14. During zygotene of prophase I of meiosis, the homologous chromosomes pair point by point (synapsis), held together by a ladder-like proteinaceous structure called the:

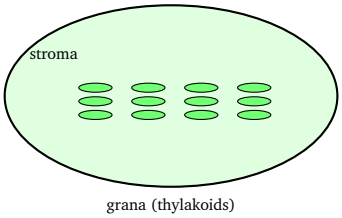
(A) spindle apparatus

(B) synaptonemal complex

(C) kinetochore

(D) nuclear lamina

Q15. In the chloroplast shown, the dark (light-independent) Calvin cycle takes place in the fluid stroma. In this cycle, atmospheric CO_2 is first accepted by the 5-carbon acceptor molecule:



(A) pyruvic acid

(B) phosphoenolpyruvate (PEP)

(C) oxaloacetic acid (OAA)

(D) ribulose-1,5-bisphosphate (RuBP)

Q16. In aerobic respiration, the electron transport chain (ETC) on the inner mitochondrial membrane passes electrons through a series of carriers to a final (terminal) electron acceptor, which is:

(A) carbon dioxide

(B) NAD^+

(C) molecular oxygen (O_2)

(D) pyruvate

Q17. According to the cohesion–tension (transpiration-pull) theory, the upward movement of water (ascent of sap) from roots to the leaves of a tall tree occurs mainly through the:

(A) xylem, pulled up as a continuous water column

(B) phloem, pushed up by active loading

(C) cortex, by simple diffusion

(D) epidermis, by capillary rise alone

Q18. A characteristic deficiency symptom in plants that is seen as yellowing (chlorosis) of the older leaves first, because the element is highly mobile and is withdrawn from old leaves, is typical of a deficiency of:

(A) calcium

(B) nitrogen

(C) boron

(D) iron

Q19. The plant growth regulator that promotes *cytokinesis* (cell division), helps overcome apical dominance by promoting lateral bud growth, and delays the ageing (senescence) of leaves is:

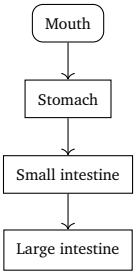
(A) abscisic acid

(B) ethylene

(C) gibberellin

(D) cytokinin

Q20. The flow diagram shows the human alimentary canal. The maximum absorption of the digested end products of food (glucose, amino acids, fatty acids) into the blood and lymph takes place in the:



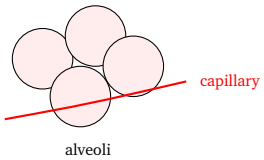
(A) mouth (buccal cavity)

(B) stomach

(C) small intestine

(D) large intestine

Q21. Gas exchange occurs across the thin alveolar walls shown. In the blood, the *majority* of carbon dioxide is transported from the body tissues to the lungs in the form of:



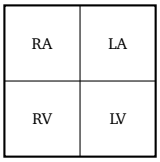
(A) oxyhaemoglobin in the red cells

(B) free CO_2 gas in the plasma

(C) carbon monoxide bound to haemoglobin

(D) bicarbonate ions (HCO_3^-) in the plasma

Q22. In the human heart shown, the valve guarding the opening between the *left atrium* and the *left ventricle*, which prevents backflow of blood into the left atrium, is the:



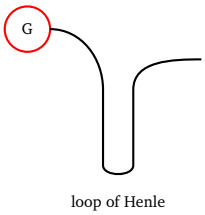
(A) bicuspid (mitral) valve

(B) tricuspid valve

(C) pulmonary semilunar valve

(D) aortic semilunar valve

Q23. In the nephron shown, the coiled segment immediately following the renal corpuscle ('G') is the proximal convoluted tubule. The chief function of this segment is the:



(A) filtration of blood under high pressure

(B) selective reabsorption of most of the useful filtrate (glucose, Na^+, water)

(C) formation of urine pigment from bile

(D) secretion of renin into the blood

Q24. The freely movable (synovial) joint that allows movement in all directions (rotation), as found between the head of the humerus and the pectoral girdle (shoulder), is a:

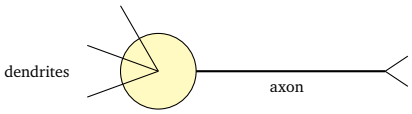
(A) hinge joint

(B) pivot joint

(C) ball-and-socket joint

(D) gliding joint

Q25. In the neuron shown, when the axon membrane is stimulated, a nerve impulse (action potential) is generated. The rising phase of the action potential (depolarisation) is brought about by the rapid inward flow of:



(A) potassium ions (K^+) into the axon

(B) sodium ions (Na^+) into the axon

(C) chloride ions (Cl^-) into the axon

(D) calcium ions (Ca^{2+}) out of the axon

Q26. The hormone secreted by the β-cells of the islets of Langerhans of the pancreas, which lowers the blood glucose level by promoting the uptake of glucose by cells and its conversion to glycogen, is:

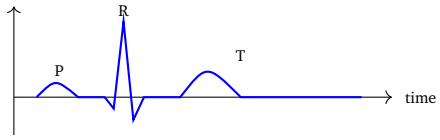
(A) insulin

(B) glucagon

(C) thyroxine

(D) adrenaline

Q27. When the heart is auscultated, two main heart sounds are heard during each cardiac cycle (often recorded alongside the ECG shown). The *first* heart sound ('LUBB') is produced by the:



(A) opening of the semilunar valves

(B) opening of the atrio-ventricular valves

(C) closure of the semilunar (aortic and pulmonary) valves

(D) closure of the atrio-ventricular (bicuspid and tricuspid) valves

Q28. At a typical chemical synapse, the arrival of an impulse at the axon terminal triggers the release of a chemical messenger into the synaptic cleft. A common excitatory neurotransmitter released at such synapses is:

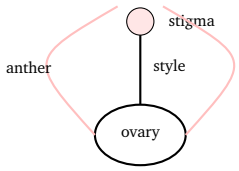
(A) acetylcholine

(B) haemoglobin

(C) insulin

(D) pepsinogen

Q29. The longitudinal section of a flower is shown. A mature *pollen grain* of most angiosperms, at the time it is shed from the anther, is typically a two-celled structure consisting of:



(A) a single large diploid cell only

(B) three vegetative cells and no generative cell

(C) a large vegetative cell and a smaller generative cell

(D) two egg cells and a central cell

Q30. Flowers that are pollinated by *wind* (anemophily), such as grasses and maize, typically show which of the following adaptations?

