SRMJEEE Biology Sample Paper – 4

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 members of the kingdom Fungi, the rigid cell wall that surrounds the cell is composed chiefly of:

(A) cellulose

(B) peptidoglycan (murein)

(C) chitin

(D) lignin

Q2. Gymnosperms are distinguished from angiosperms by the fact that their seeds are:

(A) naked, the ovules not being enclosed in an ovary

(B) enclosed within a ripened ovary (fruit)

(C) produced without any seed at all

(D) formed only after double fertilisation

Q3. The largest phylum in the animal kingdom, whose members possess jointed appendages and a chitinous exoskeleton, is:

(A) Mollusca

(B) Arthropoda

(C) Annelida

(D) Echinodermata

Q4. The system of binomial nomenclature, in which every species is given a two-word Latinised scientific name, was introduced by:

(A) Charles Darwin

(B) Gregor Mendel

(C) Robert Hooke

(D) Carolus Linnaeus

Q5. The onion, an underground modification that stores food in fleshy scale leaves around a much reduced, disc-like condensed stem, is an example of a:

(A) stem tuber

(B) bulb

(C) rhizome

(D) corm

Q6. Vexillary (papilionaceous) aestivation, in which the posterior standard petal overlaps the two lateral wings which in turn overlap the two anterior keel petals, is characteristic of the family:

(A) Solanaceae

(B) Liliaceae

(C) Fabaceae

(D) Poaceae

Q7. In the cockroach, the exchange of respiratory gases is carried out by a network of air-filled tubes that open to the exterior through spiracles. This breathing apparatus is the:

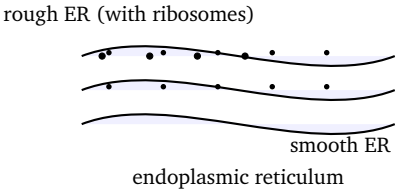
(A) tracheal system

(B) book lungs

(C) gills

(D) moist skin

Q8. The organelle shown below is a network of interconnected membranous tubules and flattened sacs; the portion studded with ribosomes is "rough" and synthesises proteins, while the smooth portion (no ribosomes) makes lipids. This organelle is the:



(A) endoplasmic reticulum

(B) lysosome

(C) centriole

(D) vacuole

Q9. The widely accepted fluid-mosaic model of the plasma membrane, which pictures a fluid lipid bilayer in which proteins are embedded and free to move, was proposed by:

(A) Robert Brown

(B) Camillo Golgi

(C) Robert Hooke

(D) Singer and Nicolson

Q10. The rate of an enzyme-catalysed reaction is greatest at a particular temperature and pH; beyond these values the activity falls sharply because the enzyme protein is:

(A) synthesised faster

(B) denatured (its three-dimensional shape is destroyed)

(C) converted into a coenzyme

(D) permanently activated

Q11. During the telophase of mitosis, the chromosomes reach the poles, decondense, and a nuclear envelope reassembles around each set. This is usually followed by:

(A) cytokinesis (division of the cytoplasm into two cells)

(B) separation of the sister chromatids

(C) alignment of chromosomes at the equator

(D) the exchange of segments between homologues

Q12. In meiosis, the chromosome number is halved during meiosis I, while meiosis II merely separates sister chromatids. Hence meiosis I and meiosis II are described, respectively, as:

(A) equational and reductional

(B) both reductional

(C) reductional and equational

(D) both equational

Q13. When a plant cell is placed in a hypertonic solution, water leaves the cell by osmosis and the protoplast shrinks away from the cell wall. This phenomenon is called:

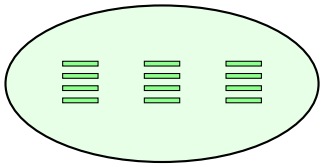
(A) turgidity

(B) imbibition

(C) deplasmolysis

(D) plasmolysis

Q14. In the chloroplast shown, the light-dependent reactions of photosynthesis (capture of light, photolysis of water and synthesis of ATP and NADPH) take place specifically on the:



chloroplast — thylakoids stacked into grana

(A) stroma (the fluid matrix)

(B) outer chloroplast membrane

(C) thylakoid membranes (grana)

(D) ribosomes of the chloroplast

Q15. During aerobic respiration, the largest amount of ATP is generated by oxidative phosphorylation, which is driven by the flow of electrons along the:

(A) glycolytic pathway in the cytoplasm

(B) electron transport chain on the inner mitochondrial membrane

(C) Krebs cycle in the matrix

(D) pentose phosphate pathway

Q16. Which plant growth regulator is a gas at ordinary temperatures and is chiefly responsible for the ripening of fruits and the abscission (shedding) of leaves and flowers?

