KIITEE Biology Sample Paper – 6

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. In the life cycle of a fern (pteridophyte), the dominant, photosynthetic and independent main plant body is the:

(A) Haploid gametophyte (prothallus)

(B) Diploid sporophyte

(C) Haploid spore

(D) Diploid zygote

Q2. Viroids, the causal agents of certain plant diseases such as potato spindle tuber disease, differ from true viruses because a viroid consists of:

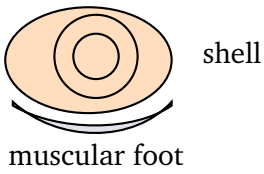
(A) DNA enclosed in a protein coat

(B) RNA enclosed in a protein coat

(C) A protein molecule only, with no nucleic acid

(D) Free RNA only, lacking a protein coat

Q3. The animal shown below has a soft, unsegmented body covered by a hard calcareous shell secreted by a fleshy fold called the mantle. It belongs to the phylum:



(A) Mollusca

(B) Arthropoda

(C) Annelida

(D) Echinodermata

Q4. Which simple permanent tissue, made of living thin-walled isodiametric cells, performs storage, photosynthesis and secretion in plants?

(A) Collenchyma

(B) Sclerenchyma

(C) Parenchyma

(D) Xylem fibres

Q5. Hyaline cartilage, the most widespread type of cartilage in the human body, is typically found:

(A) In the pinna (external flap) of the ear

(B) In the intervertebral discs of the backbone

(C) In tendons that attach muscle to bone

(D) At the ends of long bones and in the wall of the trachea

Q6. In *Opuntia* (prickly pear), the flattened green photosynthetic stem that takes over the food-making function of the reduced leaves is called a:

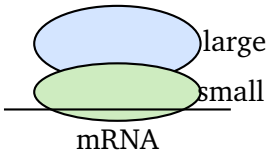
(A) Tendril

(B) Phylloclade

(C) Bulbil

(D) Stem thorn

Q7. The cell structure shown below is built of two unequal subunits, contains rRNA, and possesses no membrane. Its principal function is:



(A) Synthesis of proteins

(B) Synthesis of lipids

(C) Production of ATP

(D) Replication of DNA

Q8. An enzyme that catalyses the transfer of a chemical group (such as an amino group or a phosphate group) from one substrate molecule to another belongs to the class:

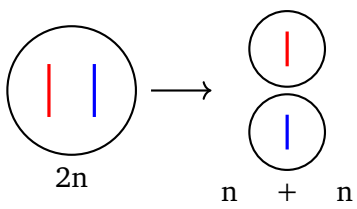
(A) Oxidoreductases

(B) Hydrolases

(C) Transferases

(D) Lyases

Q9. The diagram represents the outcome of the first meiotic division of a diploid cell. Meiosis I is described as the *reductional* division because:



(A) Sister chromatids of each chromosome separate from each other

(B) The chromosome number is halved, from diploid (2n) to haploid (n)

(C) The DNA replicates once more before the cell divides

(D) Each daughter cell receives twice the original number of chromosomes

Q10. Glycoproteins and glycolipids that project from the outer surface of the plasma membrane chiefly function in:

(A) Storage of energy as fat

(B) Catalysis of intracellular reactions

(C) Synthesis of ATP for the cell

(D) Cell recognition and cell-to-cell communication

Q11. According to Munch's pressure-flow (mass-flow) hypothesis, the translocation of sugars through the phloem takes place:

(A) From the sink towards the source

(B) Only in the upward direction, like water in xylem

(C) From the source (high turgor pressure) to the sink (low turgor pressure)

(D) By active pumping that does not need a pressure gradient

Q12. According to the criteria of Arnon and Stout, a mineral element is regarded as an *essential* element only if:

(A) The plant cannot complete its life cycle without it and it is directly involved in the plant's metabolism

(B) It is simply present in large quantities in the plant body

(C) It can be replaced by any other element of similar valency

(D) It is absorbed only when supplied artificially as fertiliser

Q13. Blackman's law of limiting factors states that when a process such as photosynthesis is governed by several factors, its rate is determined by:

(A) The simple sum of all the factors acting together

(B) The factor that is present in the minimum (least favourable) amount

(C) The factor that is present in the greatest excess

(D) Light intensity alone, regardless of other factors

Q14. In anaerobic respiration (fermentation) carried out by yeast, the pyruvate formed from glucose is incompletely broken down to:

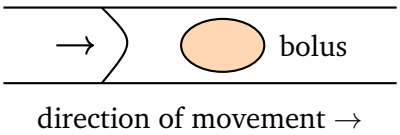
(A) Carbon dioxide and water

(B) Lactic acid only

(C) Pyruvic acid that accumulates unchanged

(D) Ethanol (ethyl alcohol) and carbon dioxide

Q15. The wave of sequential muscular contraction and relaxation of the gut wall shown below, which pushes the food bolus forward along the alimentary canal, is called:



(A) Peristalsis

(B) Segmentation

(C) Deglutition

(D) Mastication

Q16. The approximate partial pressure of oxygen (pO_2) in the alveolar air of healthy human lungs is about:

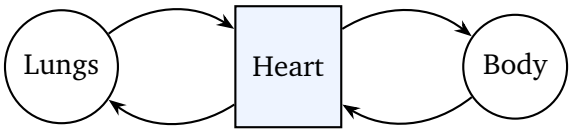
(A) 40 mmHg

(B) 159 mmHg

(C) 104 mmHg

(D) 24 mmHg

Q17. In the human double circulation shown, blood passes through the heart twice during one complete round of the body. The circuit that carries blood from the heart to the lungs and back to the heart is the:



(A) Systemic circulation

(B) Pulmonary circulation

(C) Hepatic portal circulation

(D) Coronary circulation

Q18. In haemodialysis using an artificial kidney, nitrogenous wastes such as urea are removed from the patient's blood mainly by:

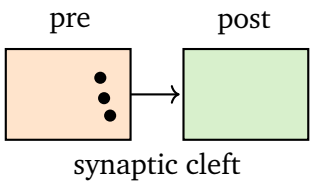
(A) Active transport against the concentration gradient

(B) Ultrafiltration driven by high blood pressure

(C) Selective reabsorption by tubule cells

(D) Diffusion across a semipermeable membrane into the dialysing fluid

Q19. At the chemical synapse shown, the arrival of a nerve impulse at the pre-synaptic terminal triggers the release of a chemical messenger into the synaptic cleft. A common neurotransmitter doing this job is:



(A) Insulin

(B) Renin

(C) Acetylcholine

(D) Pepsin

Q20. Glucagon, the hormone that raises blood glucose by stimulating glycogenolysis in the liver, is secreted by the:

(A) α-cells of the islets of Langerhans

(B) β-cells of the islets of Langerhans

(C) Follicular cells of the thyroid gland

(D) Chromaffin cells of the adrenal medulla

Q21. Which muscle type is striated in appearance but involuntary in action and is found only in the wall of the heart?

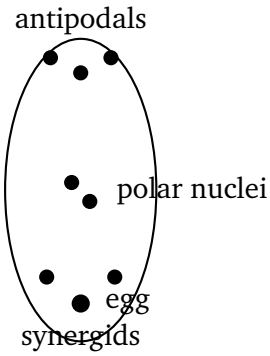
(A) Skeletal (striated voluntary) muscle

(B) Smooth (unstriated) muscle of the gut

(C) Myoepithelial muscle of glands

(D) Cardiac muscle

Q22. The mature female gametophyte (embryo sac) of a typical angiosperm, shown below, has the organisation:



(A) 8-celled and 8-nucleate

(B) 7-celled and 8-nucleate

(C) 8-celled and 7-nucleate

(D) 6-celled and 6-nucleate

Q23. In the testis, the interstitial Leydig cells secrete androgens. The cells that lie inside the seminiferous tubules and nourish the developing sperm are the:

(A) Spermatogonia

(B) Leydig cells

(C) Sertoli (nurse) cells

(D) Primary spermatocytes

Q24. After fertilisation in humans, the structure that becomes embedded (implanted) in the uterine endometrium is the:

(A) Blastocyst

(B) Zygote

(C) Morula

(D) Secondary oocyte

Q25. Although amniocentesis is a useful diagnostic test, it has been legally banned in India for one of its applications because it was being misused for:

(A) Detecting metabolic disorders of the foetus

(B) Determining the sex of the foetus, leading to female foeticide

(C) Estimating the age of the foetus

(D) Checking the position of the placenta

Q26. In Mendel's monohybrid cross, two heterozygous tall pea plants (Tt) are crossed, as shown in the Punnett square. The *genotypic* ratio of the offspring is:

	T	t
T	TT	Tt
t	Tt	tt

(A) 3 : 1

(B) 1 : 1

(C) 1 : 2 : 1

(D) 9 : 3 : 3 : 1

Q27. In mice, a cross between two yellow-coated heterozygotes (Aa $\times$ Aa) gives a phenotypic ratio of 2 yellow : 1 agouti instead of the usual 3 : 1. This happens because the homozygous (AA) genotype is:

(A) Sterile but otherwise healthy

(B) Dominant over the heterozygote

(C) Completely recessive

(D) Lethal, so AA embryos die before birth

Q28. In birds, sex is determined by the ZZ–ZW mechanism. This means that the:

(A) Female is heterogametic (ZW) and the male is homogametic (ZZ)

(B) Male is heterogametic (ZW) and the female is homogametic (ZZ)

(C) Female has a single Z chromosome (ZO)

(D) Sex is decided by an extra autosome, not by Z and W

Q29. Griffith's experiment with *Streptococcus pneumoniae* demonstrated the phenomenon of *transformation*, in which:

(A) Heat-killed virulent S cells alone were able to kill the mice

(B) The harmless R (rough) strain was transformed into the virulent S (smooth) strain by material from heat-killed S cells

(C) Living S cells were converted into living R cells by heat

(D) Protein from S cells was shown to be the genetic material

Q30. Klinefelter's syndrome in humans, in which the affected individual is a male with certain feminine features and is usually sterile, is caused by the chromosomal constitution:

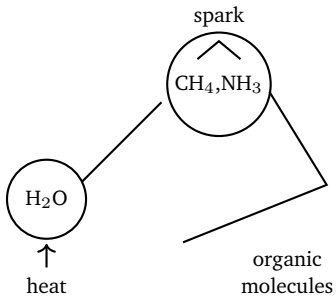
(A) 45, X (a single X, that is XO)

(B) 47, with an extra chromosome 21 (trisomy 21)

(C) 46, XY with an inverted segment

(D) 47, XXY (an extra X chromosome)

Q31. The Miller–Urey apparatus shown passed electric sparks through a mixture of CH_4, NH_3, H_2 and water vapour. The experiment demonstrated the:



(A) Abiotic (chemical) synthesis of organic molecules such as amino acids

(B) Spontaneous appearance of a complete living cell

(C) Replication of DNA outside a living cell

(D) Inheritance of acquired characters

Q32. Elephantiasis (filariasis), marked by gross swelling of the lower limbs and blockage of lymph vessels, is caused by the parasite:

(A) *Plasmodium vivax*

(B) *Entamoeba histolytica*

(C) *Wuchereria bancrofti*

(D) *Ascaris lumbricoides*

Q33. The characteristic flavour and the blue-green veins of Roquefort (blue) cheese are produced by ripening it with the fungus:

(A) *Lactobacillus acidophilus*

(B) *Penicillium roqueforti*

(C) *Saccharomyces cerevisiae*

(D) *Aspergillus niger*

Q34. The property by which cells of a malignant tumour leave their original site, travel through the blood or lymph, and start new (secondary) tumours at distant places is called:

(A) Point mutation

(B) Apoptosis

(C) Contact inhibition

(D) Metastasis

Q35. In the manufacture of a biotechnological product, the steps of separation and purification of the product carried out after the biosynthetic (fermentation) stage are together called:

(A) Downstream processing

(B) Upstream processing

(C) Inoculation

(D) Sterilisation

Q36. ELISA, widely used to diagnose infections such as AIDS and typhoid, works mainly on the principle of:

(A) DNA–DNA hybridisation with a labelled probe

(B) Separation of fragments by gel electrophoresis

(C) Antigen–antibody interaction

(D) Amplification of DNA by PCR

Q37. Rosie, the first transgenic cow, was an important achievement of biotechnology because her milk was enriched with:

(A) A much higher amount of lactose sugar

(B) The human protein alpha-lactalbumin, making the milk nutritionally balanced for human babies

(C) The hormone insulin for diabetic patients

(D) Antibiotics that prevent the milk from spoiling

Q38. The cuckoo (koel) laying its eggs in the nest of a crow, so that the crow incubates and rears the cuckoo's chicks, is a classic example of:

(A) Mutualism

(B) Commensalism

(C) Predation

(D) Brood parasitism

Q39. In the primary succession on a bare rock shown below, the pioneer community that first colonises the lifeless rock surface is usually:

Bare rock → Lichens → Mosses → Herbs → Shrubs → Forest

(A) Lichens

(B) Tall trees

(C) Shrubs

(D) Grasses

Q40. Which of the following groups consists *only* of greenhouse gases that contribute to global warming?

(A) Carbon dioxide, oxygen and nitrogen

(B) CFCs, oxygen and argon

(C) Carbon dioxide, methane, nitrous oxide and water vapour

(D) Sulphur dioxide, nitrogen dioxide and carbon monoxide

Detailed Solutions

Q1.

Solution

Concept — Pteridophyte life cycle: Pteridophytes (ferns, horsetails) are the first true vascular plants and show a clear alternation of generations.

Step 1 — Identify the main plant body: The conspicuous fern plant with roots, stem and large leaves (fronds) is the diploid sporophyte.

Step 2 — Note its features: This sporophyte is independent and photosynthetic; it bears sori that produce spores by meiosis. The gametophyte (prothallus) is small and short-lived.

Why other options are wrong:

- Option A (gametophyte) is a tiny, inconspicuous prothallus, not the dominant phase.
- Option C (spore) is a single reproductive cell, not a plant body.
- Option D (zygote) is a single fertilised cell.

Final Answer: The dominant fern body is the diploid sporophyte $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Viroids: Viroids are sub-viral infectious agents discovered by T.O. Diener.

Step 1 — Recall their composition: A viroid is made of a short, free, circular single strand of RNA with no protein coat (capsid).

Step 2 — Contrast with viruses: A virus always has a nucleic acid (DNA or RNA) enclosed in a protein coat, whereas the viroid lacks the protein coat entirely.

Why other options are wrong:

- Options A and B describe true viruses, which possess a protein coat.
- Option C (protein only, no nucleic acid) describes a prion, not a viroid.

Final Answer: A viroid is free RNA without a protein coat $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Phylum Mollusca: Molluscs are soft-bodied animals such as snails, mussels and octopuses.

Step 1 — Read the diagram: The figure shows a soft, unsegmented body with a muscular foot, covered by a hard calcareous shell.

Step 2 — Apply the key character: The shell is secreted by a fleshy fold of the body wall called the mantle. A soft body with mantle and calcareous shell is diagnostic of Mollusca.

