

KIITEE Biology Sample Paper – 4

Duration: 50 Minutes

Maximum Marks: 160

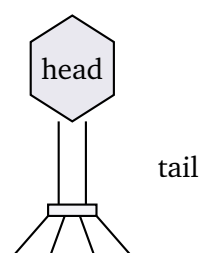
Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Biology portion of KIITEE entrance.
- Each correct answer carries **+4 marks**. There is **-1 mark per wrong answer**; unattempted questions score **0**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 (10+2) Biology — Diversity of Life, Cell Biology, Plant & Human Physiology, Reproduction, Genetics & Evolution, Biotechnology and Ecology.**
- The test is computer based. Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited.

Q1. The characteristic red colour of members of the red algae (Rhodophyceae), which lets them photosynthesise in deep water, is due to the predominance of the accessory pigment:

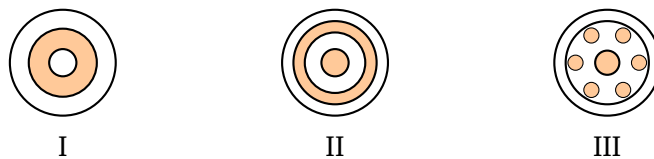
- (A) Chlorophyll *a*
- (B) Fucoxanthin
- (C) r-Phycoerythrin
- (D) Chlorophyll *c*

Q2. The bacteriophage shown below has a polyhedral head, a tail and tail fibres. The genetic material packed inside the head of a T-even bacteriophage is:



- (A) Double-stranded DNA
- (B) Single-stranded RNA
- (C) Double-stranded RNA
- (D) Single-stranded DNA

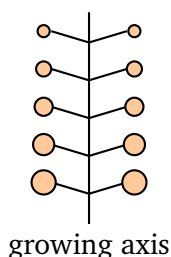
Q3. The three transverse sections below show different grades of body cavity. In section **II** the cavity is fully lined by mesoderm (shaded) on both sides. An animal built on this plan is said to be:



- (A) Acoelomate
 - (B) Coelomate
 - (C) Pseudocoelomate
 - (D) Diploblastic
- Q4.** Long, narrow, thick-walled and lignified dead cells that provide mechanical support and form the fibres of jute and hemp belong to the tissue:
- (A) Parenchyma
 - (B) Collenchyma
 - (C) Aerenchyma
 - (D) Sclerenchyma
- Q5.** Spindle-shaped, uninucleate, non-striated and involuntary muscle fibres found in the walls of the alimentary canal and blood vessels constitute:
- (A) Skeletal (striated) muscle
 - (B) Smooth (unstriated) muscle
 - (C) Cardiac muscle
 - (D) Myoepithelial tissue



Q6. In the inflorescence shown, the main axis continues to grow and the flowers are borne laterally in acropetal succession (oldest at the base, youngest at the tip). This type of inflorescence is:

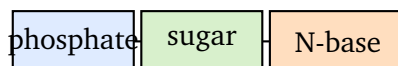


- (A) Racemose
- (B) Cymose
- (C) Solitary
- (D) Cyathium

Q7. The cell organelle made of flattened, stacked membranous cisternae that modifies, packages and dispatches proteins and lipids for secretion, and gives rise to lysosomes, is the:

- (A) Smooth endoplasmic reticulum
- (B) Rough endoplasmic reticulum
- (C) Golgi apparatus
- (D) Peroxisome

Q8. A nucleotide, the building block of nucleic acids, is shown below as three units joined together. These three components are:



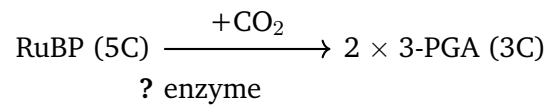
- (A) Nitrogen base + glucose + phosphate
- (B) Amino acid + sugar + phosphate
- (C) Nitrogen base + sugar only
- (D) Nitrogenous base + pentose sugar + phosphate group



- Q9.** Cytokinesis in a dividing plant cell differs from that in an animal cell because, instead of a cleavage furrow, the cytoplasm is partitioned by:
- (A) A contractile ring of actin
 - (B) Cell plate formation in the centre
 - (C) Constriction of the plasma membrane
 - (D) Budding of the cell wall
- Q10.** The nucleolus, a dense, non-membrane-bound region inside the nucleus, is the principal site of synthesis and assembly of:
- (A) Ribosomal RNA (rRNA)
 - (B) Messenger RNA (mRNA)
 - (C) DNA
 - (D) Transfer RNA (tRNA)
- Q11.** When a living plant cell is placed in a strongly hypertonic solution, water leaves the cell and the protoplast shrinks away from the cell wall. This phenomenon is called:
- (A) Imbibition
 - (B) Deplasmolysis
 - (C) Plasmolysis
 - (D) Endosmosis
- Q12.** Which micronutrient is an essential component of the enzymes nitrate reductase and nitrogenase, and is therefore vital for nitrogen metabolism in plants?
- (A) Manganese
 - (B) Zinc
 - (C) Copper
 - (D) Molybdenum



- Q13.** In the Calvin cycle outlined below, atmospheric CO₂ is fixed onto the 5-carbon acceptor RuBP to give two molecules of 3-phosphoglyceric acid. The enzyme that catalyses this first carboxylation step is:

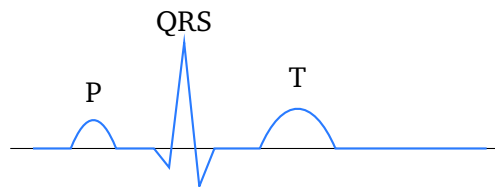


- (A) RuBisCO
(B) PEP carboxylase
(C) Pyruvate kinase
(D) Nitrogenase
- Q14.** The respiratory quotient (RQ), the ratio of CO₂ evolved to O₂ consumed, for the complete aerobic oxidation of a carbohydrate such as glucose is:
- (A) 0.7
(B) 1.0
(C) 0.9
(D) Greater than 1
- Q15.** Bile, secreted by the liver and stored in the gall bladder, helps in the digestion of fats mainly by:
- (A) Directly hydrolysing triglycerides
(B) Supplying the enzyme lipase
(C) Emulsifying fats into small droplets
(D) Acidifying the chyme entering the duodenum
- Q16.** The volume of air that still remains in the lungs even after the most forceful expiration, and which cannot be expelled, is the:
- (A) Tidal volume
(B) Vital capacity



- (C) Inspiratory reserve volume
- (D) Residual volume

Q17. In the electrocardiogram (ECG) trace shown, the large, sharp deflection produced by the depolarisation of the ventricles (the signal for ventricular contraction) is the:



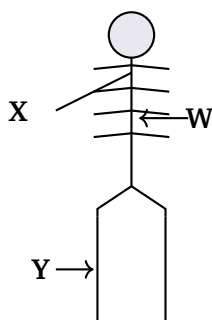
- (A) QRS complex
 - (B) P wave
 - (C) T wave
 - (D) PR segment
- Q18.** Antidiuretic hormone (ADH, vasopressin) increases water reabsorption from the renal tubules. A deficiency of ADH leads to the production of large volumes of dilute urine, a condition called:
- (A) Diabetes mellitus
 - (B) Diabetes insipidus
 - (C) Glycosuria
 - (D) Oedema
- Q19.** Which part of the human brain is chiefly responsible for the maintenance of posture and body balance and for the smooth coordination of voluntary muscular movements?
- (A) Cerebrum
 - (B) Medulla oblongata
 - (C) Cerebellum
 - (D) Hypothalamus



Q20. Over-secretion of growth hormone from the anterior pituitary during childhood, before the epiphyseal plates of the long bones close, results in:

- (A) Dwarfism
- (B) Acromegaly
- (C) Cretinism
- (D) Gigantism

Q21. The human skeleton is divided into the axial skeleton (skull, vertebral column, ribs and sternum) and the appendicular skeleton (limbs and girdles). In the schematic below, which labelled part belongs to the *axial* skeleton?



- (A) W — the vertebral column
- (B) X — the forelimb (humerus)
- (C) Y — the hind-limb (femur)
- (D) The pelvic girdle

Q22. The transfer of pollen grains from the anther of a flower to the stigma of a flower on a *different* plant of the same species is called:

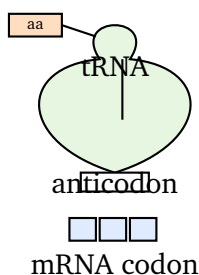
- (A) Autogamy
- (B) Geitonogamy
- (C) Xenogamy
- (D) Cleistogamy



- Q23.** Which of the following is a male accessory gland in humans that secretes a fructose-rich fluid forming the major fraction of the seminal plasma?
- (A) The epididymis
 - (B) The seminal vesicle
 - (C) Bartholin's gland
 - (D) The rete testis
- Q24.** A sharp mid-cycle surge of which hormone is the immediate trigger for ovulation (rupture of the Graafian follicle and release of the ovum)?
- (A) Follicle-stimulating hormone (FSH)
 - (B) Progesterone
 - (C) Estrogen
 - (D) Luteinising hormone (LH)
- Q25.** Medical termination of pregnancy (MTP) is generally regarded as relatively safe when it is carried out:
- (A) During the first trimester (up to about 12 weeks)
 - (B) During the third trimester
 - (C) Only after 20 weeks of pregnancy
 - (D) Only at full term
- Q26.** A cross in which an F_1 hybrid is crossed with one of its homozygous parental types is termed a:
- (A) Reciprocal cross
 - (B) Dihybrid cross
 - (C) Back cross
 - (D) Monohybrid cross



- Q27.** An individual with blood group AB carries both A and B antigens on the surface of the red blood cells because the I^A and I^B alleles are equally expressed. This is an example of:
- (A) Incomplete dominance
 - (B) Codominance
 - (C) Complete dominance
 - (D) Epistasis
- Q28.** Two genes that lie far apart on the same chromosome show a higher recombination (crossing-over) frequency than two genes lying close together. This is because:
- (A) They are very tightly linked
 - (B) They are located on different chromosomes
 - (C) Crossing over never occurs between linked genes
 - (D) The chance of a chiasma forming between them is greater
- Q29.** During translation, the clover-leaf shaped tRNA shown carries an amino acid at one end and reads a codon on the mRNA through the triplet at its lower loop. This codon-reading triplet on the tRNA is the:



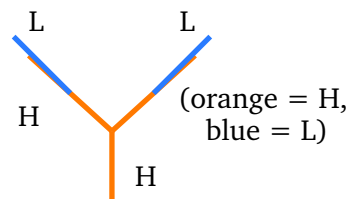
- (A) Anticodon
- (B) Acceptor (amino-acid) end
- (C) Codon
- (D) Promoter