(A) auxin

(B) gibberellin

(C) cytokinin

(D) ethylene

Q17. Trypsin, a protein-digesting enzyme that is secreted in an inactive form (trypsinogen) and acts in the small intestine, is produced by the:

(A) salivary glands

(B) pancreas

(C) gastric glands of the stomach

(D) liver

Q18. The greater part of the oxygen carried in human blood is transported from the lungs to the tissues in the form of:

(A) oxyhaemoglobin (oxygen bound to haemoglobin)

(B) bicarbonate ions in the plasma

(C) carbaminohaemoglobin

(D) oxygen dissolved freely in the plasma

Q19. The heartbeat is myogenic; the wave of contraction is initiated by a specialised patch of tissue in the wall of the right atrium that acts as the natural pacemaker. This structure is the:

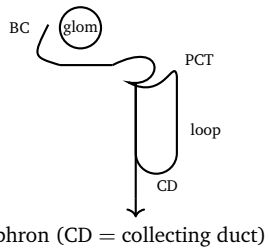
(A) atrioventricular (AV) node

(B) bundle of His

(C) sino-atrial (SA) node

(D) Purkinje fibres

Q20. In the nephron shown, the hormone ADH (vasopressin) acts to make the wall of the marked segment more permeable to water, so that more water is reabsorbed and a concentrated urine is formed. This segment is the:



nephron (CD = collecting duct)

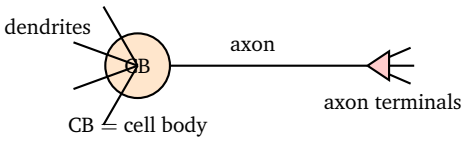
(A) glomerulus

(B) proximal convoluted tubule

(C) Bowman's capsule

(D) collecting duct

Q21. In the neuron shown, the long single process that conducts the nerve impulse *away* from the cell body towards the next neuron or the effector is labelled:



(A) the dendrites

(B) the axon

(C) the cell body (cyton)

(D) the nucleus

Q22. Which endocrine gland is called the "master gland" because the hormones it secretes (such as GH, ACTH and TSH) control the activity of several other endocrine glands?

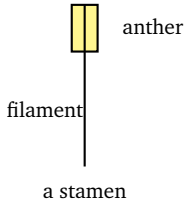
(A) the pituitary gland

(B) the thyroid gland

(C) the adrenal gland

(D) the pancreas

Q23. In the male reproductive organ of the flower shown, the swollen terminal part that contains the pollen sacs and produces the pollen grains is the:



(A) the filament

(B) the stigma

(C) the style

(D) the anther

Q24. In the seed of a flowering plant, the chief function of the endosperm is to:

(A) protect the seed from mechanical injury

(B) attract pollinators to the flower

(C) provide nourishment to the developing embryo

(D) disperse the seed by wind

Q25. The human menstrual cycle is divided, around the event of ovulation, into two main phases. The phase that precedes ovulation and the phase that follows it are called, respectively, the:

(A) luteal phase and follicular phase

(B) follicular phase and luteal phase

(C) secretory phase and proliferative phase

(D) ovulatory phase and menstrual phase

Q26. Oral contraceptive pills are a hormonal method of birth control. They prevent pregnancy mainly by:

(A) inhibiting ovulation (the release of the ovum)

(B) surgically blocking the fallopian tubes

(C) acting as a physical barrier to sperm

(D) destroying the sperm chemically after intercourse

Q27. The Punnett square below illustrates a monohybrid cross between two heterozygous tall pea plants ($Tt \times Tt$). Each gamete carries only one of the two alleles. The principle that the two alleles of a gene separate during gamete formation is Mendel's:

	T	t
T	TT	Tt
t	Tt	tt

(A) law of dominance

(B) law of independent assortment

(C) law of segregation

(D) law of linkage

Q28. Human skin colour, which shows a continuous range of shades from very light to very dark, is governed by several genes acting together. Such inheritance is described as:

(A) multiple allelism

(B) incomplete dominance

(C) codominance

(D) polygenic inheritance

Q29. Sickle-cell anaemia is caused by a point mutation in the gene for the β-globin chain of haemoglobin, which substitutes:

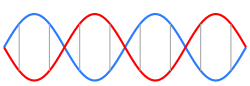
(A) valine in place of glutamate at the sixth position

(B) glutamate in place of valine at the sixth position

(C) lysine in place of glycine

(D) an extra chromosome 21

Q30. For the double-stranded DNA molecule shown, Chargaff's base-equivalence rule states that, in a sample of DNA, the amount of adenine equals the amount of thymine and the amount of guanine equals the amount of cytosine. This is written as:



DNA double helix

(A) $A = T$ and $G = C$

(B) $A = G$ and $T = C$

(C) $A = C$ and $G = T$

(D) $A + T = G + C$ always

Q31. The classic example of the regulation of gene expression in a prokaryote, in which the genes for lactose metabolism in *Escherichia coli* are switched on only when lactose is present, is the:

(A) central dogma

(B) Hardy–Weinberg model

(C) lac operon

(D) Calvin cycle

Q32. The forelimbs of a whale, a bat, a horse and a human have the same basic skeletal plan but perform different functions. Such homologous organs are evidence of:

(A) convergent evolution

(B) analogous structures

(C) spontaneous generation

(D) divergent evolution

Q33. Typhoid fever, a disease that affects the intestine and can be diagnosed by the Widal test, is caused by the bacterium:

(A) *Salmonella typhi*

(B) *Vibrio cholerae*

(C) *Mycobacterium tuberculosis*

(D) *Plasmodium vivax*

Q34. When a person is given a vaccine, the body itself produces antibodies and develops memory cells against the pathogen. This type of immunity is described as:

(A) passively acquired immunity

(B) actively acquired immunity

(C) innate (inborn) immunity

(D) passive immunity from mother's milk

Q35. Biogas, a fuel that consists chiefly of methane, is produced from animal dung and plant waste by a group of anaerobic bacteria called methanogens, such as:

(A) *Lactobacillus*

(B) *Saccharomyces*

(C) *Rhizobium*

(D) *Methanobacterium*

Q36. When a restriction endonuclease cuts the two strands of DNA at staggered points within its recognition site, it leaves short single-stranded overhangs that can base-pair with complementary overhangs. These overhangs are called:

(A) blunt ends

(B) primers

(C) sticky (cohesive) ends

(D) telomeres

Q37. The first clinical application of gene therapy was carried out to treat a child suffering from severe combined immunodeficiency caused by the deficiency of the enzyme:

(A) adenosine deaminase (ADA)

(B) DNA ligase

(C) restriction endonuclease

(D) reverse transcriptase

Q38. A plasmid is widely used as a cloning vector in genetic engineering because it is a small, circular DNA molecule that:

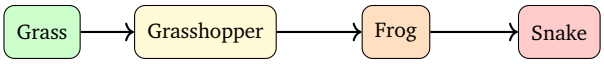
(A) is part of the bacterial chromosome and cannot be separated

(B) can replicate independently inside the host and carries a selectable marker

(C) is unable to enter a bacterial cell

(D) lacks any recognition site for restriction enzymes

Q39. The grazing food chain shown begins with green plants. In this chain, the organisms that capture solar energy and synthesise their own food, occupying the first trophic level, are the:



a grazing food chain

(A) primary consumers (herbivores)

(B) secondary consumers (carnivores)

(C) decomposers

(D) producers (autotrophs)

Q40. The protection of endangered species in their natural habitat, through national parks, wildlife sanctuaries and biosphere reserves, is known as:

(A) ex-situ conservation

(B) cryopreservation

(C) in-situ conservation

(D) conservation in seed banks

Detailed Solutions

Q1.

Solution

Concept — Cell walls across kingdoms: A cell wall is a rigid layer outside the plasma membrane, but its chemical composition differs from group to group, and this composition is a useful diagnostic feature of each kingdom.

Key fact: In the kingdom *Fungi* the cell wall is made mainly of *chitin*, a nitrogen-containing polysaccharide (the same polymer that forms the insect exoskeleton). This distinguishes fungi from plants and bacteria.

Why other options are wrong:

- (A) Cellulose forms the cell wall of *plants* and many algae, not fungi.
- (B) Peptidoglycan (murein) is the wall material of *bacteria*; (D) lignin is an additional hardening substance in woody plant tissue, not the main fungal wall component.

Final Answer: Fungal cell wall is made of chitin $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Seed plants: The seed-bearing plants (spermatophytes) are divided into gymnosperms and angiosperms. The key difference lies in whether or not the ovules (and the seeds that develop from them) are enclosed.

Key fact: In *gymnosperms* (Greek *gymnos* = naked) the ovules are *not enclosed in an ovary*; they sit exposed on the surface of scales, so the resulting seeds are "naked". Pine, *Cycas* and *Ginkgo* are examples.

Why other options are wrong:

- (B) Enclosure of the seed within a ripened ovary (fruit) is the feature of *angiosperms*.
- (C) Gymnosperms do produce seeds; (D) double fertilisation is characteristic of angiosperms, not gymnosperms.

Final Answer: Gymnosperms bear naked seeds $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — The largest phylum: Among all animal phyla, one contains more than two-thirds of all known animal species. Its members are built on a common body plan of jointed appendages.

Key fact: *Arthropoda* is the largest phylum. Its members (insects, crustaceans, arachnids, myriapods) have a segmented body, *jointed appendages* and a hard *chitinous exoskeleton* that is periodically moulted to allow growth.

Why other options are wrong:

- (A) Mollusca (snails, octopus) have a soft body, often with a calcareous shell, and no jointed legs.
- (C) Annelida are segmented worms with setae; (D) Echinodermata are spiny-skinned marine animals with tube feet — none is the largest phylum.

Final Answer: Largest phylum with jointed legs = Arthropoda $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Naming of organisms: A universal, two-word naming system is needed so that one species has the same scientific name everywhere in the world, avoiding the confusion of local common names.

Key fact: The system of *binomial nomenclature* was introduced by *Carolus Linnaeus* in his work *Species Plantarum* (1753) and *Systema Naturae*. Each name has a genus and a species component, e.g. *Homo sapiens*.

Why other options are wrong:

- (A) Charles Darwin proposed the theory of evolution by natural selection.
- (B) Gregor Mendel founded genetics; (C) Robert Hooke coined the term "cell". None devised binomial nomenclature.

Final Answer: Binomial nomenclature is due to Linnaeus $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Underground stem modifications: Several plants store food in underground stems. These remain stems (not roots) because they bear nodes, internodes, scale leaves and buds.