Why other options are wrong:

- Option B (Arthropoda) has a jointed chitinous exoskeleton and jointed legs.
- Option C (Annelida) has a segmented body with setae.
- Option D (Echinodermata) has a spiny calcareous endoskeleton and water vascular system.

Final Answer: A soft body with a mantle and calcareous shell belongs to Mollusca $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Simple permanent tissues: Parenchyma, collenchyma and sclerenchyma are the three simple tissues; parenchyma is the most basic and versatile.

Step 1 — Match cell type to description: Parenchyma is made of living, thin-walled, isodiametric cells with prominent intercellular spaces.

Step 2 — List its functions: It stores food and water, performs photosynthesis (when it contains chloroplasts, as chlorenchyma) and carries out secretion.

Why other options are wrong:

- Option A (collenchyma) gives mechanical support, with unevenly thickened walls.
- Option B (sclerenchyma) is dead and provides hardness.
- Option D (xylem fibres) are dead, lignified supporting cells.

Final Answer: The living, multi-purpose simple tissue is parenchyma $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Types of cartilage: The three kinds are hyaline, elastic and fibrous cartilage, each in characteristic locations.

Step 1 — Recall where hyaline cartilage occurs: It is the most common cartilage and is found at the ends (articular surfaces) of long bones and in the wall of the trachea and bronchi.

Step 2 — Note its make-up: Its matrix is rich in collagen fibres and provides smooth, low-friction surfaces at joints.

Why other options are wrong:

- Option A (ear pinna) contains elastic cartilage.
- Option B (intervertebral discs) contains fibrous cartilage.
- Option C (tendons) is dense regular connective tissue, not cartilage.

Final Answer: Hyaline cartilage lies at the ends of long bones and in the trachea $\Rightarrow$ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Stem modifications: Stems may be modified for support, protection, storage or photosynthesis.

Step 1 — Read the example: In *Opuntia*, the stem becomes green, flattened and fleshy and takes over photosynthesis because the leaves are reduced to spines.

Step 2 — Name the modification: Such a flattened photosynthetic stem of one or more internodes is called a phylloclade.

Why other options are wrong:

- Option A (tendril) is a thread-like climbing structure.
- Option C (bulbil) is a vegetative propagule.
- Option D (stem thorn) is a hard pointed protective structure, as in *Citrus*.

Final Answer: The flattened photosynthetic stem of *Opuntia* is a phylloclade $\Rightarrow$

B

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Ribosome: The ribosome is a non-membranous organelle built of a large and a small subunit, each containing rRNA and proteins.

Step 1 — Read the diagram: The figure shows two unequal subunits sitting on a strand of mRNA, with no surrounding membrane.

Step 2 — Link to function: Ribosomes are the sites of translation, where the mRNA message is read and amino acids are joined to make a polypeptide (protein).

Why other options are wrong:

- Option B (lipid synthesis) occurs on the smooth endoplasmic reticulum.
- Option C (ATP production) occurs in mitochondria.
- Option D (DNA replication) occurs in the nucleus.

Final Answer: The two-subunit, membrane-less organelle synthesises proteins $\Rightarrow$ A

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Classification of enzymes: Enzymes are grouped by the type of reaction they catalyse (oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases).

Step 1 — Identify the reaction: The reaction here is the transfer of a chemical group (amino or phosphate) from one molecule to another.

Step 2 — Match to the class: Enzymes that transfer functional groups between substrates are transferases (e.g., transaminases, kinases).

Why other options are wrong:

- Option A (oxidoreductases) catalyse oxidation–reduction (electron transfer).
- Option B (hydrolases) break bonds by adding water.

- Option D (lyases) add or remove groups to form double bonds, without using water.

Final Answer: Group-transfer enzymes are transferases $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Meiosis I: Meiosis consists of two divisions; the first separates homologous chromosomes.

Step 1 — Read the diagram: A single diploid (2n) cell divides into two cells, each receiving one chromosome of every homologous pair, so each is haploid (n).

Step 2 — Explain the term: Because the chromosome number is reduced from 2n to n, meiosis I is called the reductional division.

Why other options are wrong:

- Option A (sister chromatids separating) happens in meiosis II, the equational division.
- Option C (DNA replicating again) does not occur between meiosis I and II.
- Option D (doubling the number) is the opposite of what meiosis does.

Final Answer: Meiosis I is reductional because 2n becomes n $\Rightarrow$ B

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Membrane carbohydrates: Short carbohydrate chains attached to membrane proteins (glycoproteins) and lipids (glycolipids) form the glycocalyx on the cell surface.

Step 1 — Locate them: These sugar groups project outward from the outer surface of the plasma membrane.

Step 2 — State their role: They act as identity markers, helping in cell recognition, cell-to-cell adhesion and communication (for example, distinguishing self from non-self).

Why other options are wrong:

- Option A (energy storage) is the role of fats and starch.
- Option B (catalysis) is the role of enzymes.
- Option C (ATP synthesis) occurs in mitochondria.

Final Answer: Surface glycoproteins/glycolipids work in cell recognition $\Rightarrow$ D

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Pressure-flow hypothesis: Munch's hypothesis explains how food (sucrose) moves through the phloem.

