SRMJEEE Biology Sample Paper – 6

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. Diatoms and dinoflagellates are unicellular, chiefly photosynthetic eukaryotes that float as plankton in oceans and fresh water. In Whittaker's five-kingdom system they are placed in the kingdom:

(A) Protista

(B) Monera

(C) Fungi

(D) Plantae

Q2. In the plant kingdom, true vascular tissue (xylem and phloem) for the conduction of water and food makes its *first* appearance in the:

(A) algae

(B) bryophytes

(C) pteridophytes

(D) gymnosperms

Q3. Which phylum is characterised by a dorsoventrally flattened body and is regarded as the first group of animals to show *bilateral symmetry* (e.g. *Planaria*)?

(A) Porifera

(B) Platyhelminthes

(C) Cnidaria

(D) Annelida

Q4. A grouping of organisms at any level of the classification hierarchy — such as a species, a genus or a family — that is treated as a unit is called a:

(A) phylogeny

(B) nomenclature

(C) taxonomy

(D) taxon

Q5. Monocotyledonous plants such as wheat and maize typically possess which type of root system?

(A) fibrous root system

(B) taproot system

(C) adventitious storage roots only

(D) no root system

Q6. In the family Solanaceae (e.g. tomato, brinjal), the ovary is bilocular and the ovules are borne on a central axis where the septa meet. This type of placentation is:

(A) parietal

(B) marginal

(C) axile

(D) free central

Q7. The body of the cockroach is divided into head, thorax and abdomen, and it bears walking legs attached to the thorax. The number of body divisions and pairs of legs are, respectively:

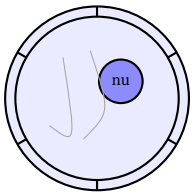
(A) two divisions and four pairs of legs

(B) three divisions and three pairs of legs

(C) two divisions and three pairs of legs

(D) three divisions and five pairs of legs

Q8. The cell organelle shown below is bounded by a double-membraned nuclear envelope with pores, encloses the chromatin, and contains a dense *nucleolus*. As the control centre of the cell it is the:



nuclear envelope with pores; nucleolus (nu) inside

(A) mitochondrion

(B) lysosome

(C) Golgi apparatus

(D) nucleus

Q9. In a prokaryotic cell, the irregular, membrane-less region of the cytoplasm in which the single circular DNA molecule lies is called the:

(A) nucleoid

(B) nucleolus

(C) nuclear envelope

(D) centrosome

Q10. A complete, catalytically active enzyme (the holoenzyme) is made up of a protein part together with a non-protein part. The protein part of such an enzyme is called the:

(A) coenzyme

(B) apoenzyme

(C) prosthetic group

(D) substrate

Q11. Mitosis is the type of cell division that takes place in somatic (body) cells and:

(A) halves the chromosome number in the daughter cells

(B) produces four genetically different gametes

(C) occurs only in the reproductive organs

(D) keeps the chromosome number constant in the daughter cells

Q12. The X-shaped points at which homologous chromosomes remain joined and which mark the sites of crossing over, becoming clearly visible at the diplotene stage, are called:

(A) centromeres

(B) kinetochores

(C) chiasmata

(D) synaptonemal complexes

Q13. The translocation of sugars in the phloem from source to sink is best explained by the:

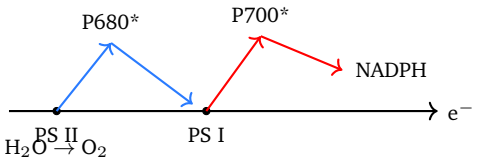
(A) pressure-flow (mass-flow) hypothesis

(B) transpiration-pull (cohesion–tension) theory

(C) root-pressure mechanism

(D) active diffusion through stomata

Q14. The Z-scheme below shows electron flow in the light reactions. Photophosphorylation that involves *both* Photosystem II and Photosystem I, splits water and produces NADPH along with ATP is the:



non-cyclic Z-scheme (PS II → PS I)

(A) cyclic photophosphorylation

(B) non-cyclic photophosphorylation

(C) substrate-level phosphorylation

(D) oxidative phosphorylation

Q15. The respiratory quotient (RQ) is the ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration. For a carbohydrate such as glucose, the RQ is:

(A) 0.7

(B) 0.9

(C) 1.0

(D) infinity (∞)

Q16. The response of plants to the relative lengths of day and night, which determines flowering and is mediated by the pigment phytochrome, is called:

(A) vernalisation

(B) phototropism

(C) thigmotropism

(D) photoperiodism

Q17. The hydrochloric acid secreted by the oxyntic (parietal) cells of the stomach activates pepsinogen into pepsin and:

(A) kills most microbes entering with the food

(B) completes the digestion of fats

(C) neutralises the acidic chyme

(D) absorbs glucose into the blood

Q18. The volume of air inspired or expired during a single normal, quiet breath, amounting to about 500 mL in an adult, is the:

(A) vital capacity

(B) tidal volume

(C) residual volume

(D) inspiratory reserve volume

Q19. Human blood is a fluid connective tissue. Its formed elements (cells) are the erythrocytes, the leucocytes and the platelets, all of which are suspended in a straw-coloured fluid called the:

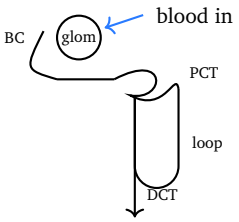
(A) lymph

(B) serum only

(C) plasma

(D) tissue fluid

Q20. In the nephron shown, the volume of filtrate formed by both kidneys per minute at the glomeruli — about 125 mL/min in a healthy adult — is called the:



filtrate formed at the glomerulus

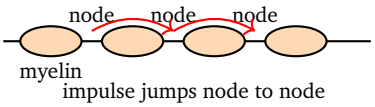
(A) renal blood flow

(B) tubular secretion rate

(C) osmotic clearance

(D) glomerular filtration rate (GFR)

Q21. In the myelinated neuron shown, the impulse appears to "jump" from one node of Ranvier to the next, greatly speeding up conduction. This fast, jumping mode of impulse transmission is called:



(A) saltatory conduction

(B) continuous conduction

(C) synaptic transmission

(D) axoplasmic flow

Q22. The hormone secreted by the parathyroid glands that *raises* the level of calcium in the blood by acting on bone, kidney and intestine is:

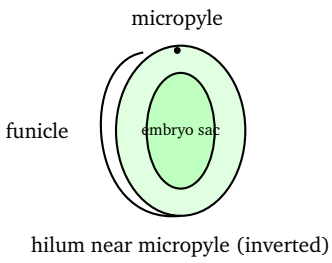
(A) calcitonin

(B) insulin

(C) parathormone (PTH)

(D) thyroxine

Q23. The ovule shown is the commonest type in angiosperms: its body is inverted through 180° so that the micropyle lies close to the hilum. This type of ovule is described as:



(A) orthotropous

(B) anatropous

(C) campylotropous

(D) amphitropous

Q24. The development of a fruit *without* fertilisation of the ovule, giving a seedless fruit such as the banana, is called:

(A) apomixis

(B) polyembryony

(C) parthenogenesis

(D) parthenocarpy

Q25. In the human female reproductive system, the organ that produces the ova and also secretes the hormones oestrogen and progesterone is the:

(A) ovary

(B) uterus

(C) fallopian tube

(D) cervix

Q26. IVF (in-vitro fertilisation), ZIFT and GIFT are examples of special clinical techniques that help infertile couples to have a child. Collectively such techniques are known as:

(A) amniocentesis

(B) medical termination of pregnancy

(C) assisted reproductive technologies (ART)

(D) lactational amenorrhoea

Q27. The cross shown is a test cross of a dihybrid *RrYy* plant with a double-recessive *rryy* plant. The phenotypic ratio obtained in the offspring is:

	RY	Ry	rY	ry
ry	$RrYy$	$Rryy$	$rrYy$	$rryy$

dihybrid test cross

(A) $9:3:3:1$

(B) $1:1:1:1$

(C) $3:1$

(D) $1:2:1$

Q28. Red–green colour blindness in humans is inherited as an X-linked recessive trait. Consequently it is expressed:

(A) only in females

(B) equally and in dominant fashion in both sexes

(C) only when present on the Y chromosome

(D) more frequently in males than in females

Q29. Thalassemia, in which the synthesis of one of the globin chains of haemoglobin is reduced, is inherited as an:

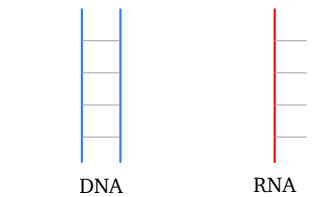
(A) autosomal recessive disorder

(B) X-linked dominant disorder

(C) Y-linked disorder

(D) chromosomal aneuploidy

Q30. The two nucleic acids are compared in the figure. Compared with DNA, a molecule of RNA characteristically contains the sugar ribose and, in place of thymine, the base:



(A) adenine

(B) uracil

(C) cytosine

(D) guanine

Q31. During translation, the codon that signals the *start* of protein synthesis and usually codes for methionine is:

(A) UAA

(B) UGA

(C) AUG

(D) UAG

Q32. The evolution of a number of differently beaked finch species from a single ancestral type on the Galapagos Islands, each adapted to a different food source, is a classic example of:

(A) convergent evolution

(B) industrial melanism

(C) genetic drift

(D) adaptive radiation

Q33. Amoebiasis (amoebic dysentery), marked by abdominal pain and stools with blood and mucus, is caused by the protozoan:

(A) *Entamoeba histolytica*

(B) *Plasmodium vivax*

(C) *Salmonella typhi*

(D) *Wuchereria bancrofti*

Q34. The property of malignant tumour cells by which they spread from their original site to distant organs through the blood and lymph, starting new tumours, is called:

(A) apoptosis

(B) differentiation

(C) metastasis

(D) contact inhibition

Q35. In sewage treatment, the amount of oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria is measured as the:

(A) dissolved oxygen (DO)

(B) biochemical oxygen demand (BOD)

(C) total dissolved solids (TDS)

(D) chemical neutralisation value

Q36. The process by which a competent bacterial cell takes up free (naked) DNA from its surroundings and incorporates it, thereby acquiring a new character, is called:

(A) transduction

(B) conjugation

(C) translation

(D) transformation

Q37. "Golden rice" is a transgenic variety engineered to combat vitamin-A deficiency because its grains are enriched with the provitamin-A pigment:

(A) beta-carotene

(B) haemoglobin

(C) chlorophyll

(D) anthocyanin

Q38. DNA fingerprinting, used in forensics and paternity testing, identifies individuals by analysing highly variable, repeated DNA sequences known as:

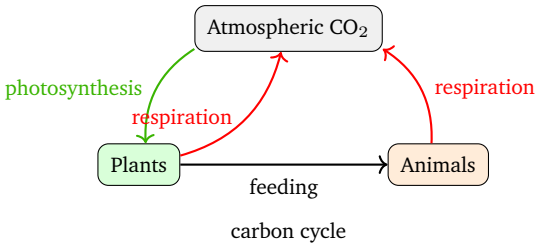
(A) exons

(B) variable number tandem repeats (VNTRs)

(C) promoters

(D) structural genes

Q39. In the carbon cycle shown, atmospheric carbon dioxide is fixed into organic matter by green plants and returned to the atmosphere by living things. The process that *removes* CO_2 from the atmosphere is:



(A) respiration

(B) combustion

(C) photosynthesis

(D) decomposition

Q40. The excessive enrichment of a water body with nutrients such as nitrates and phosphates, which triggers algal blooms and a fall in dissolved oxygen, is known as:

(A) biomagnification

(B) sedimentation

(C) biological oxygen recovery

(D) eutrophication

Detailed Solutions

Q1.

Solution

Concept — Kingdom Protista: In Whittaker's five-kingdom scheme, Protista is a kingdom of single-celled *eukaryotes* that do not fit neatly into plants, animals or fungi. It includes chrysophytes (diatoms and golden algae), dinoflagellates, euglenoids, slime moulds and protozoans.

Key fact: Diatoms have an indestructible silica cell wall (forming "diatomaceous earth") and dinoflagellates often cause red tides; both are photosynthetic, eukaryotic and chiefly aquatic, so they are placed in *Protista*.

Why other options are wrong:

- (B) Monera contains only prokaryotes (bacteria, cyanobacteria), but diatoms are eukaryotic.
- (C) Fungi are heterotrophic with chitinous walls; (D) Plantae are multicellular land plants, whereas diatoms are unicellular.

Final Answer: Diatoms and dinoflagellates are Protista $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Evolution of vascular tissue: As plants colonised land they evolved conducting tissues — xylem (water and minerals) and phloem (food) — to move materials over distance. The presence of such tissue defines the "vascular plants" (tracheophytes).

Key fact: *Pteridophytes* (ferns, horsetails, *Selaginella*) are the *first* group of plants to possess true xylem and phloem, which is why they can grow taller than mosses. They are therefore the most primitive vascular plants.

Why other options are wrong:

- (A) Algae are simple thalloid plants with no vascular tissue at all.
- (B) Bryophytes (mosses, liverworts) are non-vascular and depend on diffusion; (D) gymnosperms are vascular but appear *after* pteridophytes.

Final Answer: Vascular tissue first appears in pteridophytes $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Phylum Platyhelminthes: These are the flatworms — dorsoventrally flattened, triploblastic, acoelomate animals. They are the first phylum in the animal series to display *bilateral symmetry* and organ-level organisation.

Key fact: *Planaria* (free-living), liver fluke and tapeworm are flatworms. Their flattened shape gives a large surface area for gas exchange, and excretion is carried out by flame cells (protonephridia).

Why other options are wrong:

- (A) Porifera (sponges) are asymmetrical or radially symmetrical and have only a cellular grade of organisation.
- (C) Cnidaria (*Hydra*, jellyfish) show *radial* symmetry; (D) Annelida are segmented coelomates that appear later in the series.

Final Answer: Flat, bilaterally symmetrical *Planaria* = Platyhelminthes $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Categories in classification: Living organisms are arranged in a hierarchy of ranks — kingdom, phylum, class, order, family, genus and species. Each ranked group at any level is a unit of classification.

Key fact: A *taxon* (plural taxa) is any such taxonomic group of organisms treated as a unit, for example the species *Homo sapiens*, the genus *Panthera* or the family Felidae. The science of identifying, naming and classifying such taxa is taxonomy.

Why other options are wrong:

- (A) Phylogeny is the evolutionary history of a group, not a unit of rank.
- (B) Nomenclature is the naming of organisms; (C) taxonomy is the *science* of classification, whereas the group itself is the taxon.

Final Answer: A ranked group of organisms = a taxon $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Root systems: The first root of a plant is the radicle. Whether it persists or is replaced gives the two major root systems, and this differs between monocots and dicots.

Key fact: In *monocots* (wheat, maize, grasses) the primary root is short-lived and is replaced by a cluster of thin roots of similar size arising from the stem base — the *fibrous root system*. It anchors the plant near the surface and prevents soil erosion.

Why other options are wrong:

- (B) The taproot system (one main root with branches) is typical of *dicots* such as gram and mustard.
- (C) Adventitious roots also occur, but the standard monocot pattern is the fibrous system; (D) all flowering plants have roots.

Final Answer: Monocots have a fibrous root system $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Placentation: Placentation describes the arrangement of ovules on the placenta inside the ovary. The pattern (marginal, axile, parietal, free central, basal) is an important family character.

Key fact: In *Solanaceae* (tomato, brinjal, potato), the ovary is bilocular (often becoming multilocular by false septa) and the ovules are attached to a central column formed where the septa meet — this is *axile* placentation.

