SRMJEEE Biology Sample Paper – 1

Duration: 47 Minutes **Maximum Marks: 40**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Biology section of **SRMJEEE** (SRM Joint Engineering Entrance Examination).
- Each correct answer carries **+1 mark**. There is **no negative marking**; an unattempted or wrong answer scores 0.
- Only **one** option is correct. Choose carefully.
- The actual SRMJEEE is a **computer-based test** conducted in remote-proctored online mode, with all sections sharing a common time window and no per-section limit.
- Personal calculators, mobile phones, log tables and other electronic gadgets are strictly prohibited.

Q1. In Whittaker's five-kingdom system of classification, all organisms made up of *prokaryotic* cells are grouped under the kingdom:

(A) Monera

(B) Protista

(C) Fungi

(D) Plantae

Q2. In which group of plants is the gametophyte the dominant, green, and independent phase of the life cycle?

(A) Pteridophytes

(B) Bryophytes

(C) Gymnosperms

(D) Angiosperms

Q3. Which of the following animals belongs to a phylum characterised by a *water vascular system* and *tube feet*?

(A) Earthworm

(B) Cockroach

(C) Starfish

(D) Hydra

Q4. In the binomial system of nomenclature, the scientific name of a species has two parts; the first word denotes the genus, while the second word denotes the:

(A) family

(B) order

(C) kingdom

(D) species (specific epithet)

Q5. The edible part of a potato is an underground stem modification that stores food and bears 'eyes' (axillary buds). It is a:

(A) stem tuber

(B) bulb

(C) taproot

(D) rhizome

Q6. A papilionaceous corolla, diadelphous stamens and a pulvinus at the leaf base are characteristic features of the plant family:

(A) Solanaceae

(B) Liliaceae

(C) Fabaceae

(D) Poaceae

Q7. In the cockroach, the removal of nitrogenous wastes (excretion) is carried out by:

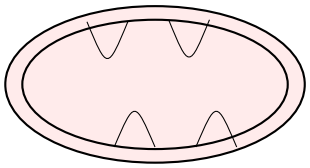
(A) nephridia

(B) Malpighian tubules

(C) kidneys

(D) flame cells

Q8. The cell organelle shown below is bounded by a double membrane whose inner membrane is folded into *cristae*, and is called the "powerhouse of the cell". It is the:



cristae visible on the inner membrane

(A) chloroplast

(B) Golgi apparatus

(C) nucleus

(D) mitochondrion

Q9. A prokaryotic cell differs fundamentally from a eukaryotic cell in that the prokaryotic cell lacks:

(A) membrane-bound organelles and a true (membrane-bound) nucleus

(B) a plasma membrane

(C) ribosomes

(D) cytoplasm

Q10. Enzymes increase the rate of a biochemical reaction mainly by:

(A) increasing the activation energy of the reaction

(B) lowering the activation energy of the reaction

(C) raising the temperature of the cell

(D) shifting the equilibrium constant of the reaction

Q11. During which stage of mitosis do the sister chromatids separate at the centromere and move towards opposite poles of the cell?

(A) prophase

(B) metaphase

(C) anaphase

(D) telophase

Q12. Crossing over, the exchange of segments between homologous chromosomes that produces genetic recombination, takes place during:

(A) metaphase II

(B) anaphase I

(C) telophase I

(D) the pachytene stage of prophase I

Q13. The loss of water in the form of vapour from the aerial parts of a plant, chiefly through the stomata, is known as:

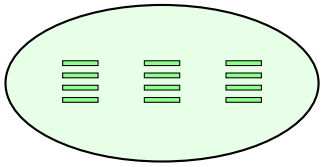
(A) transpiration

(B) guttation

(C) translocation

(D) imbibition

Q14. In the chloroplast shown, the light reactions occur on the thylakoid (grana) membranes. The photolysis (splitting) of water that releases O_2 is associated with:



chloroplast — grana (thylakoid stacks)

(A) Photosystem I (P700)

(B) Photosystem II (P680)

(C) the Calvin cycle in the stroma

(D) the mitochondrial matrix

Q15. The complete aerobic oxidation of one molecule of glucose to CO_2 and water yields a net total of approximately how many ATP molecules?

(A) 2

(B) 8

(C) 38

(D) 4

Q16. Which plant growth regulator is chiefly responsible for apical dominance and is applied to stem cuttings to promote the formation of roots?