(A) large, brightly coloured, scented petals with nectar

(B) light, dry pollen produced in huge numbers, with well-exposed stamens and feathery stigmas

(C) sticky pollen carried on the bodies of insects

(D) flowers that open only at night and emit strong odour

Q31. During spermatogenesis in the testis, one diploid primary spermatocyte undergoes meiosis and ultimately gives rise to:

(A) one functional sperm and three polar bodies

(B) two diploid sperms

(C) one large ovum and one sperm

(D) four haploid spermatids that mature into four sperms

Q32. In the human menstrual cycle, ovulation (rupture of the Graafian follicle and release of the ovum at about mid-cycle) is induced by a sudden sharp rise in the level of:

(A) progesterone from the corpus luteum

(B) luteinising hormone (LH) from the pituitary

(C) relaxin from the placenta

(D) antidiuretic hormone (ADH)

Q33. Among the following, the disease that is classified as a *sexually transmitted disease* (STD), spread mainly through unprotected sexual contact, is:

(A) malaria

(B) tuberculosis

(C) syphilis

(D) typhoid

Q34. To determine whether a tall pea plant showing the dominant phenotype is homozygous (TT) or heterozygous (Tt), Mendel crossed it with a plant of genotype tt. This kind of cross, made with the homozygous recessive parent, is called a:

(A) test cross

(B) dihybrid cross

(C) reciprocal cross

(D) self-cross

Q35. In *Mirabilis jalapa* (4 o'clock plant), a cross between a red-flowered (RR) and a white-flowered (rr) plant gives *pink* (Rr) flowers in the F_1. This blending, where the heterozygote shows an intermediate phenotype, is an example of:

(A) complete dominance

(B) codominance

(C) incomplete dominance

(D) multiple allelism

Q36. The phenomenon of linkage and the recombination of linked genes were experimentally established by T. H. Morgan, who carried out his classic genetic experiments on the:

(A) garden pea (*Pisum sativum*)

(B) bread mould (*Neurospora*)

(C) bacterium (*Escherichia coli*)

(D) fruit fly (*Drosophila melanogaster*)

Q37. In honey bees, sex is determined by the number of chromosome sets: females (queen and workers) develop from fertilised eggs and are diploid, whereas the males (drones) develop from unfertilised eggs and are haploid. This mechanism of sex determination is called:

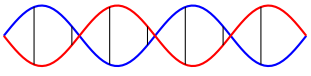
(A) the XX–XY mechanism

(B) haplodiploidy

(C) the XX–XO mechanism

(D) polyploidy

Q38. The DNA strand shown is a polymer (polynucleotide). The repeating monomer unit, a *nucleotide*, is made up of three components, namely:



double helix

(A) a nitrogenous base, a pentose (deoxyribose) sugar and a phosphate group

(B) only two complementary nitrogenous bases

(C) an amino acid, a fatty acid and glycerol

(D) three molecules of glucose joined together

Q39. During translation (protein synthesis) on the ribosome, the sequence of a messenger RNA is read three bases at a time. Each such triplet of bases (a codon) on the mRNA specifies:

(A) one complete protein molecule

(B) one molecule of glucose

(C) one particular amino acid to be added to the chain

(D) one ribosome of the cell

Q40. The forelimbs of a whale, a bat, a horse and a human have the same basic skeletal plan (humerus, radius, ulna, carpals) but perform different functions. Such organs, which provide anatomical evidence for evolution from a common ancestor, are called:

(A) analogous organs

(B) homologous organs

(C) vestigial organs

(D) fossil organs

Q41. Amoebiasis (amoebic dysentery), a disease marked by abdominal pain and stools with mucus and blood, is caused by a protozoan parasite that lives in the large intestine, namely:

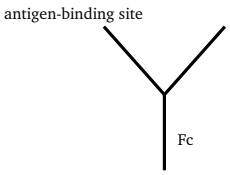
(A) *Plasmodium vivax*

(B) *Wuchereria bancrofti*

(C) *Ascaris lumbricoides*

(D) *Entamoeba histolytica*

Q42. The Y-shaped antibody is shown. When ready-made antibodies are given directly to a person (for example, the antibodies passed from mother to foetus through the placenta, or an anti-tetanus serum injection), the immunity so acquired is called:



(A) active natural immunity

(B) active artificial immunity

(C) passive immunity

(D) innate (non-specific) immunity

Q43. Biogas (mainly methane) is produced in a biogas plant from animal dung and organic waste by a group of anaerobic bacteria that also occur in the rumen of cattle. These bacteria are the:

(A) lactic acid bacteria

(B) *Rhizobium* bacteria

(C) nitrifying bacteria

(D) methanogens (e.g. *Methanobacterium*)

Q44. The technique of growing thousands of identical plants from small explants on a nutrient medium under sterile conditions, exploiting the totipotency of plant cells, is known as:

(A) micropropagation (tissue culture)

(B) mutation breeding

(C) biofortification

(D) cross-hybridisation

Q45. In recombinant DNA technology, after a gene and a vector have been cut with the same restriction enzyme, the enzyme that joins (seals) the two DNA fragments together by forming phosphodiester bonds, acting as 'molecular glue', is:

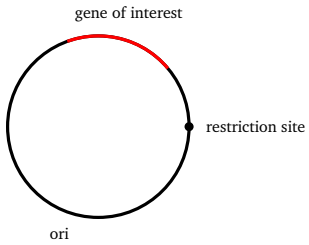
(A) restriction endonuclease

(B) DNA ligase

(C) DNA helicase

(D) exonuclease

Q46. The recombinant plasmid is shown. The process by which this recombinant DNA (vector with the foreign gene) is deliberately introduced into and taken up by a bacterial host cell is called:



(A) translation

(B) replication

(C) transformation

(D) transpiration

Q47. The first clinical use of gene therapy (in 1990) was carried out on a young girl suffering from a severe immunodeficiency caused by the lack of a functional enzyme. The missing enzyme in that disorder was:

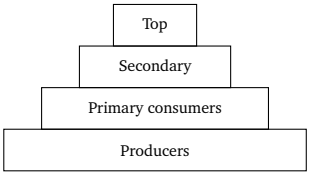
(A) insulin

(B) adenosine deaminase (ADA)

(C) DNA ligase

(D) amylase

Q48. The ecological pyramid shown represents energy at successive trophic levels. According to Lindeman's ten per cent law, the amount of energy that is transferred from one trophic level to the next higher level is only about:



(A) 1% of the energy

(B) 50% of the energy

(C) 10% of the energy

(D) 100% of the energy

Q49. In the study of populations, an age pyramid that is broad at its base (a large proportion of young, pre-reproductive individuals) and tapers towards the top represents a population that is:

(A) declining in size

(B) stable (zero growth)

(C) completely extinct

(D) growing (expanding)

Q50. The conservation strategy in which threatened species are protected within their own natural habitat, for example through national parks, wildlife sanctuaries and biosphere reserves, is called:

(A) *in-situ* conservation

(B) *ex-situ* conservation

(C) cryopreservation

(D) conservation in seed banks

Detailed Solutions

Q1.