Key fact: The onion is a *bulb* — a much reduced, flattened, disc-like *condensed stem* surrounded by concentric fleshy scale leaves that store food. Roots arise from the lower side of the disc.

Why other options are wrong:

- (A) A stem tuber (potato) is the swollen tip of an underground branch bearing "eyes".
- (C) A rhizome (ginger) grows horizontally underground; (D) a corm (*Colocasia*) is a vertical, swollen, solid stem — the onion's fleshy leaves make it a bulb.

Final Answer: Onion = bulb (condensed stem) $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Aestivation: Aestivation is the arrangement of sepals or petals in a floral bud before it opens. The pattern is a useful clue to the plant family.

Key fact: *Vexillary* (papilionaceous) aestivation is typical of the family *Fabaceae*: the largest posterior petal (standard or vexillum) overlaps the two lateral wings, which in turn overlap the two anterior keel petals. Pea and bean show this clearly.

Why other options are wrong:

- (A) Solanaceae typically show valvate or twisted aestivation in actinomorphic flowers.
- (B) Liliaceae are monocots with trimerous flowers; (D) Poaceae (grasses) have much reduced flowers without a papilionaceous corolla.

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

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Respiration in the cockroach: Insects do not use blood to carry oxygen to the tissues; instead, air is delivered directly to the cells through a system of fine tubes.

Key fact: The cockroach breathes through a *tracheal system* — a branching network of air-filled tubes (tracheae and finer tracheoles) that open to the outside through ten pairs of *spiracles*. Air thus reaches the tissues directly, independent of the blood.

Why other options are wrong:

- (B) Book lungs are the respiratory organs of arachnids (scorpions, spiders), not the cockroach.
- (C) Gills are for aquatic respiration in fish and prawns; (D) the moist skin is the respiratory surface of earthworms and frogs.

Final Answer: Cockroach respires by the tracheal system $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — The endoplasmic reticulum (ER): The ER is an extensive network of membrane-bound tubules and cisternae that runs through the cytoplasm and is continuous with the nuclear membrane. It exists in two forms.

Key fact: The *rough ER* (RER) bears ribosomes on its surface and is the site of *protein synthesis and processing*, while the *smooth ER* (SER) lacks ribosomes and synthesises *lipids and steroids* and detoxifies drugs. The figure's ribosome-studded sheets identify it as the ER.

Why other options are wrong:

- (B) A lysosome is a single membrane sac of digestive enzymes, not a tubular network.
- (C) A centriole is a cylinder of microtubules; (D) a vacuole is a fluid-filled sac — none has ribosome-bearing membranes.

Final Answer: Network of rough and smooth membranes = ER $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Membrane structure: Several models of the plasma membrane were proposed; the currently accepted one explains both the fluid nature of the membrane and the mosaic arrangement of its proteins.

Key fact: The *fluid-mosaic model* was put forward by *Singer and Nicolson* in 1972. It describes the membrane as a fluid lipid bilayer in which protein molecules float about like a "mosaic", some spanning the bilayer (integral) and some on the surface (peripheral).

Why other options are wrong:

- (A) Robert Brown discovered the cell nucleus.
- (B) Camillo Golgi described the Golgi apparatus; (C) Robert Hooke first described cells in cork. None proposed the membrane model.

Final Answer: Fluid-mosaic model = Singer and Nicolson $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Effect of temperature and pH on enzymes: Enzymes are proteins whose catalytic activity depends on a precise three-dimensional shape. Each enzyme works fastest at an optimum temperature and an optimum pH.

Key fact: Above the optimum temperature (or at extreme pH), the bonds maintaining the enzyme's shape break and the enzyme is *denatured*; the active site is distorted, the substrate no longer fits, and activity falls sharply. At very low temperature the enzyme is merely inactive (not denatured).

Why other options are wrong:

- (A) Enzymes are not synthesised faster simply by heating the cell.
- (C) Denatured enzyme protein does not become a coenzyme; (D) extreme conditions inactivate, they do not permanently activate, the enzyme.

Final Answer: Beyond the optimum the enzyme is denatured $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — End of mitosis: Telophase is the final stage of nuclear division (karyokinesis); it essentially reverses the events of prophase, after which the cytoplasm itself usually divides.

Key fact: After telophase reassembles a nuclear envelope around each daughter set of chromosomes, *cytokinesis* (division of the cytoplasm) splits the cell into two daughter cells — by a cleavage furrow in animal cells or a cell plate in plant cells.

Why other options are wrong:

- (B) Separation of sister chromatids happens earlier, in anaphase.
- (C) Alignment at the equator is metaphase; (D) exchange of segments between homologues (crossing over) is a meiotic event, not part of mitotic telophase.

Final Answer: Telophase is followed by cytokinesis $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — The two meiotic divisions: Meiosis consists of two successive divisions, meiosis I and meiosis II, that together convert one diploid cell into four haploid cells.

Key fact: In *meiosis I* the homologous chromosomes separate, so the chromosome number is halved — this is the *reductional* division. In *meiosis II* the sister chromatids separate with no further change in number — this is the *equational* division (like mitosis).