Why other options are wrong:

- (A) Parietal placentation has ovules on the inner ovary wall in a unilocular ovary (e.g. mustard).
- (B) Marginal placentation occurs in a monocarpellary pod (e.g. pea); (D) in free central placentation the septa are absent and ovules lie on a central axis (e.g. *Dianthus*).

Final Answer: Solanaceae shows axile placentation $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Body plan of the cockroach: The cockroach (*Periplaneta americana*) is an arthropod with a segmented body grouped into distinct regions (tagmata) and jointed appendages.

Key fact: Its body is divided into *three* parts — head, thorax and abdomen. The thorax bears *three* pairs of walking legs (one pair on each of the three thoracic segments) and two pairs of wings, the standard insect plan.

Why other options are wrong:

- (A),(C) A two-part body (cephalothorax + abdomen) with four pairs of legs is the arachnid plan (spiders), not insects.
- (D) Insects have three, not five, pairs of legs.

Final Answer: Three body divisions and three pairs of legs $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — The nucleus: The nucleus is the largest organelle of a eukaryotic cell and the control centre that directs the cell's activities by housing the genetic material.

Key fact: It is bounded by a double-membraned *nuclear envelope* perforated by nuclear pores, encloses the chromatin (DNA + histone proteins) and contains one or more dense *nucleoli* where ribosomal RNA is made. These features — pores, chromatin and nucleolus — identify the figure as the nucleus.

Why other options are wrong:

- (A) The mitochondrion has cristae and makes ATP; it has no nucleolus.
- (B) The lysosome is a single-membraned vesicle of digestive enzymes; (C) the Golgi apparatus is a stack of flattened cisternae.

Final Answer: Organelle with chromatin and nucleolus = nucleus $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Genetic material in prokaryotes: Prokaryotic cells lack a true, membrane-bound nucleus. Their single, circular, double-stranded DNA molecule is not enclosed by a nuclear envelope.

Key fact: This DNA lies coiled in a definite but membrane-less region of the cytoplasm called the *nucleoid*. Because there is no envelope, transcription and translation can occur together in prokaryotes.

Why other options are wrong:

- (B) The nucleolus is the rRNA-synthesising body *inside* a eukaryotic nucleus.
- (C) The nuclear envelope is absent in prokaryotes; (D) the centrosome organises the spindle in animal cells.

Final Answer: The prokaryotic DNA region is the nucleoid $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Holoenzyme and cofactors: Many enzymes are conjugated proteins. The complete, catalytically active enzyme is called the *holoenzyme*, and it has two parts: a protein part and a non-protein part (the cofactor).

Key fact: The protein part is the *apoenzyme*; it is inactive on its own. When it combines with its cofactor (a metal ion, a prosthetic group, or an organic coenzyme such as NAD^+), it becomes the active holoenzyme. In short, holoenzyme = apoenzyme + cofactor.

Why other options are wrong:

- (A) A coenzyme is a loosely bound *organic* cofactor, not the protein part.
- (C) A prosthetic group is a tightly bound cofactor; (D) the substrate is the reactant acted upon, not part of the enzyme.

Final Answer: The protein part of the holoenzyme is the apoenzyme $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Mitosis: Mitosis is an equational division in which one parent cell gives two genetically identical daughter cells. It is the basis of growth, repair and asexual reproduction.

Key fact: Mitosis occurs in *somatic* (body) cells, and because the chromosomes are duplicated once and then distributed equally, each daughter cell receives the *same chromosome number* as the parent ($2n \rightarrow 2n$). It thus keeps the chromosome number constant generation after generation.

Why other options are wrong:

- (A),(B) Halving the chromosome number and producing four different gametes are features of *meiosis*, not mitosis.
- (C) Mitosis is not confined to reproductive organs; it occurs throughout the body wherever cells divide.

Final Answer: Mitosis keeps the chromosome number constant $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Crossing over and chiasmata: During prophase I of meiosis, homologous chromosomes pair and exchange segments (crossing over). The physical, microscopically visible junctions where this exchange has occurred are the chiasmata.

Key fact: *Chiasmata* (singular chiasma) appear as X-shaped crossings between non-sister chromatids and become clearly visible at the *diplotene* stage, when the paired homologues begin to separate but stay joined at these points. They are the cytological evidence of crossing over.

Why other options are wrong:

- (A) The centromere is the constriction joining sister chromatids, unrelated to crossing over.
- (B) The kinetochore is the protein plate where spindle fibres attach; (D) the synaptonemal complex holds homologues together at zygotene but is not the cross-over point itself.

Final Answer: The sites of crossing over are the chiasmata $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Translocation in phloem: Phloem carries food (mainly sucrose) from a source (e.g. leaves) to a sink (e.g. roots, fruits). The accepted explanation of how this flow is driven is the pressure-flow model.

Key fact: In the *pressure-flow (mass-flow) hypothesis*, sugar loaded into the sieve tubes at the source lowers the water potential, so water enters from the xylem by osmosis and raises the turgor pressure. This pressure pushes the sap to the sink, where sugar is unloaded and water leaves — creating a continuous bulk flow.