(A) gibberellin

(B) cytokinin

(C) ethylene

(D) auxin

Q17. The digestion of starch in humans begins in the mouth through the action of the enzyme:

(A) salivary amylase (ptyalin)

(B) pepsin

(C) trypsin

(D) lipase

Q18. The total volume of air a person can inspire after a normal expiration — the tidal volume plus the inspiratory reserve volume — is called the:

(A) residual volume

(B) inspiratory capacity

(C) expiratory reserve volume

(D) dead-space volume

Q19. In the human circulatory system, the blood vessel that carries *oxygenated* blood from the lungs to the left atrium of the heart is the:

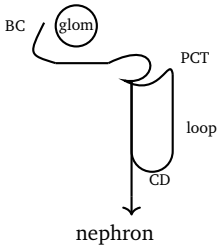
(A) pulmonary artery

(B) aorta

(C) superior vena cava

(D) pulmonary vein

Q20. In the nephron shown, after filtration at the glomerulus, the bulk of the useful substances (glucose, amino acids, water, ions) is reabsorbed in the:



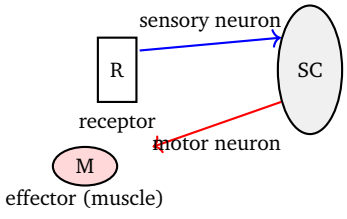
(A) glomerulus

(B) collecting duct

(C) proximal convoluted tubule (PCT)

(D) urinary bladder

Q21. In the reflex arc shown, the neuron that conducts the impulse *away* from the spinal cord to the effector muscle is the:



(A) motor (efferent) neuron

(B) sensory (afferent) neuron

(C) receptor

(D) the brain

Q22. Which hormone, secreted by the β-cells of the islets of Langerhans in the pancreas, lowers the blood glucose level?

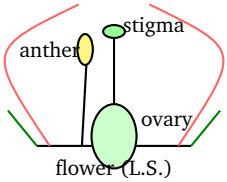
(A) glucagon

(B) insulin

(C) thyroxine

(D) adrenaline

Q23. In the longitudinal section of a flower shown, the part that ripens into the *fruit* after fertilisation is the:



(A) stigma

(B) anther

(C) petal

(D) ovary

Q24. In angiosperms, double fertilisation produces a diploid ($2n$) zygote and a triploid ($3n$):

(A) embryo

(B) seed coat

(C) primary endosperm nucleus (endosperm)

(D) pollen grain

Q25. In the human female, the release of a secondary oocyte from the mature Graafian follicle of the ovary is termed:

(A) ovulation

(B) menstruation

(C) implantation

(D) gestation

Q26. Which of the following is a *surgical* method of contraception used in the human male?

(A) tubectomy

(B) vasectomy

(C) the intra-uterine device (IUD)

(D) the oral contraceptive pill

Q27. The Punnett square shows a monohybrid cross between two heterozygous tall pea plants ($Tt \times Tt$). The phenotypic ratio of tall to dwarf plants in the F_2 generation is:

	T	t
T	TT	Tt
t	Tt	tt

(A) $1:1$

(B) $9:3:3:1$

(C) $3:1$

(D) $1:2:1$

Q28. The inheritance of the ABO blood groups in humans, controlled by the alleles I^A, I^B and i, is a classic example of:

(A) incomplete dominance

(B) polygenic inheritance

(C) sex-linked inheritance

(D) multiple alleles

Q29. Down's syndrome in humans is a chromosomal disorder caused by:

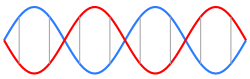
(A) an additional copy of chromosome 21 (trisomy-21)

(B) the absence of one X chromosome

(C) an additional Y chromosome

(D) a deletion in chromosome 5

Q30. In the DNA double helix shown, the base adenine (A) pairs with thymine (T). The number of hydrogen bonds between an A–T pair is:



DNA double helix

(A) three

(B) two

(C) one

(D) four

Q31. The process by which a messenger RNA (mRNA) molecule is synthesised using one strand of DNA as a template is called:

(A) translation

(B) replication

(C) transcription

(D) reverse transcription

Q32. According to the Hardy–Weinberg principle, the allele and genotype frequencies of a population remain constant from generation to generation only when:

(A) natural selection is acting

(B) genetic drift is occurring

(C) there is migration of individuals

(D) there is no mutation, migration, selection or genetic drift (and mating is random)

Q33. Malaria is caused by the protozoan parasite *Plasmodium*, which is transmitted to humans through the bite of the:

(A) female *Anopheles* mosquito

(B) male *Anopheles* mosquito

(C) *Aedes* mosquito

(D) *Culex* mosquito

Q34. An antibody (immunoglobulin) molecule has a characteristic Y-shape and is composed of how many polypeptide chains?