- Q30.** Down syndrome, characterised by a round face, broad palm and intellectual disability, is caused by the presence of an additional copy of chromosome number:
- (A) 18
 - (B) 13
 - (C) 21
 - (D) 23
- Q31.** The forelimbs of a whale, a bat and a human are built on the same basic skeletal plan but are adapted to perform very different functions. Such structures are described as:
- (A) Analogous organs
 - (B) Homologous organs
 - (C) Vestigial organs
 - (D) Atavistic organs
- Q32.** The common cold, marked by nasal congestion, sneezing and sore throat, is caused in humans by:
- (A) *Salmonella typhi*
 - (B) *Plasmodium vivax*
 - (C) *Wuchereria bancrofti*
 - (D) Rhinoviruses
- Q33.** *Azotobacter* and *Azospirillum* are widely used as biofertilizers because they are:
- (A) Symbiotic phosphate-solubilising fungi
 - (B) Mycorrhiza-forming fungi
 - (C) Free-living nitrogen-fixing bacteria
 - (D) Cyanobacteria that form root nodules



Q34. The Y-shaped IgG antibody molecule shown is built from four polypeptide chains held together by disulphide bonds. These four chains are:



- (A) Two heavy and two light chains
- (B) Four heavy chains
- (C) Four light chains
- (D) One heavy and one light chain
- Q35.** To make a bacterial host able to take up recombinant DNA (to make the cells “competent”), the cells are most commonly treated with:
- (A) A restriction endonuclease
- (B) Divalent cations such as calcium (CaCl_2) followed by a brief heat shock
- (C) DNA ligase
- (D) The enzyme cellulase
- Q36.** The biolistic, or “gene gun”, method of introducing foreign genes into plant cells works by:
- (A) Using *Agrobacterium tumefaciens* as a natural vector
- (B) Injecting DNA into the nucleus with a fine needle
- (C) Giving the cells a calcium and heat-shock treatment
- (D) Bombarding cells with high-velocity gold or tungsten particles coated with DNA
- Q37.** Tobacco plants have been made resistant to the parasitic nematode *Meloidogyne incognita* using RNA interference (RNAi). The resistance works by:

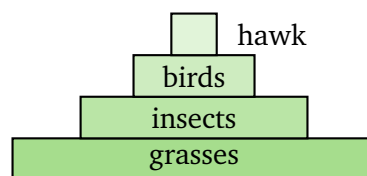


- (A) Making the plant produce a toxic crystal protein
- (B) Inserting extra copies of the nematode's own genes
- (C) Silencing a specific nematode mRNA using complementary double-stranded RNA
- (D) Increasing the rate of photosynthesis in the roots

Q38. Gause's competitive exclusion principle, derived from experiments on *Paramecium*, states that:

- (A) Two species competing for the same limiting resource cannot coexist indefinitely
- (B) Two competing species always coexist in the same niche
- (C) Competition has no effect on population size
- (D) Predators always determine the number of prey

Q39. The upright pyramid of numbers for a grassland ecosystem is drawn below. The trophic level that contains the *largest* number of individual organisms is at the:



- (A) Top carnivores (hawks)
 - (B) Producers (grasses)
 - (C) Secondary consumers (insectivorous birds)
 - (D) Primary carnivores
- Q40.** Which of the following is an example of *ex-situ* conservation of biodiversity?
- (A) A national park
 - (B) A biosphere reserve



- (C) A wildlife sanctuary
- (D) A seed bank with cryopreservation of germplasm in liquid nitrogen



Detailed Solutions

Q1.

Solution

Concept — Algal pigments: Different classes of algae owe their colour to dominant accessory pigments that also widen the range of light they can absorb.

Step 1 — Identify the class: Red algae (Rhodophyceae) characteristically appear red.

Step 2 — Name the pigment: Their red colour is due to the phycobilin pigment r-phycoerythrin, which absorbs blue-green light reaching deep water.

Why other options are wrong:

- Option A (chlorophyll *a*) is the universal green pigment present in all algae, not the cause of the red colour.
- Option B (fucoxanthin) gives the brown colour of Phaeophyceae.
- Option D (chlorophyll *c*) occurs in brown algae and diatoms.

Final Answer: The red colour is due to r-phycoerythrin ⇒

[Go Back to Q1](#)

Q2.

Solution

Concept — Virus genetic material: A virus contains only one type of nucleic acid, DNA or RNA, which may be single- or double-stranded depending on the virus.

Step 1 — Read the diagram: The figure shows a head, a tail and tail fibres, the typical form of a T-even bacteriophage.

Step 2 — Recall its nucleic acid: T-even bacteriophages (e.g. T2, T4) carry double-stranded DNA packed within the polyhedral head.

Why other options are wrong:

- Option B (single-stranded RNA) is found in TMV and many plant viruses.
- Option C (double-stranded RNA) occurs in reoviruses, not T-even phages.
- Option D (single-stranded DNA) occurs in phages such as ϕ X174, not T-even ones.

Final Answer: A T-even bacteriophage carries double-stranded DNA ⇒



Answer: (A) [Go Back to Q2](#)

Q3.

Solution

Concept — Grades of body cavity: A coelom is a body cavity lined on all sides by mesoderm; how the mesoderm is arranged defines the grade.

Step 1 — Read the diagram: In section II the cavity is completely bounded by mesoderm (shaded) on both the body-wall and gut sides.