Step 1 — Set up the gradient: At the source (e.g., a leaf), sugar is loaded into the sieve tubes, raising the solute concentration and drawing in water by osmosis, which builds high turgor pressure.

Step 2 — Drive the flow: This high pressure pushes the sugary sap towards the sink (root, fruit), where sugar is unloaded and pressure falls. So flow is from source to sink.

Why other options are wrong:

- Option A reverses the direction.
- Option B is wrong because phloem translocation can be upward or downward.
- Option D wrongly denies the need for a pressure gradient.

Final Answer: Phloem sap flows from source (high pressure) to sink (low pressure) $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Essentiality of elements: Arnon and Stout laid down the criteria that decide whether a mineral element is truly essential for a plant.

Step 1 — State the key criterion: The element must be absolutely necessary for the plant to complete its life cycle (without it, the plant cannot grow and reproduce normally).

Step 2 — Add the second criterion: The element must be directly involved in the plant's metabolism and its requirement must be specific, not replaceable by another element.

Why other options are wrong:

- Option B is wrong because mere abundance does not make an element essential.
- Option C contradicts the rule that the requirement is specific and non-replaceable.
- Option D wrongly limits absorption to fertilisers.

Final Answer: An element is essential if the plant cannot complete its life cycle without it and it has a direct metabolic role $\Rightarrow$ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Law of limiting factors: Blackman (1905) studied how several factors together control the rate of photosynthesis.

Step 1 — State the law: When a process is affected by more than one factor, its rate is set by the factor that is nearest to its minimum (the factor in shortest supply).

Step 2 — Apply it: Even if light and temperature are plentiful, a low CO_2 level can hold back photosynthesis; CO_2 is then the limiting factor.

Why other options are wrong:

- Option A is wrong because the rate is not a simple sum of factors.
- Option C is the opposite of the law (the excess factor does not limit).
- Option D wrongly singles out light alone.

Final Answer: The rate is limited by the factor in minimum supply $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Anaerobic respiration (fermentation): In the absence of oxygen, glucose is only partly oxidised, releasing little energy.

Step 1 — Trace the pathway in yeast: Glucose is broken to pyruvate by glycolysis; pyruvate is then decarboxylated and reduced.

Step 2 — Name the end products: In yeast (alcoholic fermentation), pyruvate is converted into ethanol (ethyl alcohol) and carbon dioxide.

Why other options are wrong:

- Option A (CO_2 + water) is the product of complete aerobic respiration.
- Option B (lactic acid only) is the product in animal muscle, not in yeast.
- Option C is wrong because pyruvate does not simply accumulate; it is further changed.

Final Answer: Yeast ferments glucose to ethanol and $CO_2 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Movement of food in the gut: The smooth muscle of the alimentary canal moves food by coordinated contractions.

Step 1 — Read the diagram: A ring of contraction behind the food bolus and relaxation ahead of it pushes the bolus forward, as shown by the arrow.

Step 2 — Name the process: These travelling waves of contraction and relaxation are called peristalsis.

Why other options are wrong:

- Option B (segmentation) only mixes food, it does not push it along.
- Option C (deglutition) is the act of swallowing.
- Option D (mastication) is chewing in the mouth.

Final Answer: The forward-pushing gut waves are peristalsis $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Partial pressures in respiration: Oxygen moves from regions of higher pO_2 to lower pO_2 along the respiratory pathway.

Step 1 — Recall the standard values: Atmospheric pO_2 is about 159 mmHg, alveolar pO_2 about 104 mmHg, oxygenated blood about 95 mmHg, and tissues about 40 mmHg.

Step 2 — Pick the alveolar value: The pO_2 in alveolar air is about 104 mmHg, which is enough to load oxygen onto haemoglobin.

Why other options are wrong:

- Option A (40 mmHg) is the pO_2 in the tissues.
- Option B (159 mmHg) is the pO_2 of atmospheric air.
- Option D (24 mmHg) is closer to the pCO_2 in alveoli, not pO_2.

Final Answer: Alveolar pO_2 is about 104 mmHg $\Rightarrow$ C

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Double circulation: In mammals, blood passes through the heart twice in one complete circuit, forming two loops.

Step 1 — Read the diagram: One loop runs heart $\rightarrow$ lungs $\rightarrow$ heart, and the other runs heart $\rightarrow$ body $\rightarrow$ heart.

Step 2 — Name the lung loop: The circuit carrying blood from the heart to the lungs (for oxygenation) and back to the heart is the pulmonary circulation.

Why other options are wrong:

- Option A (systemic circulation) carries blood between the heart and the rest of the body.
- Option C (hepatic portal) connects the gut to the liver.
- Option D (coronary circulation) supplies the heart muscle itself.

Final Answer: The heart-to-lungs-and-back loop is the pulmonary circulation $\Rightarrow$ B

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Haemodialysis: An artificial kidney clears wastes from the blood of a person whose kidneys have failed.

Step 1 — Set up the gradient: The patient's blood flows on one side of a semipermeable membrane; a dialysing fluid (with no urea) flows on the other side.

Step 2 — Explain the removal: Because urea is high in blood and absent in the fluid, it diffuses down its concentration gradient across the membrane into the dialysing fluid.