Solution

Concept — Kingdom Protista: Protista is the third kingdom of Whittaker's scheme and is a 'dustbin' group of all simple eukaryotes; its members are eukaryotic (have a true membrane-bound nucleus) and are mostly unicellular.

Step 1 — Recall the cell type: every protist has a true nucleus and membrane-bound organelles, so it is eukaryotic.

Step 2 — Recall the body form: protists (e.g. *Amoeba*, *Paramecium*, diatoms, euglenoids) are primarily single-celled.

Why other options are wrong:

- (A) protists are eukaryotic, not prokaryotic, and are usually unicellular not multicellular.
- (B) a peptidoglycan wall is a feature of Monera (bacteria), not protists.
- (D) non-cellular intracellular parasites describes viruses, which are not protists.

Final Answer: eukaryotic and primarily unicellular $\Rightarrow$ C

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Biological species concept: A species is the basic unit of classification; biologically it is a group of natural populations whose members can interbreed among themselves and produce fertile (viable) offspring, but are reproductively isolated from other such groups.

Step 1 — Identify the key criterion: reproductive compatibility (interbreeding) and fertile offspring.

Step 2 — Match the definition: only option (D) states free interbreeding with fertile offspring.

Why other options are wrong:

- (A) mere external resemblance is the (older) morphological idea, not the biological species concept.

- (B) living in the same area defines a population/community, not a species.
- (C) chromosome number alone does not define a species.

Final Answer: interbreed freely and give fertile offspring $\Rightarrow$ D

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Pteridophytes: Pteridophytes (ferns, horsetails, club mosses) are the first plants to have a well-developed vascular system (xylem and phloem) for the conduction of water and food; hence they are called the first true (vascular) land plants.

Step 1 — Compare with bryophytes: bryophytes (mosses) lack proper vascular tissue, whereas pteridophytes possess it.

Step 2 — Identify the distinguishing feature: presence of xylem and phloem.

Why other options are wrong:

- (A) flowers, fruits and enclosed seeds are features of angiosperms.
- (C) in pteridophytes the sporophyte (not gametophyte) is the dominant phase.
- (D) naked seeds on cones are a feature of gymnosperms; pteridophytes are seedless.

Final Answer: well-developed vascular tissue $\Rightarrow$ B

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Platyhelminthes symmetry: Flatworms are the first phylum in the animal kingdom to show bilateral symmetry, in which the body can be divided into identical right and left halves by only one (median) plane.

Step 1 — Recall the evolutionary trend: sponges are asymmetrical, cnidarians are radially symmetrical, and flatworms onwards show bilateral symmetry.

Step 2 — Match: Platyhelminthes show bilateral symmetry.

Why other options are wrong:

- (B) radial symmetry is shown by Coelenterata (cnidarians) and adult echinoderms.
- (C) asymmetry is shown by most sponges (Porifera).
- (D) biradial symmetry (as in ctenophores) is not the flatworm condition.

Final Answer: bilateral symmetry $\Rightarrow$ A

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Xylem elements: Xylem has four elements — tracheids, vessels, xylem fibres and xylem parenchyma. Vessels (tracheary elements) are long tubes made of dead, lignified cells placed end to end, with their end walls dissolved, so water flows freely through them.

Step 1 — Match the description: dead, lignified, no end walls, forms continuous tubes.

Step 2 — Identify the element: these are the vessels of xylem.

Why other options are wrong:

- (A) sieve tube elements belong to phloem and conduct food, not water.
- (C) companion cells are living phloem cells associated with sieve tubes.
- (D) xylem parenchyma is living and stores food; it does not form the main conducting tubes.

Final Answer: vessels (tracheary elements) $\Rightarrow$ B

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Cardiac muscle: Cardiac muscle is found only in the heart wall. It is striated like skeletal muscle but its fibres are branched, uninucleate and involuntary, and adjacent fibres are joined by intercalated discs that allow rapid impulse spread.

Step 1 — Read the clues: striated + branched + involuntary + intercalated discs + heart wall.

Step 2 — Match: all these features point to cardiac muscle.

Why other options are wrong:

- (A) smooth muscle is unstriated and spindle-shaped, lacking intercalated discs.
- (B) skeletal muscle is striated but unbranched and voluntary.
- (D) areolar tissue is a loose connective tissue, not a muscle.

Final Answer: cardiac muscle $\Rightarrow$ C

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Leaf venation: When the veinlets form a network (mesh), the venation is reticulate; this is typical of dicot leaves. When the veins run parallel to one another, the venation is parallel; this is typical of monocot leaves.

Step 1 — Read the pattern: network/mesh-like veinlets = reticulate venation.

Step 2 — Assign the group: reticulate venation occurs in dicotyledonous plants.

Why other options are wrong:

- (A) grasses and other monocots show parallel venation, not reticulate.
- (B) ferns/mosses are not the defining group for reticulate venation in the dicot/monocot context.
- (C) being aquatic does not determine venation type.

Final Answer: dicotyledonous plants $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Frog heart: The frog has a three-chambered heart with two atria (right and left) and a single (undivided) ventricle. Because there is only one ventricle, oxygenated and deoxygenated blood get partially mixed there.

Step 1 — Read the clue: mixing occurs in the single ventricle.

Step 2 — Count the chambers: two atria + one ventricle = three chambers.

Why other options are wrong:

- (A) a two-chambered heart (one atrium, one ventricle) is found in fishes.
- (C) a fully separated four-chambered heart is found in birds and mammals.
- (D) a single undivided tube is not the frog condition.