Step 2 — Classify: An animal with a true mesoderm-lined cavity is a coelomate (e.g. annelids, arthropods, chordates).

Why other options are wrong:

- Option A (acoelomate) has no body cavity (section I, solid mesoderm).
- Option C (pseudocoelomate) has a cavity not fully lined by mesoderm (section III).
- Option D (diploblastic) refers to two germ layers, not a cavity grade.

Final Answer: A true mesoderm-lined cavity makes the animal coelomate ⇒ **B**

Answer: (B) [Go Back to Q3](#)

Q4.

Solution

Concept — Mechanical (supporting) tissue: Sclerenchyma provides rigidity and strength; its cells are dead at maturity with thick lignified walls.

Step 1 — Match the description: Long, narrow, thick-walled, lignified, dead supporting cells are sclerenchyma fibres.

Step 2 — Confirm with the example: Commercial fibres such as jute and hemp are bundles of sclerenchyma fibres.

Why other options are wrong:

- Option A (parenchyma) is thin-walled living packing tissue.
- Option B (collenchyma) is living tissue with corner thickenings.
- Option C (aerenchyma) is parenchyma with large air spaces.

Final Answer: Lignified dead supporting fibres belong to sclerenchyma ⇒ **D**



Answer: (D) [Go Back to Q4](#)

Q5.

Solution

Concept — Muscle types: Muscle is classed as skeletal, smooth or cardiac by structure, location and control.

Step 1 — Match the features: Spindle-shaped, single nucleus, no striations and involuntary action describe smooth (unstriated) muscle.

Step 2 — Confirm the location: Smooth muscle lines the walls of hollow viscera such as the gut, blood vessels and urinary bladder.

Why other options are wrong:

- Option A (skeletal) is striated, multinucleate and voluntary.
- Option C (cardiac) is striated, branched and found only in the heart.
- Option D (myoepithelial tissue) is not one of the three standard muscle types.

Final Answer: Spindle-shaped, uninucleate, non-striated involuntary fibres are smooth muscle ⇒

Answer: (B) [Go Back to Q5](#)

Q6.

Solution

Concept — Inflorescence types: The pattern of flowering depends on whether the main axis keeps growing (racemose) or ends in a flower (cymose).

Step 1 — Read the diagram: The figure shows a main axis that keeps growing, bearing lateral flowers with the oldest at the base and the youngest near the tip.

Step 2 — Identify the pattern: Indefinite growth of the axis with acropetal flowering is racemose.

Why other options are wrong:

- Option B (cymose) has the axis ending in a flower, with basipetal order.
- Option C (solitary) bears a single flower, not a cluster.
- Option D (cyathium) is a special cup-like inflorescence of *Euphorbia*.

Final Answer: Indefinite axis with acropetal flowers is a racemose inflorescence



⇒

Answer: (A) [Go Back to Q6](#)

Q7.

Solution

Concept — Endomembrane system: The Golgi apparatus is the cell's processing and dispatch centre.

Step 1 — Match the structure: A stack of flattened cisternae receiving material from the ER is the Golgi apparatus (dictyosome).

Step 2 — Recall its functions: It modifies, packages and secretes proteins and lipids and buds off lysosomes and secretory vesicles.

Why other options are wrong:

- Option A (smooth ER) makes lipids; it is a network of tubules, not stacked cisternae.
- Option B (rough ER) synthesises proteins but does not do final packaging.
- Option D (peroxisome) is a single small vesicle for oxidation reactions.

Final Answer: The stacked packaging-and-secretion organelle is the Golgi apparatus ⇒

Answer: (C) [Go Back to Q7](#)

Q8.

Solution

Concept — Nucleotide structure: The repeating unit of a nucleic acid is a nucleotide.

Step 1 — Read the diagram: Three units are linked: a phosphate, a sugar and a nitrogen base.

Step 2 — Name them precisely: A nucleotide = a nitrogenous base + a pentose sugar (ribose/deoxyribose) + a phosphate group.

Why other options are wrong:

- Option A wrongly names the sugar as glucose; nucleic-acid sugar is a pentose.



- Option B uses an amino acid, which is the monomer of proteins, not nucleic acids.
- Option C omits the phosphate (that would be a nucleoside, not a nucleotide).

Final Answer: A nucleotide is base + pentose sugar + phosphate \Rightarrow **D**

Answer: (D) [Go Back to Q8](#)

Q9.

Solution

Concept — Cytokinesis: Division of the cytoplasm follows nuclear division but differs between plant and animal cells.

Step 1 — Note the plant constraint: A rigid cell wall prevents a furrow from pinching the cell inward.

Step 2 — Identify the mechanism: A cell plate forms in the centre and grows outward to the parent wall, dividing the cell.

Why other options are wrong:

- Option A (contractile actin ring) and Option C (membrane constriction) describe the cleavage furrow of animal cells.
- Option D (budding) is a mode of asexual reproduction, not cytokinesis.

Final Answer: Plant cytokinesis occurs by cell plate formation \Rightarrow **B**

Answer: (B) [Go Back to Q9](#)

Q10.

Solution

Concept — Nucleolus: The nucleolus is a dense, membraneless region inside the nucleus, rich in RNA and protein.

Step 1 — Identify its product: The nucleolus is the site of synthesis of ribosomal RNA (rRNA).

Step 2 — Note its role: Here rRNA combines with proteins to form ribosomal subunits, which then move to the cytoplasm.

Why other options are wrong:

- Option B (mRNA) is transcribed from genes throughout the nucleoplasm.