Why other options are wrong:

- (B) The cohesion–tension (transpiration-pull) theory explains water movement in *xylem*, not food in phloem.
- (C) Root pressure pushes water up the xylem at night; (D) phloem transport is an active, pressure-driven process, not simple diffusion through stomata.

Final Answer: Phloem transport follows the pressure-flow mechanism $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Two types of photophosphorylation: The synthesis of ATP during the light reactions is called photophosphorylation and occurs in two forms — cyclic (PS I only) and non-cyclic (PS II and PS I together), shown as the Z-scheme.

Key fact: In *non-cyclic* photophosphorylation the electron path is open: PS II splits water (releasing O_2), passes electrons through the chain to PS I, and PS I finally reduces $NADP^+$ to NADPH. It therefore makes *both ATP and NADPH* and evolves oxygen — exactly the Z-scheme in the figure.

Why other options are wrong:

- (A) Cyclic photophosphorylation uses only PS I, recycles the electron, makes ATP *alone* and produces no O_2 or NADPH.
- (C) Substrate-level phosphorylation occurs in glycolysis/Krebs cycle; (D) oxidative phosphorylation occurs in mitochondria during respiration.

Final Answer: The water-splitting Z-scheme is non-cyclic photophosphorylation $\Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Respiratory quotient (RQ): The RQ is the ratio of the volume of carbon dioxide released to the volume of oxygen consumed during respiration. Its value reveals the kind of substrate being oxidised.

Key fact: For a *carbohydrate* such as glucose the equation is $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$. Since 6 volumes of CO_2 are produced for 6 volumes of O_2 used, RQ $= 6/6 = \mathbf{1.0}$.

Why other options are wrong:

- (A) RQ ≈ 0.7 is typical of *fats*, which need more oxygen.
- (B) RQ ≈ 0.9 is typical of *proteins*; (D) RQ tends to infinity only in anaerobic respiration of organic acids, where O_2 is not used.

Final Answer: RQ of carbohydrates $= 1.0 \Rightarrow$ C

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Photoperiodism: Many plants flower only when the daily duration of light and dark reaches a critical value. This response to the relative lengths of day and night is photoperiodism.

Key fact: Plants are grouped as short-day, long-day or day-neutral, and it is actually the length of the *dark period* that is critical. The blue-green pigment *phytochrome*, present in leaves, perceives the light/dark signal and triggers the flowering response.

Why other options are wrong:

- (A) Vernalisation is the promotion of flowering by a cold treatment, not by day length.
- (B) Phototropism is bending towards light; (C) thigmotropism is a growth response to touch.

Final Answer: Response to day/night length = photoperiodism $\Rightarrow$ D

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Gastric secretion: The gastric glands of the stomach secrete a strongly acidic juice. The oxyntic (parietal) cells produce hydrochloric acid, giving the stomach contents a pH of about 1.5–2.5.

Key fact: This *HCl* converts inactive pepsinogen into the active enzyme pepsin, provides the acidic medium needed for pepsin to act, and *kills most bacteria and microbes* swallowed with the food, acting as a chemical barrier against infection.

Why other options are wrong:

- (B) Fat digestion is completed in the small intestine by pancreatic lipase, not by stomach acid.
- (C) Neutralisation of the acidic chyme is done by alkaline bile and pancreatic juice in the duodenum; (D) glucose absorption occurs in the small intestine.

Final Answer: Gastric HCl activates pepsin and kills microbes $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Respiratory volumes: The lungs handle several measurable volumes of air. The amount moved in ordinary, relaxed breathing is the smallest of these named volumes.

Key fact: The *tidal volume* (TV) is the volume of air breathed in or out during a single normal, quiet respiration — about 500 mL in a healthy adult. With a breathing rate near 12–16 per minute, this moves roughly 6–8 litres of air per minute.

Why other options are wrong:

- (A) Vital capacity is the maximum air that can be exhaled after the deepest inhalation ($\sim$3500–4500 mL).
- (C) Residual volume ($\sim$1100–1200 mL) cannot be exhaled; (D) IRV ($\sim$2500–3000 mL) is the extra air forcibly inhaled *beyond* a tidal breath.

Final Answer: Normal quiet-breath air ($\sim$500 mL) = tidal volume $\Rightarrow$ B

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Composition of blood: Blood is a fluid connective tissue made of a liquid matrix and formed elements. The formed elements are the red cells (erythrocytes), white cells (leucocytes) and platelets (thrombocytes).

Key fact: The liquid matrix in which these cells are suspended is the *plasma*, a straw-coloured fluid that is about 90–92% water and carries proteins (albumin, globulins, fibrinogen), nutrients, salts, hormones and wastes. Plasma makes up roughly 55% of the blood volume.

Why other options are wrong:

- (A) Lymph is the colourless fluid of the lymphatic system, similar to plasma but with fewer proteins and no RBCs.
- (B) Serum is plasma *minus* the clotting factor fibrinogen, obtained after clotting; (D) tissue fluid bathes cells outside the blood vessels.

Final Answer: The fluid carrying the blood cells is plasma $\Rightarrow$ C

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Glomerular filtration: The first step in urine formation is ultrafiltration of blood across the glomerular capillaries into the Bowman's capsule. The rate at which this filtrate is produced is a key measure of kidney function.