Final Answer: three-chambered (two atria, one ventricle) $\Rightarrow$ B

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Rough endoplasmic reticulum: The RER is a membranous network whose outer surface bears ribosomes. The attached ribosomes synthesise proteins, and the RER channels and helps transport these (often secretory) proteins, sending them on to the Golgi apparatus.

Step 1 — Identify the organelle: membranes studded with ribosomes = rough ER.

Step 2 — State its main job: synthesis and intracellular transport of secretory/membrane proteins.

Why other options are wrong:

- (A) ATP generation by oxidative phosphorylation is the work of mitochondria.
- (B) storage and replication of DNA is the work of the nucleus.
- (C) photosynthesis occurs in chloroplasts (and only in plant cells).

Final Answer: synthesises and helps transport secretory proteins $\Rightarrow$ D

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Osmosis: Osmosis is the passive net movement of water (solvent) molecules across a selectively permeable membrane from a region of higher water potential (more dilute) to a region of lower water potential (more concentrated). No metabolic energy is required.

Step 1 — Read the key terms: water moving across a selectively permeable membrane down its water-potential gradient.

Step 2 — Name the process: osmosis.

Why other options are wrong:

- (B) active transport moves solutes against the gradient using ATP.
- (C) phagocytosis is the bulk engulfing of solid particles by the membrane.
- (D) imbibition is absorption of water by solid hydrophilic colloids (e.g. dry seeds).

Final Answer: osmosis $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Fats (triglycerides): A neutral fat is an ester formed when one molecule of glycerol (a trihydric alcohol) combines with three fatty acid molecules, with the loss of three water molecules. These are the chief storage lipids.

Step 1 — Recall the building blocks: glycerol + fatty acids.

Step 2 — Count: one glycerol + three fatty acids = a triglyceride (neutral fat).

Why other options are wrong:

- (A) two amino acids joined by a peptide bond form a dipeptide (protein chemistry).
- (C) many glucose units linked by glycosidic bonds form a polysaccharide.
- (D) base + sugar + phosphate describes a nucleotide.

Final Answer: one glycerol + three fatty acids $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Coenzymes: Many enzymes need a non-protein helper (a cofactor). When this cofactor is an organic molecule that is only loosely (transiently) bound, it is called a coenzyme; many coenzymes (e.g. NAD^+, FAD, coenzyme A) are derived from vitamins.

Step 1 — Read the clue: non-protein organic helper, vitamin-derived, loosely bound, essential for activity.

Step 2 — Name it: coenzyme.

Why other options are wrong:

- (A) a substrate is the reactant acted upon by the enzyme, not a helper.
- (B) a competitive inhibitor blocks the active site and reduces activity.
- (D) a zymogen is an inactive precursor of an enzyme.

Final Answer: coenzyme $\Rightarrow$ C

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Mitotic metaphase: In metaphase the spindle is fully formed and all the condensed chromosomes line up at the centre (equator) of the cell, forming the metaphase plate; spindle fibres attach to the centromere (kinetochore) of each chromosome.

Step 1 — Recall the metaphase event: alignment of chromosomes at the equatorial plate with spindle fibres on their centromeres.

Step 2 — Confirm from the figure: the figure shows chromosomes lined up at the centre with fibres from both poles.

Why other options are wrong:

- (B) separation of sister chromatids to opposite poles is anaphase.
- (C) reappearance of the nuclear envelope and nucleolus is telophase.
- (D) the first condensation of chromatin into chromosomes is prophase.

Final Answer: chromosomes align at the equatorial plate $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Synaptonemal complex: During zygotene of prophase I, homologous chromosomes come together in pairs (synapsis). They are held in close, point-by-point alignment by a ladder-like protein structure called the synaptonemal complex; the paired structure is called a bivalent (tetrad).

Step 1 — Read the clue: ladder-like protein structure formed during synapsis of homologues.

Step 2 — Name it: synaptonemal complex.

Why other options are wrong:

- (A) the spindle apparatus moves chromosomes; it does not bind homologues for synapsis.
- (C) the kinetochore is the protein plate on the centromere where spindle fibres attach.
- (D) the nuclear lamina lines the inner nuclear membrane and is unrelated to synapsis.

Final Answer: synaptonemal complex $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Calvin cycle CO_2 acceptor: In the Calvin (C3) cycle, which occurs in the stroma, atmospheric CO_2 is fixed by the enzyme RuBisCO onto the 5-carbon acceptor ribulose-1,5-bisphosphate (RuBP), forming two molecules of 3-phosphoglyceric acid (3-PGA).

Step 1 — Recall the primary CO_2 acceptor in C3 plants: RuBP (a 5-carbon sugar phosphate).

Step 2 — Confirm: CO_2+ RuBP $\rightarrow$ two 3-PGA.

Why other options are wrong:

- (A) pyruvic acid is a respiratory intermediate, not the Calvin-cycle acceptor.
- (B) PEP is the CO_2 acceptor in the C4 pathway, not in the Calvin cycle.
- (C) OAA is the first product of CO_2 fixation in C4 plants, not the acceptor in C3.

Final Answer: ribulose-1,5-bisphosphate (RuBP) $\Rightarrow$ D

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Electron transport chain: In the ETC on the inner mitochondrial membrane, electrons from NADH and $FADH_2$ pass through a series of carriers. At the end of the chain (complex IV), the electrons (with protons) combine with molecular oxygen to form water; thus O_2 is the terminal electron acceptor.

Step 1 — Trace the electrons: they flow from carrier to carrier and finally to O_2.

Step 2 — Note the product: O_2 accepts the electrons and is reduced to water.

Why other options are wrong:

- (A) CO_2 is released earlier (in the link reaction and Krebs cycle), not the final acceptor here.
- (B) NAD^+ is an electron *carrier* that delivers electrons to the chain.
- (D) pyruvate is a glycolytic product, not the terminal acceptor.

Final Answer: molecular oxygen (O_2) $\Rightarrow$ C

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Ascent of sap: Water absorbed by the roots rises to the top of a tall tree through the xylem. The cohesion–tension theory states that transpiration from the leaves creates a pull (tension) that, because water molecules cohere into a continuous column, draws the whole column up through the xylem.

Step 1 — Identify the conducting tissue: the xylem carries water upward.

Step 2 — Identify the mechanism: a continuous, cohesive water column is pulled up by transpiration tension.

Why other options are wrong:

- (B) the phloem transports food (sugars), not the ascent of water.
- (C) the cortex is not the main long-distance water-conducting pathway to the top.