- Option C (DNA) is replicated in the nucleoplasm during S phase, not in the nucleolus.
- Option D (tRNA) is also made in the nucleoplasm, not chiefly in the nucleolus.

Final Answer: The nucleolus synthesises rRNA \Rightarrow

[Go Back to Q10](#)

Q11.

Solution

Concept — Osmotic behaviour of cells: A cell loses water when its surroundings have a lower water potential (hypertonic).

Step 1 — Trace the water movement: In a hypertonic solution, water exits the vacuole and cytoplasm by exosmosis.

Step 2 — Name the result: The protoplast shrinks and pulls away from the cell wall; this is plasmolysis.

Why other options are wrong:

- Option A (imbibition) is absorption of water by hydrophilic colloids.
- Option B (deplasmolysis) is the reverse, regaining water in a hypotonic solution.
- Option D (endosmosis) is entry of water, the opposite of what occurs here.

Final Answer: Shrinkage of the protoplast in a hypertonic solution is plasmolysis \Rightarrow

[Go Back to Q11](#)

Q12.

Solution

Concept — Micronutrients: Trace elements act mainly as activators or components of enzymes.

Step 1 — Link element to enzyme: Molybdenum (Mo) is a constituent of nitrate reductase and of nitrogenase.

Step 2 — Note the function: These enzymes reduce nitrate and fix nitrogen, so Mo is essential for plant nitrogen metabolism.



Why other options are wrong:

- Option A (manganese) activates enzymes of photosynthetic water-splitting.
- Option B (zinc) is needed for auxin synthesis.
- Option C (copper) is part of certain oxidase enzymes.

Final Answer: The micronutrient in nitrate reductase/nitrogenase is molybdenum
 \Rightarrow

[Go Back to Q12](#)

Q13.

Solution

Concept — Calvin cycle: The dark reactions fix CO_2 in the stroma using the enzyme RuBisCO.

Step 1 — Read the diagram: CO_2 is added to the 5-carbon acceptor RuBP to form two molecules of 3-PGA.

Step 2 — Name the enzyme: This carboxylation is catalysed by ribulose-1,5-bisphosphate carboxylase-oxygenase (RuBisCO).

Why other options are wrong:

- Option B (PEP carboxylase) fixes CO_2 in the mesophyll of C_4 plants, onto PEP not RuBP.
- Option C (pyruvate kinase) is a glycolytic enzyme.
- Option D (nitrogenase) fixes nitrogen, not carbon.

Final Answer: CO_2 fixation onto RuBP is catalysed by RuBisCO \Rightarrow

[Go Back to Q13](#)

Q14.

Solution

Concept — Respiratory quotient (RQ): $\text{RQ} = \text{volume of } \text{CO}_2 \text{ released} \div \text{volume of } \text{O}_2 \text{ consumed}$, and depends on the substrate.

Step 1 — Write the equation for glucose: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$.

Step 2 — Compute RQ: $\text{RQ} = 6\text{CO}_2/6\text{O}_2 = 1.0$.

Why other options are wrong:



- Option A (0.7) is the RQ for fats, which need more O_2 .
- Option C (0.9) is the RQ for proteins.
- Option D (greater than 1) occurs in organic-acid respiration or anaerobic conditions, not for glucose.

Final Answer: RQ for carbohydrate (glucose) is 1.0 \Rightarrow **B**

Answer: (B) [Go Back to Q14](#)

Q15.

Solution

Concept — Role of bile: Bile contains bile salts but no digestive enzyme.

Step 1 — Identify the action: Bile salts break large fat globules into tiny droplets, increasing the surface area.

Step 2 — Link to digestion: This emulsification lets pancreatic lipase act efficiently on the fats.

Why other options are wrong:

- Option A: bile does not hydrolyse triglycerides; lipase does.
- Option B: bile carries no enzymes.
- Option D: bile is alkaline and neutralises the acidic chyme rather than acidifying it.

Final Answer: Bile aids fat digestion by emulsifying fats into small droplets \Rightarrow **C**

Answer: (C) [Go Back to Q15](#)

Q16.

Solution

Concept — Lung volumes: The air left in the lungs after a maximal forced expiration is fixed and cannot be expelled.

Step 1 — Match the definition: The volume remaining after the most forceful expiration is the residual volume (about 1100–1200 mL).

Step 2 — Note its role: It keeps the alveoli partly inflated so gaseous exchange continues between breaths.

Why other options are wrong:



- Option A (tidal volume) is the air moved in normal quiet breathing.
- Option B (vital capacity) is the maximum air exchanged, which can be expelled.
- Option C (inspiratory reserve volume) is extra air taken in during forced inspiration.

Final Answer: The air left after forceful expiration is the residual volume \Rightarrow

Answer: (D) [Go Back to Q16](#)

Q17.

Solution

Concept — ECG waves: A normal ECG shows a P wave, a QRS complex and a T wave, each marking an electrical event of the heart.

Step 1 — Read the trace: The tall, sharp central deflection is the QRS complex.

Step 2 — Link to the heart: The QRS complex represents depolarisation of the ventricles, which triggers ventricular contraction (systole).

Why other options are wrong:

- Option B (P wave) marks atrial depolarisation.
- Option C (T wave) marks ventricular repolarisation.
- Option D (PR segment) is the delay at the AV node, not a contraction signal.