Why other options are wrong:

- Option A (active transport) needs energy and carrier proteins, not used here.
- Option B (ultrafiltration by pressure) is how the natural glomerulus filters, not the dialyser.
- Option C (tubular reabsorption) is a kidney tubule function, absent in the machine.

Final Answer: Wastes leave the blood by diffusion across the dialysis membrane $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Chemical synapse: At a chemical synapse, the electrical impulse is carried across the cleft by a chemical messenger.

Step 1 — Read the diagram: The impulse reaches the pre-synaptic terminal, where vesicles release a neurotransmitter into the synaptic cleft, which then acts on the post-synaptic membrane.

Step 2 — Name the messenger: A widely used neurotransmitter at such synapses (and at the neuromuscular junction) is acetylcholine.

Why other options are wrong:

- Option A (insulin) is a hormone of the pancreas.
- Option B (renin) is an enzyme from the kidney.
- Option D (pepsin) is a digestive enzyme of the stomach.

Final Answer: The synaptic neurotransmitter here is acetylcholine $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Endocrine pancreas: The islets of Langerhans have α-cells and β-cells with opposite actions on blood sugar.

Step 1 — Identify the glucagon source: Glucagon is secreted by the α-cells of the islets of Langerhans.

Step 2 — Recall its action: Glucagon raises blood glucose by breaking down stored glycogen in the liver (glycogenolysis); it opposes insulin.

Why other options are wrong:

- Option B (β-cells) secrete insulin, which lowers blood glucose.
- Option C (thyroid) secretes thyroxine.
- Option D (adrenal medulla) secretes adrenaline.

Final Answer: Glucagon comes from the α-cells of the islets of Langerhans $\Rightarrow$ A

Answer: (A) Go Back to Q20

Q21.

Solution

Concept — Types of muscle: The three muscle types are skeletal (striated, voluntary), smooth (unstriated, involuntary) and cardiac.

Step 1 — Combine the clues: We need a muscle that looks striated but works involuntarily and is found only in the heart.

Step 2 — Identify it: Cardiac muscle is striated like skeletal muscle yet involuntary like smooth muscle, and its branched fibres with intercalated discs occur only in the heart wall.

Why other options are wrong:

- Option A (skeletal) is striated but voluntary.
- Option B (smooth) is involuntary but not striated.
- Option C (myoepithelial) cells are specialised contractile cells of glands, not the cardiac type asked for.

Final Answer: Striated, involuntary, heart-only muscle is cardiac muscle $\Rightarrow$ D

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Structure of the embryo sac: The typical angiosperm embryo sac develops from a functional megaspore by three mitotic divisions.

Step 1 — Count the nuclei and cells: The result is eight nuclei distributed in seven cells: an egg apparatus (one egg + two synergids), three antipodal cells, and one large central cell with two polar nuclei.

Step 2 — State the organisation: Because two of the eight nuclei lie together in the single central cell, the embryo sac is 7-celled but 8-nucleate.

Why other options are wrong:

- Option A (8-celled, 8-nucleate) wrongly counts the two polar nuclei as two separate cells.
- Option C (8-celled, 7-nucleate) has both numbers wrong.
- Option D (6-celled, 6-nucleate) does not match the development.

Final Answer: The mature embryo sac is 7-celled and 8-nucleate $\Rightarrow$ B

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Cells of the testis: Two important non-germ cell types are the Leydig cells and the Sertoli cells.

Step 1 — Separate their roles: Leydig (interstitial) cells lie outside the tubules and secrete male hormones (androgens).

Step 2 — Identify the nourishing cells: Inside the seminiferous tubules, the Sertoli (nurse) cells provide nutrition and support to the developing sperm.

Why other options are wrong:

- Option A (spermatogonia) are the dividing germ cells, not the nurse cells.
- Option B (Leydig cells) secrete androgens; they do not nourish sperm.
- Option D (primary spermatocytes) are stages of developing sperm, not their nurses.

Final Answer: The sperm-nourishing cells are the Sertoli cells $\Rightarrow$ C

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Early development and implantation: After fertilisation, the zygote divides repeatedly while moving towards the uterus.

Step 1 — Trace the stages: Zygote $\rightarrow$ morula $\rightarrow$ blastocyst. By the time it reaches the uterus, it has become a blastocyst with an outer trophoblast.

Step 2 — Identify the implanting stage: The trophoblast of the blastocyst attaches to and becomes embedded in the uterine endometrium; this is implantation.

Why other options are wrong:

- Option B (zygote) is the single cell formed just after fertilisation.
- Option C (morula) is an earlier solid ball of cells, before implantation.
- Option D (secondary oocyte) is the pre-fertilisation egg stage.

Final Answer: The blastocyst is the stage that implants in the endometrium $\Rightarrow$ A

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Amniocentesis: This is a test in which a sample of amniotic fluid is drawn to study the foetal cells and chromosomes.

Step 1 — State the genuine use: It can detect genetic disorders and chromosomal abnormalities such as Down's syndrome in the foetus.

Step 2 — State the misuse and the ban: Because it also reveals the sex of the foetus, it was misused for female foeticide; hence the test for sex determination is legally banned in India.