- (D) capillary rise alone cannot raise water to the top of a tall tree.

Final Answer: through the xylem as a continuous pulled-up column $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Nitrogen deficiency: Nitrogen is a component of chlorophyll, proteins and nucleic acids and is a highly *mobile* element. When it is deficient, the plant moves nitrogen from older leaves to growing parts, so the older leaves turn yellow (chlorosis) first.

Step 1 — Read the clue: chlorosis appearing in the *older* leaves first, element is mobile.

Step 2 — Identify the element: mobile elements (N, P, K, Mg) show symptoms in old leaves first; the classic chlorosis here is nitrogen deficiency.

Why other options are wrong:

- (A) calcium is immobile, so its deficiency shows first in the *young* leaves/growing tips.
- (C) boron is immobile; its deficiency also affects young tissues first.
- (D) iron is immobile, so iron-deficiency chlorosis appears in the *young* leaves first.

Final Answer: nitrogen $\Rightarrow$ B

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Cytokinins: Cytokinins promote cytokinesis (cell division), help in the formation of new leaves and chloroplasts, promote the growth of lateral buds (overcoming apical dominance) and delay the senescence (ageing) of leaves (the Richmond–Lang effect).

Step 1 — Match the listed roles: cell division + lateral bud growth + delay of senescence all point to cytokinin.

Step 2 — Conclude: the hormone is cytokinin.

Why other options are wrong:

- (A) abscisic acid promotes dormancy and stomatal closure (a growth inhibitor).
- (B) ethylene promotes ripening, senescence and abscission.
- (C) gibberellin mainly causes stem elongation and bolting.

Final Answer: cytokinin $\Rightarrow$ D

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Site of absorption: Although small amounts of absorption occur elsewhere, the *maximum* absorption of digested food (monosaccharides, amino acids, fatty acids) takes place in the small intestine, whose lining is folded into villi and microvilli that greatly increase the absorptive surface.

Step 1 — Recall where digestion is completed: digestion finishes in the small intestine.

Step 2 — Note the adaptation: villi and microvilli make the small intestine the principal site of absorption.

Why other options are wrong:

- (A) the mouth only does minor starch digestion; little absorption occurs there.
- (B) the stomach absorbs only some water, alcohol and certain drugs.
- (D) the large intestine mainly absorbs water and some minerals, not the bulk of nutrients.

Final Answer: small intestine $\Rightarrow$ C

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — CO_2 transport: About 70% of the carbon dioxide carried by blood travels as bicarbonate ions (HCO_3^-) in the plasma; roughly 20–23% is carried as carbaminohaemoglobin and only about 7% is dissolved in plasma.

Step 1 — Recall the major fraction: most CO_2 is converted (by carbonic anhydrase) to bicarbonate.

Step 2 — Identify the form: bicarbonate ions in the plasma.

Why other options are wrong:

- (A) oxyhaemoglobin is the transport form of oxygen, not carbon dioxide.
- (B) only $\sim$7% of CO_2 is dissolved freely in plasma.
- (C) carbon monoxide is a poison and is not a normal transport form of CO_2.

Final Answer: bicarbonate ions in the plasma $\Rightarrow$ D

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Heart valves: The opening between the left atrium and the left ventricle is guarded by the bicuspid (mitral) valve (two flaps); the right atrio-ventricular opening is guarded by the tricuspid valve (three flaps). These valves prevent the backflow of blood into the atria.

Step 1 — Locate the valve: between LA and LV.

Step 2 — Name it: the left AV valve is the bicuspid (mitral) valve.

Why other options are wrong:

- (B) the tricuspid valve guards the right atrio-ventricular opening.
- (C) the pulmonary semilunar valve guards the opening into the pulmonary artery.
- (D) the aortic semilunar valve guards the opening into the aorta.

Final Answer: bicuspid (mitral) valve $\Rightarrow$ A

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Proximal convoluted tubule (PCT): The PCT is the coiled segment just after Bowman's capsule. It is the chief site of selective reabsorption: nearly all glucose and amino acids, most Na^+ and a large part of the water and bicarbonate are reabsorbed back into the blood here.

Step 1 — Identify the segment: the coil immediately after the renal corpuscle is the PCT.

Step 2 — State its function: selective reabsorption of useful substances from the filtrate.

Why other options are wrong:

- (A) filtration of blood under pressure occurs in the glomerulus/Bowman's capsule, not the PCT.
- (C) urine pigment (urochrome) is not formed from bile in the PCT.
- (D) secretion of renin is done by the juxtaglomerular apparatus, not the PCT.

Final Answer: selective reabsorption of the useful filtrate $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Ball-and-socket joint: In a ball-and-socket joint the rounded head (ball) of one bone fits into the cup-like socket of another, permitting movement in all planes including rotation. The shoulder (humerus–pectoral girdle) and hip joints are examples.

Step 1 — Read the clue: movement in all directions (rotation), at the shoulder.

Step 2 — Name the joint: ball-and-socket joint.

Why other options are wrong:

- (A) a hinge joint (e.g. elbow, knee) allows movement in one plane only.
- (B) a pivot joint (e.g. atlas–axis) allows only rotation about an axis.
- (D) a gliding joint allows only slight sliding movements (e.g. between carpals).

Final Answer: ball-and-socket joint $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Action potential: At rest the axon membrane is polarised (negative inside). On stimulation, voltage-gated sodium channels open and Na^+ rushes *into* the axon, reversing the membrane potential (it becomes positive inside). This inward Na^+ flow is the depolarisation (rising) phase.

Step 1 — Identify the rising phase ion: the inward movement of Na^+.

Step 2 — Confirm: this Na^+ influx causes depolarisation.

Why other options are wrong:

- (A) K^+ moves *out* during repolarisation (the falling phase), not in.
- (C) Cl^- influx is not responsible for the rising phase of the action potential.
- (D) outward Ca^{2+} movement does not produce the depolarisation here.

Final Answer: inflow of sodium ions (Na^+) $\Rightarrow$ B

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Insulin: Insulin is secreted by the β-cells of the islets of Langerhans of the pancreas. It is the hypoglycaemic hormone: it lowers blood glucose by promoting glucose uptake by cells and its conversion to glycogen (glycogenesis) in the liver and muscles.

Step 1 — Read the function: lowers blood glucose, promotes glycogen formation.