Why other options are wrong:

- (A) reverses the two; meiosis I is reductional, not equational.
- (B),(D) only one of the two divisions reduces the number, so they cannot both be reductional or both equational.

Final Answer: Meiosis I reductional, meiosis II equational $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Osmotic behaviour of cells: A cell's water balance depends on the concentration of the surrounding solution. A hypertonic solution has a higher solute (lower water) concentration than the cell sap.

Key fact: In a *hypertonic* solution, water moves *out* of the cell by osmosis; the protoplast shrinks and pulls away from the rigid cell wall. This shrinkage is called *plasmolysis*, and the cell is said to be plasmolysed.

Why other options are wrong:

- (A) Turgidity results when a cell in a hypotonic solution takes *in* water and swells — the opposite case.
- (B) Imbibition is the absorption of water by dry colloids; (C) deplasmolysis is the *recovery* of a plasmolysed cell placed back in water.

Final Answer: Cell in a hypertonic solution undergoes plasmolysis $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Sites of photosynthesis: The chloroplast has two distinct compartments: the flattened membrane sacs called thylakoids (stacked into grana) and the surrounding fluid called the stroma. The two sets of reactions occur in different places.

Key fact: The *light reactions* — light absorption by the photosystems, photolysis of water, and the synthesis of ATP and NADPH — take place on the *thylakoid membranes (grana)*, where the chlorophyll and the electron carriers are located.

Why other options are wrong:

- (A) The stroma is the site of the light-*independent* reactions (Calvin cycle), which fix CO_2.
- (B) The outer membrane only bounds the organelle; (D) chloroplast ribosomes make proteins, not the light reactions.

Final Answer: Light reactions occur on the thylakoid (grana) membranes $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Where most ATP is made: Aerobic respiration occurs in four stages, but they do not contribute equally to ATP. The final stage produces by far the most ATP.

Key fact: In *oxidative phosphorylation*, electrons from NADH and $FADH_2$ pass along the *electron transport chain* on the *inner mitochondrial membrane*; the energy released pumps protons and drives ATP synthase, generating the bulk of the cell's ATP. Oxygen is the final electron acceptor.

Why other options are wrong:

- (A) Glycolysis yields only a small net gain of 2 ATP.
- (C) The Krebs cycle directly makes only 2 ATP (as GTP); (D) the pentose phosphate pathway makes NADPH for biosynthesis, not bulk ATP.

Final Answer: Most ATP comes from the electron transport chain $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Plant growth regulators: Of the five major classes of plant hormones, only one is a gas under normal conditions and diffuses readily between cells and tissues.

Key fact: *Ethylene* (C_2H_4) is the gaseous plant hormone. It promotes the *ripening of fruits*, hastens the senescence and *abscission* of leaves and flowers, and breaks dormancy. Ethephon is a source used commercially to ripen fruit.

Why other options are wrong:

- (A) Auxin governs apical dominance and rooting and is not a gas.
- (B) Gibberellins cause stem elongation; (C) cytokinins promote cell division — none of these is the gaseous ripening hormone.

Final Answer: Gaseous ripening/abscission hormone = ethylene $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Protein digestion: Several enzymes digest proteins along the gut. They are secreted as inactive precursors (zymogens) so that they do not digest the gland that makes them.

Key fact: *Trypsin* is secreted by the *pancreas* as inactive *trypsinogen*; in the small intestine, enterokinase converts it to active trypsin, which then hydrolyses proteins (and activates other pancreatic zymogens) at the alkaline pH of the intestine.

Why other options are wrong:

- (A) Salivary glands secrete amylase (for starch), not trypsin.
- (C) Gastric glands secrete pepsin (as pepsinogen); (D) the liver secretes bile, which contains no digestive enzymes.

Final Answer: Trypsin is secreted by the pancreas $\Rightarrow$ B

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Oxygen transport in blood: Oxygen is carried in the blood in two ways: a small amount dissolved in the plasma and a large amount bound chemically to the respiratory pigment.

Key fact: About 97% of the oxygen is carried as *oxyhaemoglobin*, formed when O_2 binds reversibly to the iron of haemoglobin in the red blood cells. In the tissues, where the partial pressure of O_2 is low, oxyhaemoglobin dissociates and releases the oxygen.

Why other options are wrong:

- (B) Bicarbonate ions are the main form in which *carbon dioxide* (not oxygen) is carried.
- (C) Carbaminohaemoglobin carries CO_2 on haemoglobin; (D) only about 3% of oxygen is carried dissolved in plasma.

Final Answer: Oxygen is carried chiefly as oxyhaemoglobin $\Rightarrow$ A

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Conducting system of the heart: The mammalian heartbeat is myogenic (originates in the heart muscle itself). A specialised patch of nodal tissue sets the rhythm and several structures relay the impulse.

Key fact: The *sino-atrial (SA) node*, located in the wall of the right atrium near the opening of the superior vena cava, generates impulses fastest and so acts as the *pacemaker*, setting the heart rate. The impulse then spreads to the AV node and the ventricles.