(A) two

(B) four (two heavy and two light chains)

(C) one

(D) six

Q35. The microorganism responsible for the formation of curd from milk, by producing lactic acid, is:

(A) *Saccharomyces* (yeast)

(B) *Penicillium*

(C) *Lactobacillus* (lactic acid bacteria)

(D) *Aspergillus*

Q36. Restriction endonucleases, often called the “molecular scissors” of genetic engineering, cut a DNA molecule at:

(A) completely random positions

(B) only the two ends of the molecule

(C) every base pair along the molecule

(D) specific palindromic recognition sequences

Q37. Bt cotton, a transgenic crop resistant to certain insect pests, carries an insecticidal-protein gene derived from the bacterium:

(A) *Bacillus thuringiensis*

(B) *Agrobacterium tumefaciens*

(C) *Escherichia coli*

(D) *Rhizobium leguminosarum*

Q38. In recombinant DNA technology, the technique used to separate DNA fragments according to their size, by moving them through a matrix under an electric field, is:

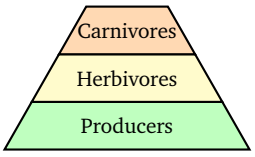
(A) the polymerase chain reaction (PCR)

(B) differential centrifugation

(C) gel electrophoresis

(D) paper chromatography

Q39. The pyramid of energy for any ecosystem, such as the grassland ecosystem shown, is always:



pyramid of energy

(A) inverted

(B) upright

(C) spindle-shaped

(D) sometimes inverted

Q40. The thinning of the ozone layer in the stratosphere (the “ozone hole”) is caused mainly by the release of:

(A) carbon dioxide

(B) methane

(C) sulphur dioxide

(D) chlorofluorocarbons (CFCs)

Detailed Solutions

Q1.

Solution

Concept — Whittaker's five kingdoms: In 1969 R.H. Whittaker classified all living organisms into five kingdoms — Monera, Protista, Fungi, Plantae and Animalia — using criteria such as cell structure (prokaryotic vs eukaryotic), body organisation, mode of nutrition and phylogeny.

Key fact: The defining feature of *Monera* is the prokaryotic cell — no membrane-bound nucleus and no membrane-bound organelles. All bacteria, cyanobacteria, mycoplasma and archaebacteria are placed here.

Why other options are wrong:

- (B) Protista are unicellular but *eukaryotic* (e.g. *Amoeba*, *Euglena*).
- (C) Fungi and (D) Plantae are multicellular eukaryotes with membrane-bound nuclei.

Final Answer: Prokaryotes belong to Monera $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Alternation of generations: Plant life cycles alternate between a haploid gametophyte and a diploid sporophyte. Which phase dominates differs across plant groups and is a key identifying feature.

Key fact: In *bryophytes* (mosses, liverworts) the gametophyte is the main, green, photosynthetic and independent plant body; the sporophyte is small and dependent on the gametophyte for nutrition.

Why other options are wrong:

- (A) In pteridophytes the *sporophyte* is dominant; the gametophyte (prothallus) is tiny.
- (C),(D) In gymnosperms and angiosperms the sporophyte is dominant and the gametophyte is greatly reduced and dependent.

Final Answer: Gametophyte dominates in bryophytes $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Phylum Echinodermata: Members of this phylum are exclusively marine and possess a unique *water vascular system* (used in locomotion, food capture and respiration) along with *tube feet* and an endoskeleton of calcareous ossicles.

Key fact: The starfish (*Asterias*) is a classic echinoderm; it moves and captures prey using rows of tube feet powered by the water vascular system.

Why other options are wrong:

- (A) Earthworm = Annelida (metameric segmentation, nephridia).
- (B) Cockroach = Arthropoda (jointed legs, chitinous exoskeleton).
- (D) Hydra = Cnidaria (radial symmetry, cnidoblasts).

Final Answer: Starfish (Echinodermata) $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Binomial nomenclature: Introduced by Carolus Linnaeus, every species is given a two-word Latinised name. The first word is the *genus* (generic name) and the second word is the *specific epithet*, which together name the species uniquely.

Key fact: For example, in *Mangifera indica*, "*Mangifera*" is the genus and "*indica*" is the specific epithet denoting the species. The genus is written with a capital, the species in lower case, and both are italicised.

Why other options are wrong:

- (A),(B),(C) family, order and kingdom are *higher* taxonomic categories; they are not part of the two-word species name.

Final Answer: The second word denotes the species (specific epithet) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Underground stem modifications: Some stems grow underground and store food. They are still classed as stems (not roots) because they bear nodes, internodes, scale leaves and *axillary buds*.

Key fact: The potato is a *stem tuber* — the swollen tip of an underground branch. Its "eyes" are nodes bearing axillary buds, proving it is a stem, not a root.