Why other options are wrong:

- Option A is a legitimate, permitted use, not the banned one.
- Options C and D are not the reasons for which the test is banned.

Final Answer: Amniocentesis is banned because of its misuse for sex determination $\Rightarrow$ B

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Monohybrid cross genotypes: A cross between two heterozygotes (Tt $\times$ Tt) gives a definite genotypic ratio.

Step 1 — Fill the Punnett square: The four boxes give TT, Tt, Tt and tt.

Step 2 — Count the genotypes: This is 1 TT : 2 Tt : 1 tt, i.e. a genotypic ratio of 1 : 2 : 1.

Why other options are wrong:

- Option A (3 : 1) is the phenotypic ratio, not the genotypic ratio.
- Option B (1 : 1) is the ratio of a test cross.
- Option D (9 : 3 : 3 : 1) is the dihybrid phenotypic ratio.

Final Answer: The genotypic ratio of Tt $\times$ Tt is 1 : 2 : 1 $\Rightarrow$ C

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — Lethal genes: A lethal allele kills the organism when present in a particular genotype, altering the expected ratio.

Step 1 — Work out the cross: Aa $\times$ Aa is expected to give 1 AA : 2 Aa : 1 aa.

Step 2 — Apply the lethality: The homozygous AA embryos die before birth, so only 2 Aa (yellow) : 1 aa (agouti) survive, giving the observed 2 : 1 ratio.

Why other options are wrong:

- Option A (sterile) would not remove the AA class from the count at birth.
- Option B (more dominant) does not change the ratio in this way.
- Option C (recessive) is wrong, since the yellow allele behaves as a dominant for coat colour.

Final Answer: The 2 : 1 ratio arises because homozygous AA is lethal $\Rightarrow$ D

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Sex determination in birds: Birds use the ZZ–ZW system, the reverse of the mammalian XX–XY pattern.

Step 1 — Assign the sexes: In birds the male is ZZ (homogametic) and the female is ZW (heterogametic).

Step 2 — Interpret heterogamety: Because the female has two different sex chromosomes (Z and W), she produces two kinds of eggs and so the female determines the sex of the offspring.

Why other options are wrong:

- Option B reverses the sexes (that is the mammalian pattern).
- Option C (ZO) describes the grasshopper XX–XO system, not birds.
- Option D wrongly attributes sex to an autosome.

Final Answer: In birds the female is heterogametic (ZW), male homogametic (ZZ) $\Rightarrow$ A

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Griffith's transformation experiment: Griffith (1928) worked with two strains of *Streptococcus pneumoniae*: virulent S (smooth) and harmless R (rough).

Step 1 — Recall the key result: When live R cells were mixed with heat-killed S cells and injected, the mice died, and live S bacteria were recovered.

Step 2 — Interpret it: Some "transforming principle" from the dead S cells had changed the harmless R strain into the virulent S strain. This change is called transformation.

Why other options are wrong:

- Option A is wrong because heat-killed S cells alone did not kill the mice.
- Option C reverses the direction of the change.

- Option D is wrong; later work showed DNA, not protein, was the transforming material.

Final Answer: R was transformed into S by material from heat-killed S cells $\Rightarrow$ B

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Chromosomal disorders: Abnormal numbers of sex chromosomes cause specific syndromes.

Step 1 — Recall Klinefelter's karyotype: It results from an extra X chromosome, giving 47 chromosomes with the sex constitution XXY.

Step 2 — Note the features: The individual is phenotypically male but shows some feminine development (such as gynaecomastia) and is usually sterile.

Why other options are wrong:

- Option A (45, X / XO) is Turner's syndrome, a female.
- Option B (trisomy 21) is Down's syndrome.
- Option C (an inversion) is a structural change, not Klinefelter's.

Final Answer: Klinefelter's syndrome is 47, XXY $\Rightarrow$ D

Answer: (D) Go Back to Q30

Q31.

Solution

Concept — Origin of life experiment: S.L. Miller and H.C. Urey (1953) tested Oparin and Haldane's idea of chemical evolution.

Step 1 — Read the apparatus: Water vapour rose from a boiling flask into a chamber containing CH_4, NH_3 and H_2, where electric sparks simulated lightning; the products were then condensed and collected.

Step 2 — State the result: On analysis, the collected liquid contained simple organic molecules, including amino acids, formed from inorganic gases.

Why other options are wrong:

- Option B is wrong; no living cell was produced.
- Option C is wrong; the experiment did not replicate DNA.
- Option D refers to Lamarck's idea, unrelated to this experiment.

Final Answer: Miller–Urey showed the abiotic synthesis of organic molecules like amino acids $\Rightarrow$ A

Answer: (A) Go Back to Q31

Q32.

Solution

Concept — Filariasis: This is a chronic disease spread by mosquitoes (*Culex*).

Step 1 — Identify the parasite: Filariasis (elephantiasis) is caused by the filarial worms *Wuchereria bancrofti* (and *W. malayi*).

Step 2 — Note the effect: The worms live in and block the lymphatic vessels, causing gross swelling of the affected body part, often the legs.