Why other options are wrong:

- (A) The AV node only relays (and slightly delays) the impulse from the atria to the ventricles.
- (B) The bundle of His and (D) Purkinje fibres conduct the impulse through the ventricles but do not initiate the beat.

Final Answer: Pacemaker of the heart = SA node $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Hormonal control of water reabsorption: The final concentration of urine is adjusted in the last part of the nephron under the control of antidiuretic hormone (ADH, vasopressin) from the posterior pituitary.

Key fact: ADH increases the permeability of the wall of the *collecting duct* (and distal tubule) to water; more water is therefore reabsorbed into the surrounding hyperosmotic medulla, producing a small volume of concentrated urine and conserving body water.

Why other options are wrong:

- (A) The glomerulus only filters blood; (C) the Bowman's capsule collects the filtrate.
- (B) The proximal tubule reabsorbs the bulk of water automatically, but it is not the ADH-controlled, facultative site — that is the collecting duct.

Final Answer: ADH acts on the collecting duct $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Parts of a neuron: A neuron has three main parts — the cell body (cyton), the branched dendrites that receive impulses, and the single long axon that transmits them. Identifying their direction of conduction is the key.

Key fact: The *axon* is the long single process that carries the nerve impulse *away* from the cell body towards the axon terminals, where it passes the signal across a synapse to the next neuron or to an effector.

Why other options are wrong:

- (A) Dendrites *receive* impulses and conduct them *towards* the cell body — the opposite direction.
- (C) The cell body contains the nucleus and integrates signals; (D) the nucleus is a part of the cell body, not the conducting process.

Final Answer: Process conducting impulses away = axon $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — The master endocrine gland: One small gland at the base of the brain secretes several tropic hormones that regulate the secretion of many other endocrine glands.

Key fact: The *pituitary gland* (hypophysis) is the "master gland". It releases growth hormone (GH), and tropic hormones such as *ACTH* (controls the adrenal cortex), *TSH* (controls the thyroid), FSH and LH (control the gonads), thereby coordinating the whole endocrine system.

Why other options are wrong:

- (B) The thyroid is itself controlled by the pituitary (via TSH).
- (C) The adrenal is controlled by ACTH from the pituitary; (D) the pancreas regulates blood glucose but does not control other glands.

Final Answer: The master gland is the pituitary $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — The stamen: The stamen is the male reproductive organ (microsporophyll) of a flower. It has two parts: a stalk and a head that produces pollen.

Key fact: The *anther* is the swollen terminal part of the stamen; it contains the pollen sacs (microsporangia) in which *pollen grains* (the male gametophytes) are produced. The slender stalk that holds up the anther is the filament.

Why other options are wrong:

- (A) The filament merely supports the anther and produces no pollen.
- (B) The stigma and (C) the style are parts of the *female* organ (the pistil), not of the stamen.

Final Answer: Pollen-bearing part of the stamen = anther $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — The endosperm: In angiosperms, double fertilisation produces a triploid ($3n$) tissue alongside the embryo. This tissue has a definite nutritive role in the seed.

Key fact: The *endosperm* is a food-storing tissue that provides *nourishment to the developing embryo*. In many seeds (e.g. cereals, castor) it persists and is consumed during germination; in others it is absorbed by the growing embryo (non-endospermic seeds).

Why other options are wrong:

- (A) Mechanical protection of the seed is the job of the seed coat (testa).
- (B) Attracting pollinators is a function of petals and nectaries; (D) wind dispersal is achieved by wings or hairs, not the endosperm.

Final Answer: Endosperm nourishes the embryo $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Phases of the menstrual cycle: The roughly 28-day cycle is centred on ovulation (about day 14). The events of the ovary before and after ovulation define the two main phases.

Key fact: Before ovulation is the *follicular phase*, in which FSH stimulates a follicle to mature; after ovulation is the *luteal phase*, in which the ruptured follicle becomes the corpus luteum and secretes progesterone to prepare the uterus.

Why other options are wrong:

- (A) reverses the order; the follicular phase comes first.
- (C) "Proliferative" and "secretory" refer to the uterine (endometrial) cycle and are again in the wrong order here; (D) the menstrual phase is only the brief bleeding phase at the start, not the whole pre- or post-ovulatory period.

Final Answer: Follicular phase then luteal phase $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Hormonal contraception: Oral contraceptive pills contain synthetic oestrogen and progesterone (or progesterone alone). They work through the body's own hormonal feedback system.

Key fact: The pills act mainly by *inhibiting ovulation*: the steroids suppress the secretion of FSH and LH from the pituitary, so no follicle matures and no ovum is released. They also thicken the cervical mucus and alter the endometrium as additional effects.

Why other options are wrong:

- (B) Blocking the fallopian tubes surgically is tubectomy (sterilisation), not the action of a pill.
- (C) A physical barrier is the mechanism of condoms/diaphragms; (D) chemical killing of sperm is the action of spermicides.

Final Answer: Oral pills prevent ovulation $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Mendel's laws: Mendel proposed laws governing the inheritance of characters. The monohybrid cross illustrates how the pair of alleles for one gene behaves during gamete formation.