Step 2 — Identify the hormone: insulin.

Why other options are wrong:

- (B) glucagon (α-cells) *raises* blood glucose by breaking down glycogen.
- (C) thyroxine controls basal metabolism, not the direct lowering of blood glucose.
- (D) adrenaline raises blood glucose during stress ('fight or flight').

Final Answer: insulin $\Rightarrow$ A

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Heart sounds: Two sounds are heard per cardiac cycle. The first sound 'LUBB' is produced by the closure of the atrio-ventricular (bicuspid and tricuspid) valves at the start of ventricular systole; the second sound 'DUP' is produced by the closure of the semilunar valves at the start of ventricular diastole.

Step 1 — Match the first sound: 'LUBB' coincides with closure of the AV valves.

Step 2 — Confirm: this happens as the ventricles begin to contract.

Why other options are wrong:

- (A) opening of the semilunar valves does not produce a heart sound.
- (B) opening of the AV valves is silent.
- (C) closure of the semilunar valves produces the *second* sound 'DUP', not the first.

Final Answer: closure of the atrio-ventricular valves $\Rightarrow$ D

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Neurotransmitter: At a chemical synapse the impulse causes synaptic vesicles in the axon terminal to release a chemical messenger (neurotransmitter) into the synaptic cleft, which then acts on the next neuron. Acetylcholine is a common excitatory neurotransmitter.

Step 1 — Recall what is released at a synapse: a neurotransmitter.

Step 2 — Pick the example: acetylcholine.

Why other options are wrong:

- (B) haemoglobin is a blood respiratory pigment, not a neurotransmitter.
- (C) insulin is a hormone of the pancreas, not a synaptic transmitter.
- (D) pepsinogen is an inactive digestive proenzyme of the stomach.

Final Answer: acetylcholine $\Rightarrow$ A

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Mature pollen grain: When shed, the pollen grain of most angiosperms is two-celled: a large vegetative (tube) cell with abundant food reserves and a smaller generative cell floating within it. The generative cell later divides to form two male gametes.

Step 1 — Recall the contents of the shed pollen: a vegetative cell and a generative cell.

Step 2 — Match: a large vegetative cell and a smaller generative cell.

Why other options are wrong:

- (A) the pollen grain is not a single diploid cell; it is haploid and (when shed) two-celled.
- (B) there is one generative cell, not three vegetative cells.
- (D) two egg cells and a central cell describe parts of the female embryo sac, not pollen.

Final Answer: a vegetative cell and a generative cell $\Rightarrow$ C

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Wind pollination (anemophily): Wind-pollinated flowers are typically small, dull, without scent or nectar. They produce large amounts of light, dry pollen, have well-exposed stamens (so pollen is caught by the wind) and large, feathery stigmas (to trap floating pollen).

Step 1 — Recall anemophilous adaptations: light dry pollen, huge pollen output, exposed anthers, feathery stigma.

Step 2 — Match: option (B) lists exactly these features.

Why other options are wrong:

- (A) large, coloured, scented, nectar-bearing petals are insect-pollination (entomophily) features.

- (C) sticky pollen carried on insect bodies is again entomophily, not wind pollination.
- (D) night-opening, strongly scented flowers attract moths/bats (animal pollination).

Final Answer: light dry pollen, exposed stamens, feathery stigmas $\Rightarrow$ B

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Spermatogenesis: A diploid primary spermatocyte undergoes meiosis I to give two haploid secondary spermatocytes, and each of these undergoes meiosis II to give two spermatids — a total of four haploid spermatids. These spermatids then differentiate (spermiogenesis) into four functional sperms.

Step 1 — Track the divisions: 1 primary spermatocyte $\rightarrow$ 2 secondary $\rightarrow$ 4 spermatids.

Step 2 — Note the outcome: all four spermatids become functional sperms (unlike oogenesis, which wastes three as polar bodies).

Why other options are wrong:

- (A) one functional cell + three polar bodies is the outcome of *oogenesis*, not spermatogenesis.
- (B) the sperms produced are haploid, not diploid, and there are four, not two.
- (C) a large ovum is a product of oogenesis, not of spermatogenesis.

Final Answer: four haploid spermatids that form four sperms $\Rightarrow$ D

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — LH surge and ovulation: In the menstrual cycle, both LH and FSH rise mid-cycle, but it is a rapid, sharp rise of luteinising hormone (the LH surge, around day 14) that induces the rupture of the mature Graafian follicle and the release of the ovum (ovulation).

Step 1 — Recall the trigger: the mid-cycle LH surge.

Step 2 — Identify the hormone: luteinising hormone (LH) from the anterior pituitary.

Why other options are wrong:

- (A) progesterone (from the corpus luteum) rises *after* ovulation and maintains the endometrium.
- (C) relaxin is involved later, around parturition, not in triggering ovulation.
- (D) ADH regulates water balance and has no role in ovulation.

Final Answer: luteinising hormone (LH) $\Rightarrow$ B

Answer: (B) Go Back to Q32

Q33.

Solution

Concept — Sexually transmitted diseases (STDs): STDs (also called venereal or reproductive tract infections) spread mainly through unprotected sexual contact. Syphilis (caused by *Treponema pallidum*), gonorrhoea, genital herpes and AIDS are well-known examples.

Step 1 — Test each option: which spreads chiefly by sexual contact?

Step 2 — Identify: syphilis is a classic STD.

Why other options are wrong:

- (A) malaria is transmitted by the bite of a female *Anopheles* mosquito.
- (B) tuberculosis spreads through the air (droplet infection).
- (D) typhoid spreads through contaminated food and water.

Final Answer: syphilis $\Rightarrow$ C

Answer: (C) Go Back to Q33

Q34.

Solution

Concept — Test cross: A test cross is a cross of an individual showing the dominant phenotype (unknown genotype) with a homozygous recessive individual. The phenotypes of the offspring reveal whether the tested parent was homozygous (TT) or heterozygous (Tt).

Step 1 — Read the clue: crossing the dominant plant with the homozygous recessive (tt).

Step 2 — Name it: a test cross.

Note — Outcome: TT $\times$ tt gives all tall offspring, whereas Tt $\times$ tt gives a 1 tall : 1 dwarf ratio, so the offspring reveal the unknown genotype.

Why other options are wrong:

- (B) a dihybrid cross involves two pairs of contrasting characters.
- (C) a reciprocal cross swaps the sexes of the parents carrying the traits.
- (D) a self-cross is selfing of the same plant, not a cross with tt.