Why other options are wrong:

- (B) A bulb (onion) is a condensed disc-like stem with fleshy leaves, not a tuber.
- (C) A taproot (carrot) is a root and bears no buds; (D) a rhizome (ginger) grows horizontally.

Final Answer: Potato is a stem tuber $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Family Fabaceae (Leguminosae): This family is recognised by its distinctive *papilionaceous* (butterfly-like) corolla of five petals (one standard, two wings, two keel), *diadelphous* stamens (9 fused + 1 free), a monocarpellary superior ovary forming a legume (pod), and pulvinate leaf bases.

Key fact: Common examples are pea, gram, bean and groundnut. Many Fabaceae fix atmospheric nitrogen via root-nodule bacteria (*Rhizobium*).

Why other options are wrong:

- (A) Solanaceae have actinomorphic flowers and a bicarpellary ovary (e.g. brinjal).
- (B) Liliaceae are monocots with trimerous flowers; (D) Poaceae (grasses) have spikelets and a feathery stigma.

Final Answer: Fabaceae $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Excretion in insects: Insects such as the cockroach are uricotelic and excrete nitrogenous waste with very little water loss, an adaptation to terrestrial life.

Key fact: The *Malpighian tubules*, thin yellow tubules attached at the junction of the midgut and hindgut, absorb nitrogenous wastes from the haemolymph and convert them to uric acid, which leaves with the faeces.

Why other options are wrong:

- (A) Nephridia are the excretory organs of annelids (earthworm).
- (C) Kidneys belong to vertebrates; (D) flame cells (protonephridia) occur in flatworms.

Final Answer: Malpighian tubules $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — The mitochondrion: It is a double-membraned organelle; the outer membrane is smooth while the inner membrane is thrown into folds called *cristae* that increase surface area for the electron transport chain.

Key fact: The mitochondrion is the "powerhouse of the cell" because it carries out the Krebs cycle (in the matrix) and oxidative phosphorylation (on the cristae), generating most of the cell's ATP. The figure's cristae are the giveaway.

Why other options are wrong:

- (A) The chloroplast is double-membraned too, but its internal membranes form flat thylakoid stacks (grana), not cristae, and it is green.
- (B) The Golgi apparatus is a stack of flattened cisternae; (C) the nucleus contains chromatin and a nucleolus.

Final Answer: Organelle with cristae = mitochondrion $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Prokaryotic vs eukaryotic cells: The single most important distinction is the presence or absence of a true (membrane-bound) nucleus and other membrane-bound organelles.

Key fact: Prokaryotes (bacteria, cyanobacteria) have their genetic material lying free in the cytoplasm (the nucleoid) and lack mitochondria, ER, Golgi, lysosomes and a nuclear envelope. Eukaryotes possess all of these.

Why other options are wrong:

- (B) Both cell types have a plasma membrane.
- (C) Both have ribosomes (prokaryotic 70S, eukaryotic 80S); (D) both have cytoplasm.

Final Answer: Prokaryotes lack membrane-bound organelles/true nucleus $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Enzyme catalysis: Enzymes are biological catalysts (mostly proteins). Every reaction must cross an energy barrier called the *activation energy* (E_a); enzymes provide an alternative reaction pathway with a lower E_a.

Key fact: By forming an enzyme–substrate complex, an enzyme stabilises the transition state and *lowers the activation energy*, so a much larger fraction of substrate molecules can react. The enzyme itself is unchanged at the end.

Why other options are wrong:

- (A) Increasing E_a would *slow* the reaction — the opposite of catalysis.
- (C) Enzymes do not heat the cell; (D) a catalyst speeds both forward and reverse rates equally, so it does *not* change the equilibrium constant.

Final Answer: Enzymes lower the activation energy $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Phases of mitosis: Mitosis proceeds through prophase, metaphase, anaphase and telophase, distinguished by the behaviour of the chromosomes.

Key fact: At *anaphase*, the centromeres split, the sister chromatids separate, and the spindle fibres pull them as daughter chromosomes to opposite poles — the stage that actually distributes the genetic material equally.

Why other options are wrong:

- (A) In prophase chromosomes merely condense and the spindle starts forming.
- (B) In metaphase chromosomes line up at the equator (still joined); (D) in telophase nuclei reform after separation is complete.

Final Answer: Sister chromatids separate in anaphase $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Prophase I of meiosis: The long prophase I is subdivided into leptotene, zygotene, pachytene, diplotene and diakinesis. Homologous chromosomes pair (synapsis) and then exchange segments.

Key fact: *Crossing over* — the reciprocal exchange of genetic material between non-sister chromatids of homologous chromosomes at the chiasmata — occurs during the *pachytene* stage and is a major source of genetic recombination.