Final Answer: Ventricular depolarisation appears as the QRS complex \Rightarrow

Answer: (A) [Go Back to Q17](#)

Q18.

Solution

Concept — ADH and water balance: ADH makes the distal tubule and collecting duct more permeable to water, conserving it.

Step 1 — Trace the deficiency: Without ADH, the tubules cannot reabsorb water, so large volumes of dilute urine are lost.

Step 2 — Name the disorder: This water-losing condition is diabetes insipidus.

Why other options are wrong:

- Option A (diabetes mellitus) is due to insulin problems, with high blood



glucose and glycosuria.

- Option C (glycosuria) is glucose in urine, a sign of diabetes mellitus, not ADH lack.
- Option D (oedema) is fluid retention in tissues, the opposite outcome.

Final Answer: ADH deficiency causes diabetes insipidus ⇒

Answer: (B) [Go Back to Q18](#)

Q19.

Solution

Concept — Brain regions: Each part of the brain has a specialised role; coordination of movement and balance is one of them.

Step 1 — Identify the region: The cerebellum, in the hindbrain, governs posture, balance and the fine coordination of voluntary movement.

Step 2 — Note the consequence of damage: Cerebellar damage causes loss of muscular coordination and balance.

Why other options are wrong:

- Option A (cerebrum) controls thought, memory and voluntary initiation.
- Option B (medulla oblongata) controls heartbeat, breathing and other vital reflexes.
- Option D (hypothalamus) regulates temperature, hunger and the endocrine system.

Final Answer: Balance and coordination are controlled by the cerebellum ⇒

Answer: (C) [Go Back to Q19](#)

Q20.

Solution

Concept — Growth hormone disorders: The effect of excess GH depends on whether the long-bone growth plates are still open.

Step 1 — Note the timing: The question specifies childhood, before the epiphyseal plates close.

Step 2 — Identify the outcome: Excess GH while the bones can still elongate causes abnormally tall stature, i.e. gigantism.



Why other options are wrong:

- Option A (dwarfism) results from GH *deficiency* in childhood.
- Option B (acromegaly) is excess GH in adults, after the plates have closed.
- Option C (cretinism) is caused by thyroid hormone deficiency, not GH excess.

Final Answer: Excess GH before epiphyseal closure causes gigantism ⇒

[Go Back to Q20](#)

Q21.

Solution

Concept — Axial vs appendicular skeleton: The axial skeleton is the central frame (skull, vertebral column, ribs, sternum); the appendicular skeleton is the limbs and their girdles.

Step 1 — Read the diagram: W marks the central vertical column of the body, X the upper limb bone and Y the lower limb bone.

Step 2 — Classify: W (the vertebral column) is part of the axial skeleton.

Why other options are wrong:

- Option B (humerus, forelimb) is appendicular.
- Option C (femur, hind-limb) is appendicular.
- Option D (pelvic girdle) is appendicular.

Final Answer: The vertebral column (W) belongs to the axial skeleton ⇒

[Go Back to Q21](#)

Q22.

Solution

Concept — Modes of pollination: Pollination is classed by where the pollen comes from relative to the receiving flower.

Step 1 — Read the description: Pollen goes to the stigma of a flower on a *different plant* of the same species.

Step 2 — Name it: This cross-pollination between two different plants is xenogamy.

Why other options are wrong:



- Option A (autogamy) is self-pollination within the same flower.
- Option B (geitonogamy) is between two flowers of the *same* plant.
- Option D (cleistogamy) is self-pollination in flowers that never open.

Final Answer: Pollination between different plants is xenogamy \Rightarrow

Answer: (C) [Go Back to Q22](#)

Q23.

Solution

Concept — Male accessory glands: In human males the accessory glands are the seminal vesicles, the prostate and the bulbourethral (Cowper's) glands.

Step 1 — Identify the largest contributor: The paired seminal vesicles secrete a fructose-rich, alkaline fluid that makes up the major fraction of semen.

Step 2 — Note its role: The fructose nourishes and energises the sperm.

Why other options are wrong:

- Option A (epididymis) is a duct for sperm maturation and storage, not an accessory gland.
- Option C (Bartholin's gland) is a *female* gland.
- Option D (rete testis) is a network of tubules inside the testis, not a gland.

Final Answer: The fructose-rich major secretion comes from the seminal vesicle \Rightarrow

Answer: (B) [Go Back to Q23](#)

Q24.

Solution

Concept — Hormonal control of ovulation: Ovulation is triggered by a hormone surge at mid-cycle.

Step 1 — Identify the surge: A rapid, large rise in luteinising hormone (LH) occurs around day 14.

Step 2 — Link to the event: This LH surge causes the Graafian follicle to rupture and release the secondary oocyte.

Why other options are wrong:



- Option A (FSH) mainly stimulates follicle growth earlier in the cycle.
- Option B (progesterone) rises after ovulation, maintaining the endometrium.
- Option C (estrogen) builds up before ovulation but does not itself rupture the follicle; it triggers the LH surge.

Final Answer: The mid-cycle surge that triggers ovulation is LH \Rightarrow

[Go Back to Q24](#)

Q25.

Solution

Concept — MTP safety: The risk of medical termination rises with the stage of pregnancy.

Step 1 — Recall the safe window: MTP is considered relatively safe up to the first trimester (about 12 weeks of gestation).

Step 2 — Note the reason: The fetus is small and the procedure carries lower risk early in pregnancy.