Final Answer: test cross $\Rightarrow$ A

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Incomplete dominance: When neither allele is fully dominant, the heterozygote shows an *intermediate* (blended) phenotype. In *Mirabilis jalapa*, RR is red, rr is white and the heterozygote Rr is pink. The F_2 then shows a 1 red : 2 pink : 1 white phenotypic ratio.

Step 1 — Read the clue: the heterozygote (Rr) is an intermediate pink.

Step 2 — Name it: incomplete dominance.

Why other options are wrong:

- (A) in complete dominance the heterozygote looks exactly like the dominant homozygote (would be red, not pink).
- (B) in codominance both alleles are fully expressed together (e.g. AB blood group), not blended into an intermediate.
- (D) multiple allelism refers to more than two alleles of a gene (e.g. ABO), which is not shown here.

Final Answer: incomplete dominance $\Rightarrow$ C

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Morgan's material: Thomas Hunt Morgan established linkage and recombination through breeding experiments on the fruit fly *Drosophila melanogaster*, which is easy to culture, has a short life cycle and produces many offspring.

Step 1 — Recall Morgan's experimental organism: *Drosophila* (the fruit fly).

Step 2 — Confirm: his work on linked genes in *Drosophila* extended Mendel's findings.

Why other options are wrong:

- (A) the garden pea was used by Mendel, not by Morgan for linkage.
- (B) *Neurospora* was used by Beadle and Tatum (one gene–one enzyme).
- (C) *E. coli* was used in molecular genetics (e.g. Meselson–Stahl, lac operon), not Morgan's linkage work.

Final Answer: fruit fly (*Drosophila melanogaster*) $\Rightarrow$ D

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Haplodiploidy: In honey bees, females (queen, workers) arise from fertilised eggs and are diploid (2n), while males (drones) arise from unfertilised eggs (parthenogenesis) and are haploid (n). This haploid-male/diploid-female system is called haplodiploidy.

Step 1 — Read the clue: males haploid (from unfertilised eggs), females diploid (from fertilised eggs).

Step 2 — Name the mechanism: haplodiploidy.

Why other options are wrong:

- (A) the XX–XY mechanism is the human/*Drosophila* system, where both sexes are diploid.

- (C) the XX–XO mechanism (as in grasshoppers) again keeps both sexes diploid.
- (D) polyploidy means having more than two whole chromosome sets, which is not what determines bee sex.

Final Answer: haplodiploidy $\Rightarrow$ B

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Nucleotide: DNA is a polynucleotide. Each nucleotide (the repeating monomer) is built of three parts: a nitrogenous base (A, T, G or C), a pentose sugar (deoxyribose in DNA) and a phosphate group. (A base + sugar alone, without the phosphate, is a nucleoside.)

Step 1 — List the three components: nitrogen base + deoxyribose sugar + phosphate.

Step 2 — Match: option (A) names exactly these three.

Why other options are wrong:

- (B) two complementary bases form a base *pair*, not a nucleotide monomer.
- (C) amino acid + fatty acid + glycerol mixes the building blocks of proteins and fats.
- (D) three glucose units form a (poly)saccharide, not a nucleotide.

Final Answer: nitrogen base + deoxyribose sugar + phosphate $\Rightarrow$ A

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Genetic code and translation: During translation, the mRNA is read in groups of three bases called codons. Each codon specifies one particular amino acid (the code is a triplet code); tRNA molecules, by their anticodons, bring the correct amino acids to the ribosome in the order dictated by the codons.

Step 1 — Recall the reading unit: a codon is a triplet of bases.

Step 2 — State what a codon codes for: one specific amino acid.

Why other options are wrong:

- (A) a whole protein is coded by many codons (the entire mRNA), not by one codon.
- (B) a codon does not code for glucose; it codes for an amino acid.
- (D) a codon does not code for a ribosome.

Final Answer: one particular amino acid $\Rightarrow$ C

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Homologous organs: Organs that have the same basic structural plan and developmental origin but may perform different functions are called homologous organs. The forelimbs of whale, bat, horse and human share the same bone plan, indicating descent from a common ancestor (divergent evolution).

Step 1 — Read the clue: same basic skeletal plan, different functions.

Step 2 — Name them: homologous organs (evidence of divergent evolution).

Why other options are wrong:

- (A) analogous organs have different structure but the *same* function (e.g. wings of insect and bird) and show convergent evolution.
- (C) vestigial organs are reduced, functionless remnants (e.g. the human appendix).
- (D) 'fossil organs' is not a recognised category of this comparison.

Final Answer: homologous organs $\Rightarrow$ B

Answer: (B) Go Back to Q40

Q41.

Solution

Concept — Amoebiasis: Amoebiasis (amoebic dysentery) is caused by the protozoan *Entamoeba histolytica*, which lives in the large intestine of humans. Symptoms include constipation, abdominal pain and stools with mucus and blood; houseflies act as mechanical carriers.

Step 1 — Match disease to pathogen: amoebic dysentery $\rightarrow$ *Entamoeba histolytica*.

Step 2 — Confirm the site: it parasitises the large intestine.

Why other options are wrong:

- (A) *Plasmodium vivax* causes malaria.
- (B) *Wuchereria bancrofti* causes filariasis (elephantiasis).
- (C) *Ascaris lumbricoides* causes ascariasis (roundworm infection).

Final Answer: *Entamoeba histolytica* $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q41

Q42.

Solution

Concept — Passive immunity: When ready-made antibodies are supplied directly to the body (rather than the body making its own), the protection is called passive immunity. Examples are the antibodies passed from mother to foetus through the placenta (or to the infant through colostrum) and the injection of pre-formed antibodies (anti-tetanus serum).

Step 1 — Read the clue: ready-made antibodies given directly.

Step 2 — Name it: passive immunity.

Why other options are wrong:

- (A) active natural immunity develops after the body itself fights a natural infection.
- (B) active artificial immunity develops after vaccination, when the body makes its own antibodies.
- (D) innate immunity is the non-specific, inborn defence (skin, phagocytes), not antibody transfer.

Final Answer: passive immunity $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Methanogens and biogas: Biogas is produced by anaerobic bacteria called methanogens (e.g. *Methanobacterium*). They grow in the absence of oxygen on cellulosic material (such as cattle dung) and in the rumen of cattle, producing a mixture of gases that is rich in methane.