Why other options are wrong:

- (B) Anaphase I separates whole homologues (no exchange then).
- (A),(C) metaphase II and telophase I are far too late — recombination has already occurred.

Final Answer: Crossing over occurs at pachytene of prophase I $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Loss of water from plants: Plants lose water by several routes; the dominant one from aerial parts is evaporation through the stomata.

Key fact: *Transpiration* is the loss of water as *vapour* from the aerial surfaces, mainly through stomata. It creates the transpiration pull that draws water up the xylem and helps cool the plant.

Why other options are wrong:

- (B) Guttation is the loss of liquid water (droplets) through hydathodes, not vapour.
- (C) Translocation is the transport of food in phloem; (D) imbibition is the absorption of water by hydrophilic solids (e.g. seeds swelling).

Final Answer: Loss of water vapour = transpiration $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — The light reactions: On the thylakoid membranes there are two photosystems, PS I (P700) and PS II (P680). They absorb light and drive electron flow that ultimately makes ATP and NADPH.

Key fact: The *photolysis* (splitting) of water, $2H_2O \rightarrow 4H^+ + 4e^- + O_2$, is carried out by the oxygen-evolving complex associated with *Photosystem II*. This is the source of the O_2 released in photosynthesis and of the electrons that replace those lost by P680.

Why other options are wrong:

- (A) PS I re-energises electrons to reduce $NADP^+$ but does not split water.
- (C) The Calvin cycle (stroma) fixes CO_2 and is light-independent; (D) the mitochondrion does respiration, not photosynthesis.

Final Answer: Photolysis is linked to Photosystem II $\Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — ATP yield of aerobic respiration: Glucose is oxidised in four stages — glycolysis, link reaction, the Krebs (TCA) cycle and oxidative phosphorylation along the electron transport chain.

Key fact: The classical (theoretical) net yield is about *38 ATP* per glucose: 2 (net) from glycolysis, 2 from the Krebs cycle (GTP), and the remainder from oxidative phosphorylation of the NADH and $FADH_2$ produced. (Realistic estimates are ∼30–36, but the standard textbook figure is 38.)

Why other options are wrong:

- (A) Only 2 net ATP come from glycolysis alone (anaerobic).
- (B),(D) 8 and 4 greatly under-count the contribution of the electron transport chain.

Final Answer: About 38 ATP per glucose $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Plant growth regulators: Five major classes (auxins, gibberellins, cytokinins, ethylene, abscisic acid) control growth and development, each with characteristic effects.

Key fact: *Auxin* (e.g. IAA), produced at shoot tips, suppresses the growth of lateral buds — the phenomenon of *apical dominance* — and synthetic auxins (IBA, NAA) are widely used to induce rooting in stem cuttings.

Why other options are wrong:

- (A) Gibberellins promote stem elongation and bolting.
- (B) Cytokinins promote cell division and *release* lateral buds (oppose apical dominance); (C) ethylene promotes fruit ripening and abscission.

Final Answer: Apical dominance and rooting = auxin $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Chemical digestion of carbohydrates: Starch digestion begins not in the stomach but in the mouth, catalysed by an enzyme in saliva.

Key fact: *Salivary amylase* (ptyalin), secreted by the salivary glands, hydrolyses about 30% of dietary starch into maltose, isomaltose and dextrins while the food is in the mouth, at a near-neutral pH.

Why other options are wrong:

- (B) Pepsin (stomach) digests proteins, not starch.
- (C) Trypsin (pancreas) digests proteins; (D) lipase digests fats.

Final Answer: Starch digestion starts with salivary amylase $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Respiratory volumes and capacities: A "capacity" is the sum of two or more lung volumes. Tidal volume (TV) is normal breathing; inspiratory reserve volume (IRV) is the extra air that can be forcibly inhaled.

Key fact: The *inspiratory capacity* (IC) $=$ TV $+$ IRV is the total volume a person can inspire after a normal expiration — exactly the quantity described in the question.

Why other options are wrong:

- (A) Residual volume is the air remaining after the most forceful expiration (cannot be exhaled).
- (C) ERV is extra air that can be *exhaled*; (D) dead-space air never reaches the alveoli.

Final Answer: TV $+$ IRV $=$ inspiratory capacity $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Pulmonary circulation: Arteries always carry blood *away* from the heart and veins carry it *towards* the heart — but in the pulmonary circuit the oxygen content is reversed compared with the systemic circuit.

Key fact: The *pulmonary veins* (four of them) return freshly *oxygenated* blood from the lungs to the *left atrium*. They are the exception to the "veins carry deoxygenated blood" rule, alongside the pulmonary artery (which carries deoxygenated blood).