Why other options are wrong:

- Option B (third trimester) carries high risk and is not routinely permitted.
- Option C (after 20 weeks) is beyond the generally safe and legal limit for routine MTP.
- Option D (full term) is delivery, not termination.

Final Answer: MTP is relatively safe in the first trimester \Rightarrow

[Go Back to Q25](#)

Q26.

Solution

Concept — Types of crosses: Crossing an F_1 hybrid with a parental genotype is used to study inheritance.

Step 1 — Match the definition: A cross of the F_1 with either homozygous parent is a back cross.

Step 2 — Note the special case: When the parent chosen is the homozygous *recessive*, the back cross is also a test cross.

Why other options are wrong:



- Option A (reciprocal cross) swaps the sexes of the parents.
- Option B (dihybrid cross) involves two gene pairs.
- Option D (monohybrid cross) is a cross between parents differing in one trait.

Final Answer: Crossing F_1 with a parent is a back cross \Rightarrow

Answer: (C) [Go Back to Q26](#)

Q27.

Solution

Concept — Allelic interactions: When both alleles of a heterozygote are fully and separately expressed, it is codominance.

Step 1 — Analyse blood group AB: The I^A allele makes antigen A and I^B makes antigen B; in AB both antigens appear together.

Step 2 — Classify: Since neither masks the other and both are expressed, this is codominance.

Why other options are wrong:

- Option A (incomplete dominance) gives a blended intermediate, not both traits side by side.
- Option C (complete dominance) means one allele masks the other.
- Option D (epistasis) is one gene masking another *different* gene.

Final Answer: Both A and B antigens expressed together is codominance \Rightarrow

Answer: (B) [Go Back to Q27](#)

Q28.

Solution

Concept — Linkage and recombination: The recombination frequency between two genes reflects the physical distance between them on the chromosome.

Step 1 — Relate distance and crossing over: The farther apart two genes are, the more room there is for a chiasma (crossover) to form between them.

Step 2 — Conclude: More crossing over means a higher recombination frequency for distant genes.

Why other options are wrong:



- Option A is wrong: distant genes are loosely, not tightly, linked.
- Option B is wrong: the genes are on the same chromosome, not different ones.
- Option C is wrong: crossing over does occur between linked genes.

Final Answer: Distant genes recombine more because crossover chance is greater
⇒

Answer: (D) [Go Back to Q28](#)

Q29.

Solution

Concept — tRNA in translation: Transfer RNA is the adapter that matches an amino acid to its codon.

Step 1 — Read the diagram: The tRNA carries an amino acid at its acceptor end and has a triplet at the lower loop.

Step 2 — Name the reading triplet: The triplet at the lower loop that base-pairs with the mRNA codon is the anticodon.

Why other options are wrong:

- Option B (acceptor end) holds the amino acid; it does not read the codon.
- Option C (codon) is on the mRNA, not on the tRNA.
- Option D (promoter) is a DNA sequence where transcription begins.

Final Answer: The tRNA reads the codon through its anticodon ⇒

Answer: (A) [Go Back to Q29](#)

Q30.

Solution

Concept — Chromosomal disorders: An extra copy of a chromosome (trisomy) causes specific syndromes.

Step 1 — Identify the syndrome: Down syndrome arises from trisomy of chromosome 21 (three copies instead of two).

Step 2 — Note the chromosome count: Such an individual has 47 chromosomes ($2n + 1$).

Why other options are wrong:



- Option A (18) gives Edwards syndrome.
- Option B (13) gives Patau syndrome.
- Option D (23) is not a human autosome number; humans have 22 autosome pairs plus the sex pair.

Final Answer: Down syndrome is trisomy of chromosome 21 ⇒

[Go Back to Q30](#)

Q31.

Solution

Concept — Homology vs analogy: Homologous organs share a common ancestral plan (divergent evolution); analogous organs share function but not origin (convergent evolution).

Step 1 — Analyse the example: Whale flipper, bat wing and human arm have the same bone arrangement (humerus, radius, ulna, carpals) but different uses.

Step 2 — Classify: Same structure, different function = homologous organs, evidence of divergent evolution.

Why other options are wrong:

- Option A (analogous) means similar function but different structure, e.g. bird and insect wings.
- Option C (vestigial) are reduced, functionless remnants like the appendix.
- Option D (atavistic) refers to the reappearance of an ancestral trait.

Final Answer: Same plan, different function makes them homologous organs ⇒

[Go Back to Q31](#)

Q32.

Solution

Concept — Causative agents of diseases: Each disease is linked to a specific pathogen.

Step 1 — Identify the pathogen: The common cold is caused by rhinoviruses (a group of RNA viruses).

Step 2 — Note the features: They infect the upper respiratory tract, causing



congestion and sneezing, and have no specific cure.

Why other options are wrong:

- Option A (*Salmonella typhi*) causes typhoid.
- Option B (*Plasmodium*) causes malaria.
- Option C (*Wuchereria*) causes filariasis.

Final Answer: The common cold is caused by rhinoviruses ⇒

Answer: (D) [Go Back to Q32](#)

Q33.

Solution

Concept — Biofertilizers: Microorganisms that enrich soil nutrients are used as biofertilizers.

Step 1 — Classify the microbes: *Azotobacter* and *Azospirillum* are free-living (non-symbiotic) bacteria of the soil.

Step 2 — Note their role: They fix atmospheric nitrogen into forms plants can absorb, raising soil fertility.