Key fact: The *glomerular filtration rate* (GFR) is the volume of filtrate formed by both kidneys per minute — about *125 mL/min* (roughly 180 litres a day) in a healthy adult. Most of this is reabsorbed, so only about 1.5 litres is finally voided as urine.

Why other options are wrong:

- (A) Renal blood flow is the total blood reaching the kidneys ($\sim$1100 mL/min), much larger than the filtration rate.
- (B) Tubular secretion adds substances to the filtrate later; (C) "osmotic clear-

ance" is not the standard term for filtrate volume.

Final Answer: Filtrate formed per minute = GFR (≈125 mL/min) ⇒ D

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Myelinated nerve fibres: Many axons are wrapped in a fatty *myelin sheath* laid down by Schwann cells, interrupted at intervals by gaps called the nodes of Ranvier. Myelin acts as an electrical insulator.

Key fact: Because the membrane can be depolarised only at the bare nodes, the impulse leaps from one node of Ranvier to the next instead of travelling continuously. This jumping mode is *saltatory conduction* (Latin *saltare*, to leap), and it makes the impulse travel much faster while using less energy.

Why other options are wrong:

- (B) Continuous conduction is the slower, point-by-point spread seen in *unmyelinated* fibres.
- (C) Synaptic transmission is the chemical passage of a signal across a synapse, not along one axon; (D) axoplasmic flow is the slow movement of cytoplasm in the axon.

Final Answer: Node-to-node jumping conduction = saltatory conduction ⇒ A

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Control of blood calcium: Blood calcium is held within narrow limits by two antagonistic hormones — parathormone (raises Ca^{2+}) and calcitonin (lowers Ca^{2+}).

Key fact: *Parathormone* (PTH), from the parathyroid glands, *raises* blood calcium by stimulating the dissolution of bone (releasing Ca^{2+}), increasing reabsorption of calcium in the kidney tubules, and promoting the activation of vitamin D so that more calcium is absorbed from the gut. It is therefore a hypercalcaemic hormone.

Why other options are wrong:

- (A) Calcitonin (from the thyroid) *lowers* blood calcium — the opposite effect.
- (B) Insulin regulates blood glucose; (D) thyroxine controls the basal metabolic rate.

Final Answer: The calcium-raising hormone is parathormone $\Rightarrow$ C

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Types of ovule: The orientation of the ovule body relative to its stalk (the funicle) and the point of attachment (hilum) defines several ovule types — orthotropous, anatropous, campylotropous, amphitropous and circinotropous.

Key fact: In the *anatropous* ovule the body is completely inverted through 180° so that the micropyle comes to lie *close to the hilum*, as shown in the figure. This is by far the commonest type, found in the great majority of flowering-plant families.

Why other options are wrong:

- (A) In the orthotropous (atropous) ovule the micropyle, chalaza and hilum lie in a straight line (erect ovule).
- (C) In the campylotropous ovule the body is curved so the micropyle bends slightly; (D) in the amphitropous ovule the curvature is greater and the embryo sac itself is bent.

Final Answer: An inverted ovule with micropyle near the hilum is anatropous $\Rightarrow$ B

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Seedless fruits: Normally a fruit develops from the ovary only after fertilisation triggers seed formation. Sometimes, however, fruits form without this step.

Key fact: *Parthenocarpy* is the development of a fruit *without fertilisation* of the ovule, so the fruit is *seedless* (e.g. banana, some grapes and oranges). It may occur naturally or be induced by applying growth regulators such as auxins or gibberellins.

Why other options are wrong:

- (A) Apomixis is the formation of seeds without fertilisation (asexual seed production), still giving seeds.
- (B) Polyembryony is the occurrence of more than one embryo in a seed; (C) parthenogenesis is the development of an *egg* into a new individual without fertilisation.

Final Answer: Seedless fruit without fertilisation = parthenocarpy $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — The human female reproductive system: It consists of a pair of ovaries, a pair of oviducts (fallopian tubes), the uterus, the cervix, the vagina and the external genitalia, working together for ovulation, fertilisation and pregnancy.

Key fact: The *ovary* is the primary female sex organ. It produces the female gametes (ova) by oogenesis and also acts as an endocrine gland, secreting *oestrogen* and *progesterone*, which control the menstrual cycle and secondary sexual characters.

Why other options are wrong:

- (B) The uterus (womb) houses and nourishes the developing embryo but does not make ova.
- (C) The fallopian tube is the site of fertilisation and transports the ovum; (D) the cervix is the narrow neck of the uterus opening into the vagina.

Final Answer: The ovum-producing, hormone-secreting organ is the ovary $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Assisted reproductive technologies (ART): Couples who cannot conceive naturally can be helped by special clinical procedures that assist the meeting of gametes or the transfer of the early embryo.

Key fact: *IVF* (fertilisation in a dish, "test-tube baby"), *ZIFT* (zygote intra-fallopian transfer) and *GIFT* (gamete intra-fallopian transfer) are all examples of ART. In ZIFT the early embryo (up to 8 cells) is placed in the fallopian tube, whereas GIFT transfers an ovum (with sperm) into the tube of a woman who cannot produce ova.

Why other options are wrong:

- (A) Amniocentesis is a prenatal diagnostic test on amniotic fluid, not a fertility treatment.
- (B) MTP is the deliberate termination of pregnancy; (D) lactational amenorrhoea is a natural method of contraception.