Why other options are wrong:

- (A) The pulmonary artery carries *deoxygenated* blood from the right ventricle to the lungs.
- (B) The aorta distributes oxygenated blood to the body; (C) the vena cava returns deoxygenated blood to the right atrium.

Final Answer: Lungs $\rightarrow$ left atrium via the pulmonary vein $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Urine formation: The nephron forms urine in three steps — glomerular filtration (at the Bowman's capsule), selective reabsorption, and tubular secretion — along its different segments.

Key fact: The *proximal convoluted tubule* (PCT) is the principal site of reabsorption: nearly all glucose and amino acids, about 70–80% of water and ions, and HCO_3^- are reclaimed here, returning useful substances to the blood.

Why other options are wrong:

- (A) The glomerulus only *filters* blood; it does not reabsorb.
- (B) The collecting duct mainly concentrates urine (water under ADH); (D) the bladder merely stores urine.

Final Answer: Bulk reabsorption occurs in the PCT $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — The reflex arc: A reflex is an automatic response to a stimulus. The pathway is: receptor → afferent (sensory) neuron → central nervous system (spinal cord) → efferent (motor) neuron → effector.

Key fact: The *motor (efferent) neuron* carries the impulse *away* from the spinal cord to the effector (muscle or gland), producing the response — shown by the red arrow leaving the spinal cord in the figure.

Why other options are wrong:

- (B) The sensory neuron carries impulses *towards* the CNS (the blue arrow).
- (C) The receptor only detects the stimulus; (D) a spinal reflex does not require the brain.

Final Answer: Impulse out to the effector = motor neuron ⇒ $\boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Endocrine pancreas: The islets of Langerhans contain α-cells (secreting glucagon) and β-cells (secreting insulin), which together regulate blood glucose antagonistically.

Key fact: *Insulin*, from the β-cells, *lowers* blood glucose by promoting cellular uptake of glucose and its conversion to glycogen (glycogenesis). Its deficiency causes diabetes mellitus.

Why other options are wrong:

- (A) Glucagon (α-cells) *raises* blood glucose.
- (C) Thyroxine controls metabolic rate; (D) adrenaline raises blood glucose during stress.

Final Answer: Blood-glucose-lowering hormone = insulin ⇒ $\boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Parts of a flower and fruit formation: The gynoecium (pistil) consists of stigma, style and ovary. After fertilisation, different parts of the flower develop into different parts of the seed and fruit.

Key fact: The *ovary* develops into the *fruit*, while the ovules inside it become the seeds. (The ovary wall becomes the pericarp.)

Why other options are wrong:

- (A) The stigma only receives pollen; (B) the anther produces pollen.
- (C) Petals are accessory whorls that usually wither after fertilisation.

Final Answer: Ovary $\rightarrow$ fruit $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Double fertilisation: Unique to angiosperms, one of the two male gametes fuses with the egg (syngamy) and the other fuses with the two polar nuclei (triple fusion) of the central cell.

Key fact: Syngamy gives the diploid ($2n$) *zygote*, while triple fusion gives the triploid ($3n$) *primary endosperm nucleus* (PEN), which develops into the nutritive endosperm.

Why other options are wrong:

- (A) The embryo arises from the zygote and is $2n$, not $3n$.
- (B) The seed coat develops from the integuments; (D) the pollen grain is the male gametophyte (pre-fertilisation).

Final Answer: $3n$ product $=$ primary endosperm nucleus $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — The ovarian cycle: Under the influence of FSH and a mid-cycle LH surge, a follicle matures and ruptures to release the female gamete.

Key fact: *Ovulation* is the release of the secondary oocyte from the mature Graafian follicle, triggered by the LH surge around day 14 of the menstrual cycle.

Why other options are wrong:

- (B) Menstruation is the shedding of the uterine lining when fertilisation does not occur.
- (C) Implantation is the embedding of the blastocyst in the uterus; (D) gestation is the pregnancy period.

Final Answer: Release of the oocyte = ovulation $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Contraceptive methods: These include natural, barrier, hormonal, intra-uterine and surgical (sterilisation) methods; the surgical methods differ for the two sexes.

Key fact: *Vasectomy* is the male sterilisation procedure in which a small portion of each vas deferens is cut and tied, preventing sperm from entering the semen.

Why other options are wrong:

- (A) Tubectomy is the corresponding *female* surgical method (fallopian tubes).
- (C) The IUD is an intra-uterine device; (D) the pill is a hormonal method — neither is surgical.

Final Answer: Male surgical method = vasectomy $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Monohybrid cross: Crossing two heterozygotes for a single gene follows Mendel's law of segregation; the Punnett square gives the genotype and phenotype ratios of the offspring.