Why other options are wrong:

- Option A is wrong: they fix nitrogen, they are not phosphate-solubilising fungi.
- Option B is wrong: they are bacteria, not mycorrhizal fungi.
- Option D is wrong: they are free-living and do not form root nodules (that is *Rhizobium*).

Final Answer: They are free-living nitrogen-fixing bacteria ⇒

Answer: (C) [Go Back to Q33](#)



Q34.

Solution

Concept — Antibody structure: An antibody (immunoglobulin) is a Y-shaped protein with a defined chain composition.

Step 1 — Read the diagram: The Y shows two long chains and two short chains joined together.

Step 2 — Name the chains: Each antibody (e.g. IgG) has two identical heavy (H) chains and two identical light (L) chains, written H_2L_2 .

Why other options are wrong:

- Option B (four heavy chains) ignores the light chains.
- Option C (four light chains) ignores the heavy chains.
- Option D (one H + one L) is only half a molecule.

Final Answer: An antibody has two heavy and two light chains \Rightarrow **A**

Answer: (A) [Go Back to Q34](#)

Q35.

Solution

Concept — Making cells competent: Bacterial membranes normally resist DNA uptake, so they must be treated to become competent.

Step 1 — Identify the treatment: Cells are incubated with divalent cations such as calcium ($CaCl_2$), which increase membrane permeability to DNA.

Step 2 — Add the heat shock: A brief heat shock (about $42^\circ C$) then drives the recombinant DNA into the cells.

Why other options are wrong:

- Option A (restriction enzyme) cuts DNA; it does not make cells competent.
- Option C (DNA ligase) seals DNA fragments; it has no role in uptake.
- Option D (cellulase) digests plant cell walls, not bacterial membranes.

Final Answer: Cells are made competent with $CaCl_2$ plus heat shock \Rightarrow **B**

Answer: (B) [Go Back to Q35](#)



Q36.

Solution

Concept — Gene transfer methods: The biolistic (gene gun) method is a direct, physical way to deliver DNA into cells.

Step 1 — Describe the technique: Microscopic gold or tungsten particles are coated with DNA.

Step 2 — Note the delivery: These particles are fired at high velocity into the cells, where the DNA enters and integrates.

Why other options are wrong:

- Option A (*Agrobacterium*) is a biological vector method, not biolistics.
- Option B (microinjection) uses a fine needle, a different method.
- Option C (calcium/heat shock) is used for bacterial transformation, not the gene gun.

Final Answer: The gene gun bombards cells with DNA-coated metal particles ⇒

D

Answer: (D) [Go Back to Q36](#)

Q37.

Solution

Concept — RNA interference (RNAi): RNAi silences a target gene by destroying its mRNA before it is translated.

Step 1 — Set up the strategy: A gene producing double-stranded RNA complementary to a vital nematode mRNA is introduced into the plant.

Step 2 — Explain the result: When the nematode feeds, the dsRNA silences (degrades) its specific mRNA, so the parasite cannot survive in the transgenic plant.

Why other options are wrong:

- Option A describes the Bt-toxin strategy, not RNAi.
- Option B is wrong: extra nematode genes would not give resistance.
- Option D is unrelated to nematode resistance.

Final Answer: RNAi works by silencing a specific nematode mRNA with complementary dsRNA ⇒ C



Answer: (C) [Go Back to Q37](#)

Q38.

Solution

Concept — Competitive exclusion: Gause showed that two species needing the same resource cannot share one niche forever.

Step 1 — State the principle: Two species competing for the same limiting resource cannot coexist indefinitely; the better competitor eliminates the other.

Step 2 — Note the evidence: In Gause's *Paramecium* cultures, one species was driven out when both used the same food.

Why other options are wrong:

- Option B contradicts the principle.
- Option C is wrong: competition strongly affects population size.
- Option D describes predation, not competitive exclusion.

Final Answer: Competitors for the same resource cannot coexist indefinitely ⇒

A

Answer: (A) [Go Back to Q38](#)

Q39.

Solution

Concept — Pyramid of numbers: This pyramid plots the number of individuals at each trophic level; in a grassland it is upright.

Step 1 — Read the diagram: The widest base level holds the producers (grasses), and the levels narrow upward.

Step 2 — Identify the largest count: The producers (grasses) are by far the most numerous, forming the broad base.

Why other options are wrong:

- Option A (top carnivores) are fewest, at the narrow apex.
- Option C (insectivorous birds) are an intermediate, smaller level.
- Option D (primary carnivores) are fewer than the producers below them.

Final Answer: The most numerous level is the producers (grasses) ⇒ B



Answer: (B) [Go Back to Q39](#)

Q40.

Solution

Concept — In-situ vs ex-situ conservation: In-situ protects species in their natural habitat; ex-situ protects them outside it.

Step 1 — Identify ex-situ methods: Seed banks, zoos, botanical gardens and cryopreservation keep organisms or germplasm away from the wild.

Step 2 — Pick the example: A seed bank with cryopreserved germplasm in liquid nitrogen is clearly ex-situ.

Why other options are wrong:

- Options A (national park), B (biosphere reserve) and C (wildlife sanctuary) all protect species in their natural habitat, so they are in-situ methods.

Final Answer: A cryopreserved seed bank is ex-situ conservation ⇒

Answer: (D) [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	A	7	C	8	D	9	B	10	A
11	C	12	D	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	C
31	B	32	D	33	C	34	A	35	B
36	D	37	C	38	A	39	B	40	D