Final Answer: IVF, ZIFT and GIFT are assisted reproductive technologies $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — The test cross: A test cross crosses an individual showing the dominant phenotype with a fully recessive (homozygous) individual to reveal its genotype. For a dihybrid, this also checks independent assortment.

Key fact: The dihybrid *RrYy* forms four gamete types in equal numbers — RY, Ry, rY, ry — while *rryy* forms only *ry* gametes. Combining them gives four offspring genotypes (RrYy, Rryy, rrYy, rryy), each a distinct phenotype in equal proportion, so the ratio is $1:1:1:1$, as the grid shows.

Why other options are wrong:

- (A) $9:3:3:1$ is the F_2 ratio of a dihybrid *self* cross ($RrYy \times RrYy$), not a test cross.
- (C) $3:1$ is a monohybrid F_2 ratio; (D) $1:2:1$ is a monohybrid *genotypic* ratio.

Final Answer: A dihybrid test cross gives $1:1:1:1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Sex-linked recessive inheritance: Genes carried on the X chromosome show a characteristic pattern because males have only one X. A recessive allele on the X is expressed in a male even in a single dose.

Key fact: Red–green colour blindness is *X-linked recessive*. A male (X^cY) is colour-blind if his single X carries the defective allele, but a female needs the allele on *both* X chromosomes (X^cX^c) to be affected. Hence the condition appears *far more frequently in males than in females*.

Why other options are wrong:

- (A) It is not confined to females — it is in fact commoner in males.
- (B) Being recessive, it is not expressed in dominant fashion; (C) the gene is on the X, not the Y, chromosome.

Final Answer: X-linked recessive colour blindness is commoner in males $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Mendelian (gene) disorders: Some inherited diseases are caused by mutations in a single gene and follow Mendelian patterns. Thalassemia is a quantitative defect in the production of globin chains of haemoglobin.

Key fact: *Thalassemia* is an *autosomal recessive* blood disorder. The reduced synthesis of α- or β-globin chains leads to abnormal, unstable haemoglobin and anaemia. Because it is recessive, the disease appears only when a defective allele is inherited from *both* parents.

Why other options are wrong:

- (B) It is autosomal and recessive, not X-linked dominant.
- (C) It is not Y-linked; (D) it is a single-gene (point/deletion) mutation, not a change in chromosome number (aneuploidy) like Down's syndrome.

Final Answer: Thalassemia is an autosomal recessive disorder $\Rightarrow$ A

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — DNA versus RNA: Both are nucleic acids built from nucleotides, but they differ in their sugar, one of their bases, and usually in being double- or single-stranded.

Key fact: DNA contains the sugar *deoxyribose* and the bases A, T, G, C, whereas RNA contains *ribose* and uses *uracil (U)* in place of thymine. So in RNA, adenine pairs with uracil. This base substitution is the key chemical difference highlighted in the figure.

Why other options are wrong:

- (A) Adenine occurs in both DNA and RNA and is not the replacement base.
- (C) Cytosine and (D) guanine are present in *both* nucleic acids and are unchanged.

Final Answer: RNA replaces thymine with uracil $\Rightarrow$ B

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — The genetic code in translation: mRNA is read in triplets called codons. Of the 64 codons, one acts as the start signal and three act as stop signals, framing every protein.

Key fact: The *start codon* is *AUG*, which both initiates translation and codes for the amino acid methionine. Translation then proceeds until a stop codon — *UAA, UAG or UGA* — is reached, none of which codes for any amino acid.

Why other options are wrong:

- (A) UAA, (B) UGA and (D) UAG are the three *stop* (nonsense) codons that terminate translation, not start it.

Final Answer: The start codon is AUG $\Rightarrow$ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Adaptive radiation: When a single ancestral species diversifies rapidly into many new forms, each adapted to a different ecological niche or habitat, the process is called adaptive radiation.

Key fact: *Darwin's finches* of the Galapagos Islands are the textbook example: from one seed-eating ancestor arose many species with differently shaped beaks suited to seeds, insects, cactus or even tool use. This divergence from a common stock is classic adaptive radiation.

Why other options are wrong:

- (A) Convergent evolution is the *opposite* — unrelated forms coming to resemble one another (e.g. wings of birds and bats).
- (B) Industrial melanism illustrates natural selection in peppered moths; (C) genetic drift is random change in allele frequency in small populations.

Final Answer: Darwin's finches illustrate adaptive radiation $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Protozoan diseases: Several human diseases are caused by parasitic protozoans. Amoebiasis is an intestinal infection of this kind, spread through contaminated food and water.

Key fact: *Amoebiasis* (amoebic dysentery) is caused by *Entamoeba histolytica*, which lives in the large intestine and causes constipation, abdominal pain and stools with blood and mucus. Houseflies act as mechanical carriers, transferring cysts from faeces to food.

Why other options are wrong:

- (B) *Plasmodium vivax* causes malaria, transmitted by the female *Anopheles* mosquito.
- (C) *Salmonella typhi* (a bacterium) causes typhoid; (D) *Wuchereria* (a roundworm) causes filariasis.

Final Answer: Amoebiasis is caused by *Entamoeba histolytica* $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Cancer and tumours: Cancer arises when normal controls on cell division fail, so cells divide uncontrollably to form a tumour. Malignant tumours are dangerous because they do not stay put.