Step 1 — Read the square: The four boxes are TT, Tt, Tt and tt, i.e. a genotypic ratio $1\,TT : 2\,Tt : 1\,tt$.

Step 2 — Convert to phenotype: T (tall) is dominant, so TT, Tt and Tt are all tall (3 plants) and only tt is dwarf (1 plant).

Step 3 — Ratio: tall : dwarf $= 3 : 1$.

Why other options are wrong:

- (A) $1 : 1$ is a test-cross ratio ($Tt \times tt$).
- (B) $9 : 3 : 3 : 1$ is the dihybrid F_2 ratio; (D) $1 : 2 : 1$ is the *genotypic* ratio, not the phenotypic one.

Final Answer: Tall : dwarf $= 3 : 1 \Rightarrow$ C

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Multiple alleles: When a gene exists in more than two allelic forms in a population, it shows multiple allelism, although any individual carries only two of them.

Key fact: The ABO blood group gene I has three alleles — I^A, I^B and i. I^A and I^B are codominant to each other and both dominant over i, giving four blood groups (A, B, AB, O). This is the standard example of *multiple alleles*.

Why other options are wrong:

- (A) Incomplete dominance gives a blended phenotype (e.g. pink *Mirabilis*).
- (B) Polygenic inheritance involves many genes (e.g. skin colour); (C) sex linkage is gene location on sex chromosomes.

Final Answer: ABO blood groups = multiple alleles $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Chromosomal aneuploidies: An error in chromosome segregation (non-disjunction) during meiosis can give a gamete with an extra or missing chromosome, leading to a genetic disorder in the offspring.

Key fact: *Down's syndrome* results from *trisomy-21* — an extra (third) copy of chromosome 21, giving 47 chromosomes. Features include a short stature, a furrowed tongue and intellectual disability.

Why other options are wrong:

- (B) Absence of one X (XO) is Turner's syndrome.
- (C) An extra Y or X in males (XXY) is Klinefelter's syndrome; (D) a deletion of chromosome 5 short arm is *Cri-du-chat*.

Final Answer: Down's syndrome = trisomy-21 $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Base pairing in DNA: The two antiparallel strands of DNA are held together by hydrogen bonds between complementary bases, following Chargaff's rule (A with T, G with C).

Key fact: An *A–T* pair is joined by *two* hydrogen bonds, whereas a G–C pair has three. This is why GC-rich DNA is more thermally stable (needs more energy to melt).

Why other options are wrong:

- (A) Three hydrogen bonds occur in a G–C pair, not A–T.
- (C),(D) one or four hydrogen bonds do not occur between standard complementary bases.

Final Answer: A–T pair has two hydrogen bonds $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — The central dogma: Genetic information flows DNA $\xrightarrow{\text{transcription}}$ RNA $\xrightarrow{\text{translation}}$ protein. Each arrow is a distinct, named process.

Key fact: *Transcription* is the synthesis of an mRNA molecule complementary to one (template) strand of DNA, catalysed by RNA polymerase. The mRNA then carries the message to the ribosome.

Why other options are wrong:

- (A) Translation is the synthesis of protein from mRNA at the ribosome.
- (B) Replication makes a copy of DNA from DNA; (D) reverse transcription makes DNA from RNA (in retroviruses).

Final Answer: DNA $\rightarrow$ mRNA $=$ transcription $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Hardy–Weinberg equilibrium: In an idealised population the allele frequencies p and q stay constant ($p^2+2pq+q^2=1$), meaning no evolution occurs. This holds only under strict conditions.

Key fact: Genetic equilibrium is maintained when there is *no mutation, no gene migration, no natural selection and no genetic drift*, the population is large, and mating is random. Any of these forces disturbs the frequencies and causes evolution.

Why other options are wrong:

- (A),(B),(C) natural selection, genetic drift and migration are precisely the *disturbing* forces that change allele frequencies.

Final Answer: Equilibrium needs no evolutionary force acting $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Vector-borne disease: Malaria is caused by the protozoan *Plasmodium* (P. vivax, P. falciparum, etc.) and needs a specific insect vector to complete its life cycle and spread.

Key fact: The infective sporozoites are transmitted to humans through the bite of the *female Anopheles* mosquito, which needs a blood meal for egg development and acts as the definitive host of the parasite.

Why other options are wrong:

- (B) Male *Anopheles* feed on plant nectar and do not bite/transmit.
- (C) *Aedes* transmits dengue/chikungunya; (D) *Culex* transmits filariasis.