Step 1 — Read the clues: anaerobic, occur in cattle rumen, produce methane.

Step 2 — Name the group: methanogens.

Why other options are wrong:

- (A) lactic acid bacteria make curd, not biogas.
- (B) *Rhizobium* fixes atmospheric nitrogen in root nodules.
- (C) nitrifying bacteria convert ammonia to nitrite/nitrate in the nitrogen cycle.

Final Answer: methanogens (e.g. *Methanobacterium*) $\Rightarrow$ D

Answer: (D) Go Back to Q43

Q44.

Solution

Concept — Micropropagation: Micropropagation is the production of thousands of genetically identical plants (a clone) from small pieces of tissue (explants) grown on a sterile nutrient medium in culture. It works because plant cells are totipotent — a single cell can regenerate a whole plant.

Step 1 — Read the clue: many identical plants from explants on nutrient medium, using totipotency.

Step 2 — Name the technique: micropropagation (tissue culture).

Why other options are wrong:

- (B) mutation breeding induces mutations to create new variability, not identical clones.
- (C) biofortification breeds crops richer in nutrients/vitamins.
- (D) cross-hybridisation crosses different parents to combine traits, giving

non-identical offspring.

Final Answer: micropropagation (tissue culture) $\Rightarrow$ A

Answer: (A) Go Back to Q44

Q45.

Solution

Concept — DNA ligase: After a restriction enzyme cuts the gene and the vector to give complementary (sticky) ends, the enzyme DNA ligase joins the two pieces by forming phosphodiester bonds between them. It is therefore called the 'molecular glue' of recombinant DNA technology.

Step 1 — Read the function: seals two DNA fragments by phosphodiester bonds (joining/glue).

Step 2 — Name the enzyme: DNA ligase.

Why other options are wrong:

- (A) restriction endonuclease *cuts* DNA (molecular scissors), it does not join.
- (C) DNA helicase unwinds the double helix during replication.
- (D) exonuclease removes nucleotides from the ends of a DNA strand.

Final Answer: DNA ligase $\Rightarrow$ B

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Transformation: Transformation is the process by which a bacterial cell takes up foreign (recombinant) DNA from its surroundings. In genetic engineering, the recombinant plasmid is introduced into a host (e.g. *E. coli*), often after the cells are made 'competent' (e.g. with $CaCl_2$ and a brief heat shock).

Step 1 — Read the clue: introduction and uptake of recombinant DNA by a bacterial host cell.

Step 2 — Name the process: transformation.

Why other options are wrong:

- (A) translation is the synthesis of a protein from mRNA on the ribosome.

- (B) replication is the copying of DNA; it is not the uptake of DNA by the host.
- (D) transpiration is the loss of water vapour from plants and is unrelated.

Final Answer: transformation $\Rightarrow$ C

Answer: (C) Go Back to Q46

Q47.

Solution

Concept — First gene therapy (ADA deficiency): The first clinical gene therapy (1990) was performed on a girl with severe combined immunodeficiency (SCID) caused by the lack of the enzyme adenosine deaminase (ADA). Functional ADA genes (in lymphocytes/cDNA) were introduced to restore immune function.

Step 1 — Recall the disorder: ADA-deficiency SCID.

Step 2 — Identify the missing enzyme: adenosine deaminase (ADA).

Why other options are wrong:

- (A) insulin deficiency causes diabetes, treated with insulin, not by this gene therapy.
- (C) DNA ligase is a laboratory tool enzyme, not the deficiency treated.
- (D) amylase is a digestive enzyme and is unrelated to this immunodeficiency.

Final Answer: adenosine deaminase (ADA) $\Rightarrow$ B

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Ten per cent law: Lindeman's ten per cent law states that when energy passes from one trophic level to the next higher level, only about 10% of the energy is stored and available to the next level; the remaining ~90% is lost mainly as heat in respiration and in life processes.

Step 1 — Recall the figure: about 10% of energy moves up to the next trophic level.

Step 2 — Confirm: this is why food chains rarely have more than 4–5 links.

Why other options are wrong:

- (A) 1% is not the value of the ten per cent law (10% is the standard figure).
- (B) 50% is far too high; most energy is lost, not half-transferred.
- (D) 100% transfer is impossible because of large energy losses at each level.

Final Answer: about 10% of the energy $\Rightarrow$ C

Answer: (C) Go Back to Q48

Q49.

Solution

Concept — Age pyramids: The shape of an age pyramid shows the population's future. A pyramid with a broad base (many young, pre-reproductive individuals) and a narrowing top indicates a high proportion of future breeders, so the population is growing (expanding).

Step 1 — Read the shape: broad base of young individuals, tapering top.

Step 2 — Interpret it: more young individuals will reproduce, so the population is expanding.

Why other options are wrong:

- (A) a declining population has a narrow base (fewer young) and a relatively broad upper region.
- (B) a stable population has a bell-shaped pyramid with roughly equal pre-reproductive and reproductive numbers.
- (C) a broad-based pyramid full of young individuals is the opposite of extinction.

Final Answer: growing (expanding) population $\Rightarrow$ D

Answer: (D) Go Back to Q49

Q50.

Solution

Concept — *In-situ* conservation: *In-situ* ('on site') conservation protects species *within* their natural habitat, where the whole ecosystem is conserved. National parks, wildlife sanctuaries, biosphere reserves and sacred groves are examples of in-situ conservation.

Step 1 — Read the clue: protection within the natural habitat (national parks, sanctuaries, biosphere reserves).

Step 2 — Name the strategy: in-situ conservation.

Why other options are wrong:

- (B) *ex-situ* conservation protects species *outside* their habitat (zoos, botanical gardens).
- (C) cryopreservation (storing gametes/tissues at very low temperature) is an ex-situ method.
- (D) seed banks store seeds away from the habitat and are also an ex-situ method.

Final Answer: *in-situ* conservation $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q50

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	B	4	A	5	B
6	C	7	D	8	B	9	D	10	A
11	B	12	C	13	A	14	B	15	D
16	C	17	A	18	B	19	D	20	C
21	D	22	A	23	B	24	C	25	B
26	A	27	D	28	A	29	C	30	B
31	D	32	B	33	C	34	A	35	C
36	D	37	B	38	A	39	C	40	B
41	D	42	C	43	D	44	A	45	B
46	C	47	B	48	C	49	D	50	A