Key fact: *Metastasis* is the property by which cells sloughed off a malignant tumour travel through the blood and lymph to distant sites and start new (secondary) tumours there. This spread, driven by loss of contact inhibition and activation of oncogenes, is what makes cancer life-threatening.

Why other options are wrong:

- (A) Apoptosis is *programmed cell death*, a normal control that cancer cells evade.
- (B) Differentiation is the specialisation of cells; (D) contact inhibition is the normal stopping of division on cell contact, which cancer cells *lack*.

Final Answer: Spread of cancer to distant organs = metastasis $\Rightarrow$ C

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — Sewage treatment and water quality: Microbes are used to break down the organic matter in sewage. The amount of biodegradable organic load is judged by how much oxygen the microbes need to oxidise it.

Key fact: The *biochemical oxygen demand* (BOD) is the amount of oxygen consumed by bacteria in oxidising the organic matter in one litre of water over a set time. A *higher BOD* means more organic pollution; effective sewage treatment greatly lowers the BOD of the effluent before it is released.

Why other options are wrong:

- (A) Dissolved oxygen (DO) is the oxygen actually present in the water, which *falls* as BOD rises.
- (C) TDS measures dissolved salts, not organic load; (D) "chemical neutralisation value" is not a recognised measure of organic pollution.

Final Answer: Oxygen needed to oxidise organic matter = BOD $\Rightarrow$ B

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — Modes of gene transfer in bacteria: Bacteria can acquire new genes by three natural processes — transformation, transduction and conjugation — which create genetic variation.

Key fact: *Transformation* is the uptake of free (naked) DNA from the surroundings by a *competent* host cell, which then incorporates the DNA and may express a new character. Griffith's experiment with *Streptococcus pneumoniae* first demonstrated this, and it is widely used in genetic engineering to introduce recombinant plasmids into bacteria.

Why other options are wrong:

- (A) Transduction is the transfer of DNA from one bacterium to another *via a bacteriophage*.
- (B) Conjugation transfers DNA through direct cell-to-cell contact (a pilus); (C) translation is protein synthesis, not gene transfer.

Final Answer: Uptake of naked DNA by a competent cell = transformation $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Transgenic crops for nutrition: Genetic engineering can enrich a food crop with a nutrient it normally lacks (biofortification). Golden rice was developed to fight vitamin-A deficiency in rice-eating populations.

Key fact: *Golden rice* is a transgenic rice whose grains accumulate *beta-carotene* (provitamin A), giving them a golden colour. The human body converts beta-carotene into vitamin A, so the rice helps prevent night blindness and other deficiency disorders.

Why other options are wrong:

- (B) Haemoglobin is an animal oxygen-carrying pigment, not a plant provitamin.
- (C) Chlorophyll is the green photosynthetic pigment of leaves; (D) anthocyanins are red/purple flower and fruit pigments unrelated to vitamin A.

Final Answer: Golden rice is enriched with beta-carotene $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — DNA fingerprinting: Every individual (except identical twins) has a unique DNA profile. The technique exploits regions of the genome that vary greatly in length from person to person.

Key fact: DNA fingerprinting is based on *variable number tandem repeats* (VNTRs) — short DNA sequences repeated a different number of times in different people. The number of repeats, and hence the fragment lengths, differ between individuals, giving a band pattern as unique as a fingerprint, useful in forensics and paternity testing.

Why other options are wrong:

- (A) Exons are the coding parts of genes and are relatively conserved between people.
- (C) Promoters are regulatory sequences that switch genes on; (D) structural genes encode proteins and vary far less than VNTRs.

Final Answer: DNA fingerprinting analyses VNTRs $\Rightarrow$ B

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — The carbon cycle: Carbon moves between the atmosphere, living organisms and the soil. Carbon dioxide is taken out of the air by one process and returned by several others.

Key fact: *Photosynthesis* by green plants (and other producers) *removes* CO_2 from the atmosphere, fixing it into organic compounds such as glucose. This is the only major process that draws carbon dioxide *out* of the air, balancing the CO_2 added by respiration, decomposition and combustion.

Why other options are wrong:

- (A) Respiration *releases* CO_2 from living organisms back into the air.
- (B) Combustion of fuels and (D) decomposition by microbes both *add* CO_2 to the atmosphere, not remove it.

Final Answer: CO_2 is removed from the air by photosynthesis $\Rightarrow$ C

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Water pollution effects: The addition of nutrients to a water body changes its biology dramatically. An over-supply of nutrients sets off a chain of events that can "kill" a lake.

Key fact: *Eutrophication* is the nutrient enrichment of a water body (with nitrates and phosphates from fertiliser run-off and sewage). It causes explosive algal blooms; when the algae die, their decomposition by bacteria consumes the dissolved oxygen, so fish and other aquatic life suffocate and die.

Why other options are wrong:

- (A) Biomagnification is the increasing concentration of toxins (e.g. DDT) up a food chain, a different problem.
- (B) Sedimentation is the settling of suspended solids; (C) "biological oxygen recovery" is not a recognised term.

Final Answer: Nutrient enrichment causing algal blooms = eutrophication $\Rightarrow$ D

Answer: (D) Go Back to Q40

Answer Key

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