Final Answer: Vector = female *Anopheles* $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Antibody structure: An antibody (immunoglobulin) is a Y-shaped protein produced by plasma cells (B-lymphocytes) that binds specifically to an antigen.

Key fact: Each antibody is made of *four* polypeptide chains — two identical long *heavy* chains and two identical short *light* chains — represented as H_2L_2 and held together by disulphide bonds, forming the two antigen-binding arms.

Why other options are wrong:

- (A) Two chains would give only one binding arm.
- (C) one chain cannot form the Y; (D) six does not match the H_2L_2 structure.

Final Answer: Antibody = 4 chains (2 heavy + 2 light) $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Microbes in food processing: Different microorganisms are harnessed to make fermented foods and beverages; the product depends on the organism and its metabolic by-product.

Key fact: *Lactobacillus* (lactic acid bacteria, LAB) convert the milk sugar lactose into *lactic acid*, which curdles the milk proteins to form curd; LAB also enrich the curd with vitamin B_{12}.

Why other options are wrong:

- (A) *Saccharomyces* (yeast) is used for bread and alcohol (ethanol fermentation).
- (B),(D) *Penicillium* and *Aspergillus* are moulds used for antibiotics/cheese ripening and organic acids, not curd.

Final Answer: Curd is set by *Lactobacillus* $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Restriction endonucleases: These bacterial enzymes are central to recombinant DNA technology because they cut DNA in a precise, reproducible way, allowing genes to be "cut and pasted".

Key fact: Each restriction enzyme recognises a *specific palindromic sequence* (e.g. *Eco*RI recognises GAATTC) and cuts within or near it, often leaving complementary "sticky ends" that can be joined to other DNA cut by the same enzyme.

Why other options are wrong:

- (A) Random cutting would make cloning impossible — the precision is the whole point.
- (B),(C) they cut at internal recognition sites, not only the ends and certainly not every base pair.

Final Answer: They cut at specific palindromic sites $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Transgenic (Bt) crops: Genes coding for insecticidal crystal (Cry) proteins are transferred into crop plants to make them pest-resistant, reducing the need for chemical insecticides.

Key fact: The *cry* genes (e.g. *cryIAc*) are isolated from the soil bacterium *Bacillus thuringiensis* and introduced into cotton to make *Bt cotton*, which is resistant to bollworms. The Cry protein, harmless to the plant, becomes toxic in the alkaline insect gut.

Why other options are wrong:

- (B) *Agrobacterium* is used as a *vector* to deliver genes, not as the source of the Bt toxin.
- (C),(D) *E. coli* and *Rhizobium* do not provide the insecticidal Cry gene.

Final Answer: Bt gene comes from *Bacillus thuringiensis* $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Separating DNA fragments: DNA is negatively charged (due to its phosphate backbone), so in an electric field it migrates towards the positive electrode through a sieving matrix.

Key fact: In *gel electrophoresis*, DNA fragments move through an agarose gel under a voltage; smaller fragments move faster and farther, so the fragments separate into bands according to size, visualised with a dye such as ethidium bromide under UV light.

Why other options are wrong:

- (A) PCR *amplifies* (copies) DNA; it does not separate fragments by size.
- (B) Centrifugation separates by density/mass in solution; (D) paper chromatography is used for small molecules, not DNA fragments.

Final Answer: Size separation of DNA = gel electrophoresis $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Ecological pyramids: A pyramid of energy represents the amount of energy trapped at each trophic level. Because energy transfer obeys the 10% law, energy decreases at every successive level.

Key fact: Since only about 10% of the energy passes from one trophic level to the next, each higher level always holds less energy than the one below it. Hence the *pyramid of energy is always upright* — it can never be inverted.

Why other options are wrong:

- (A),(D) the pyramid of energy is never inverted (unlike the pyramid of numbers or biomass, which sometimes can be).
- (C) "spindle-shaped" describes a pyramid of numbers in a tree ecosystem, not energy.

Final Answer: The pyramid of energy is always upright $\Rightarrow$ B

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Ozone depletion: The stratospheric ozone layer shields the Earth from harmful UV-B radiation. Certain man-made gases release halogen atoms that catalytically destroy ozone.

Key fact: *Chlorofluorocarbons* (CFCs), once widely used as refrigerants and aerosol propellants, drift up to the stratosphere where UV light frees chlorine atoms; each Cl atom destroys thousands of O_3 molecules, creating the "ozone hole".

Why other options are wrong:

- (A) CO_2 and (B) methane are greenhouse gases that cause global warming, not ozone depletion.
- (C) SO_2 causes acid rain, not the ozone hole.

Final Answer: Ozone depletion is caused by CFCs $\Rightarrow$ D

Answer: (D) Go Back to Q40

Answer Key

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