Key fact: The *law of segregation* states that the two alleles of a gene separate (segregate) during the formation of gametes, so that each gamete carries only *one* allele of the pair. The Punnett square shows that the Tt parent forms equal T and t gametes.

Why other options are wrong:

- (A) The law of dominance explains why the heterozygote shows the dominant phenotype, not the separation of alleles.
- (B) Independent assortment applies to *two or more* genes (dihybrid cross); (D) "linkage" is not a Mendelian law — it is an exception described later by Morgan.

Final Answer: Separation of alleles in gametes = law of segregation $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Quantitative (continuous) traits: Some characters do not fall into a few sharp classes but vary continuously across a range. Such traits are usually controlled by many genes acting together.

Key fact: *Polygenic inheritance* is the control of a single character by *several genes*, each adding a small effect. Human *skin colour* is the classic example: three or more gene pairs determine the amount of melanin, giving a continuous range of shades.

Why other options are wrong:

- (A) Multiple allelism is one gene with more than two alleles (e.g. ABO blood groups).
- (B) Incomplete dominance gives a single blended phenotype; (C) codominance shows both alleles fully (e.g. AB blood group) — none gives the continuous variation of skin colour.

Final Answer: Skin colour is governed by polygenic inheritance $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Point mutation and disease: A point mutation changes a single base in DNA, which can alter one amino acid in the protein and so change its function — the molecular basis of sickle-cell anaemia.

Key fact: In sickle-cell anaemia, the mutation replaces *glutamate* (Glu) by *valine* (Val) at the sixth position of the β-globin chain (Glu $\rightarrow$ Val). The resulting haemoglobin (HbS) polymerises when deoxygenated, distorting the red cells into a sickle shape.

Why other options are wrong:

- (B) reverses the substitution; the normal amino acid is glutamate and it is replaced by valine, not the other way round.
- (C) A lysine-for-glycine change is not the sickle-cell mutation; (D) an extra chromosome 21 causes Down's syndrome, an aneuploidy, not a point mutation.

Final Answer: Glutamate replaced by valine $\Rightarrow$ B

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Base composition of DNA: Erwin Chargaff analysed the base content of DNA from many species and found a constant relationship between the four bases, which later supported the base-pairing model.

Key fact: *Chargaff's rule* states that in double-stranded DNA the amount of *adenine equals thymine and guanine equals cytosine* ($A = T$, $G = C$), because A always pairs with T and G always pairs with C across the two strands.

Why other options are wrong:

- (B) A pairs with T (a purine with a pyrimidine), not with G; (C) likewise A does not pair with C.
- (D) $A + T$ and $G + C$ are *not* always equal — their ratio varies between species; only $A = T$ and $G = C$ hold universally.

Final Answer: Chargaff's rule: A = T and G = C ⇒ A

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Regulation of gene expression in bacteria: Bacteria switch genes on and off to economise resources. The genes for a metabolic pathway are often clustered and controlled together as an operon.

Key fact: The *lac operon* of *E. coli* (described by Jacob and Monod) is the classic example. When lactose is absent a repressor protein blocks transcription; when lactose is present it binds the repressor, freeing the operator, and the genes for lactose breakdown are transcribed. This is an *inducible* system.

Why other options are wrong:

- (A) The central dogma describes the flow of genetic information, not the on/off control of a gene.
- (B) The Hardy–Weinberg model concerns population allele frequencies; (D) the Calvin cycle is a photosynthetic pathway.

Final Answer: Gene regulation in *E. coli* = the lac operon ⇒ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Evidences of evolution from comparative anatomy: Structures in different organisms are compared to find common ancestry. Two patterns are recognised: homology and analogy.

Key fact: *Homologous organs* have the *same basic structure and origin* but perform different functions (e.g. the forelimbs of whale, bat, horse and human). They indicate that these animals arose from a common ancestor and then diverged — *divergent evolution* (adaptive radiation).

Why other options are wrong:

- (A) Convergent evolution produces *analogous* organs (similar function, different origin), e.g. the wings of insects and birds.
- (B) Analogous structures are evidence of convergence, not the homology de-

scribed; (C) spontaneous generation is a discarded idea, not an evolutionary mechanism.

Final Answer: Homologous organs show divergent evolution $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Bacterial diseases of the gut: Several human diseases are caused by bacteria that infect the intestine; each has a characteristic causative agent and diagnostic test.

Key fact: *Typhoid* (enteric fever) is caused by *Salmonella typhi*. The bacterium spreads through contaminated food and water, infects the intestine, and is confirmed by the *Widal test*, which detects antibodies against the pathogen.

Why other options are wrong:

- (B) *Vibrio cholerae* causes cholera (severe watery diarrhoea).
- (C) *Mycobacterium tuberculosis* causes tuberculosis; (D) *Plasmodium vivax* is a protozoan that causes malaria, not typhoid.

Final Answer: Typhoid is caused by *Salmonella typhi* $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Types of acquired immunity: Acquired (specific) immunity may be active or passive, depending on whether the body makes its own antibodies or receives ready-made ones.

Key fact: In *actively acquired immunity*, the body is exposed to an antigen (through infection or a *vaccine*) and *makes its own antibodies and memory cells*. It develops slowly but is long-lasting, which is why vaccination gives durable protection.

Why other options are wrong:

- (A),(D) Passive immunity is the transfer of ready-made antibodies (e.g. antitoxin injection, mother's milk); it acts at once but is short-lived and the body makes no memory cells.

- (C) Innate immunity is the non-specific, inborn defence (skin, phagocytes), not the response to a vaccine.

Final Answer: Vaccination gives actively acquired immunity $\Rightarrow$ B

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Microbes in energy production: Biogas is a clean fuel generated by the anaerobic breakdown of organic waste. The final, methane-producing step is carried out by a special group of bacteria.

Key fact: *Methanogens*, such as *Methanobacterium*, are anaerobic archaebacteria found in the rumen of cattle and in biogas plants. They act on the products of earlier fermentation to produce *methane* (CH_4), the chief combustible component of biogas.

Why other options are wrong:

- (A) *Lactobacillus* produces lactic acid (curd), not methane.
- (B) *Saccharomyces* (yeast) produces ethanol and CO_2; (C) *Rhizobium* fixes atmospheric nitrogen in root nodules.

Final Answer: Biogas methane is made by *Methanobacterium* $\Rightarrow$ D

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — How restriction enzymes cut DNA: Restriction endonucleases recognise specific palindromic sequences. They may cut both strands at the same point (giving blunt ends) or at staggered points.

Key fact: When the cut is *staggered* (off-centre), each fragment is left with a short single-stranded overhang. These overhangs are called *sticky (cohesive) ends*; because they are complementary, they readily base-pair with the sticky ends of any other DNA cut by the same enzyme, allowing two DNA pieces to be joined by DNA ligase.

Why other options are wrong:

- (A) Blunt ends have no overhang and so do not base-pair to hold the pieces together while joining.
- (B) Primers are short nucleotide sequences used in PCR; (D) telomeres are the protective ends of eukaryotic chromosomes.

Final Answer: Staggered cuts give sticky (cohesive) ends $\Rightarrow$ C

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Gene therapy: Gene therapy is the correction of a genetic defect by introducing a normal gene into a patient's cells. The first attempt treated an inherited immune deficiency.

Key fact: The first clinical gene therapy (1990) was given to a girl with severe combined immunodeficiency (SCID) caused by the deficiency of the enzyme *adenosine deaminase (ADA)*. Functional ADA cDNA was introduced into her lymphocytes, restoring immune function (though repeated infusions were needed).

Why other options are wrong:

- (B) DNA ligase is an enzyme that joins DNA fragments; its deficiency is not the SCID treated.
- (C) Restriction endonucleases cut DNA, and (D) reverse transcriptase makes DNA from RNA — neither is the deficient enzyme in this disorder.

Final Answer: Gene therapy first treated ADA deficiency $\Rightarrow$ A

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Cloning vectors: A cloning vector is a DNA molecule that carries a foreign gene into a host cell and allows it to be copied. Plasmids are the most commonly used bacterial vectors.

Key fact: A *plasmid* is a small, circular, extra-chromosomal DNA that *replicates independently* of the bacterial chromosome (it has its own origin of replication) and usually carries a *selectable marker* (e.g. an antibiotic-resistance gene) plus unique restriction sites. These features let researchers insert a gene, get it into

bacteria, and select the cells that took it up.

Why other options are wrong:

- (A) A plasmid is *separate* from the bacterial chromosome — that is exactly why it can be isolated and used.
- (C) A plasmid can readily be taken up by competent bacteria; (D) it does carry recognition sites so that genes can be inserted.

Final Answer: A good plasmid vector replicates independently and has a marker $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Trophic levels in a food chain: Energy flows through an ecosystem along a food chain, with each feeding step forming a trophic level. The grazing food chain always starts with green plants.

Key fact: The *producers* (autotrophs) — here the grass — occupy the *first trophic level*. They capture solar energy and synthesise food by photosynthesis, providing the energy base on which all the consumers (grasshopper, frog, snake) depend.

Why other options are wrong:

- (A) Primary consumers (herbivores, the grasshopper) occupy the second trophic level.
- (B) Secondary consumers (the frog) are carnivores at the third level; (C) decomposers act on dead matter and are not the first link of the grazing chain.

Final Answer: First trophic level = producers (autotrophs) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Strategies of biodiversity conservation: Conservation is of two broad kinds — in-situ (on site) and ex-situ (off site) — depending on whether the species is protected in or away from its natural home.

Key fact: *In-situ conservation* protects species *within their natural habitat*, through *national parks, wildlife sanctuaries and biosphere reserves* (also sacred groves). The whole ecosystem is preserved, so the species continues to evolve in its natural surroundings.

Why other options are wrong:

- (A) Ex-situ conservation protects species *outside* their habitat (zoos, botanical gardens).
- (B) Cryopreservation and (D) seed banks are particular *ex-situ* techniques, not in-situ conservation.

Final Answer: National parks and sanctuaries = in-situ conservation $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q40

Answer Key

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