Why other options are wrong:

- Option A (*Plasmodium*) causes malaria.
- Option B (*Entamoeba*) causes amoebiasis (amoebic dysentery).
- Option D (*Ascaris*) causes ascariasis, an intestinal roundworm infection.

Final Answer: Filariasis is caused by *Wuchereria bancrofti* $\Rightarrow$ C

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Microbes in cheese making: Different microbes give different cheeses their flavour and texture.

Step 1 — Identify the blue cheese microbe: The blue-green veins and the strong flavour of Roquefort (blue) cheese are produced by the fungus *Penicillium roqueforti*.

Step 2 — Recall how it works: The fungus grows through the curd as it ripens, producing the characteristic colour and taste.

Why other options are wrong:

- Option A (*Lactobacillus*) curdles milk into yoghurt/curd.
- Option C (*Saccharomyces*) is baker's/brewer's yeast.
- Option D (*Aspergillus niger*) is used to make citric acid.

Final Answer: Blue (Roquefort) cheese is ripened by *Penicillium roqueforti* $\Rightarrow$ B

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Spread of cancer: A malignant tumour is dangerous because its cells do not stay in one place.

Step 1 — Describe the behaviour: Cancer cells break away from the primary tumour and travel through the blood and lymph to other organs.

Step 2 — Name the property: The formation of new (secondary) tumours at distant sites in this way is called metastasis.

Why other options are wrong:

- Option A (point mutation) is a change in a single base of DNA, not the spread.
- Option B (apoptosis) is programmed cell death, which cancer cells often escape.
- Option C (contact inhibition) is a normal control that cancer cells lose.

Final Answer: The spread of cancer to distant sites is metastasis $\Rightarrow$ D

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Stages of a bioprocess: Industrial production has an upstream (preparation), a fermentation (biosynthetic) and a downstream stage.

Step 1 — Locate the stage: After the product has been formed by the cells in the bioreactor, it must be taken out of the broth.

Step 2 — Name it: The separation, purification and formulation of the finished product is together called downstream processing.

Why other options are wrong:

- Option B (upstream processing) is the preparation of media and inoculum, before the product is made.
- Option C (inoculation) is adding the microbe to the medium.
- Option D (sterilisation) is killing unwanted microbes, not purifying the product.

Final Answer: Post-fermentation separation and purification is downstream processing $\Rightarrow$ A

Answer: (A) Go Back to Q35

Q36.

Solution

Concept — ELISA: The Enzyme-Linked Immuno-Sorbent Assay is a sensitive method for detecting infections.

Step 1 — State the principle: It is based on the specific binding of an antigen to its antibody (antigen–antibody interaction).

Step 2 — Explain the readout: The antibody (or antigen) is linked to an enzyme; when its substrate is added, a colour develops, signalling that the matching antigen (or antibody) is present in the sample.

Why other options are wrong:

- Option A (DNA–DNA hybridisation) is the basis of molecular probes, not ELISA.
- Option B (gel electrophoresis) separates molecules by size.
- Option D (PCR) amplifies DNA; it is a different technique.

Final Answer: ELISA works on antigen–antibody interaction $\Rightarrow$ C

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Transgenic animals: These carry a foreign gene introduced deliberately to give a useful product or trait.

Step 1 — Recall Rosie: Rosie was the first transgenic cow, carrying a human gene expressed in her milk.

Step 2 — State the benefit: Her milk contained the human protein alpha-lactalbumin, making it more nutritionally balanced for human infants than ordinary cow's milk.

Why other options are wrong:

- Option A (more lactose) is not the purpose; the aim was a human nutritional protein.
- Option C (insulin) is produced in bacteria (Humulin), not in Rosie's milk.
- Option D (antibiotics) is not a feature of transgenic milk.

Final Answer: Rosie's milk was enriched with human alpha-lactalbumin $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Population interactions: Parasitism is a $(+/-)$ interaction where one species benefits at the cost of another.

Step 1 — Analyse the example: The cuckoo gains because the crow incubates and feeds its young, while the crow loses, as it spends effort on chicks that are not its own.

Step 2 — Classify it: Laying eggs in another bird's nest to be reared by it is a special form of parasitism called brood parasitism.

Why other options are wrong:

- Option A (mutualism) needs both partners to benefit.
- Option B (commensalism) needs one to benefit and the other to be unaffected.
- Option C (predation) involves one animal killing and eating another.

Final Answer: The cuckoo–crow relationship is brood parasitism $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept — Primary succession: This is the gradual development of a community on a previously lifeless area, such as bare rock.

Step 1 — Identify the pioneers: The first organisms (pioneer community) to colonise bare rock are usually lichens, which can survive harsh, dry conditions.

Step 2 — Trace the sequence: Lichens secrete acids that weather the rock, helping soil to form; this allows mosses, then herbs, shrubs and finally trees (the climax forest) to follow.

Why other options are wrong:

- Options B and C (trees, shrubs) appear only in the later stages, after soil has formed.
- Option D (grasses) come after the early lichen and moss stages, not first.

Final Answer: The pioneers of primary succession on bare rock are lichens $\Rightarrow$ A

Answer: (A) Go Back to Q39

Q40.

Solution

Concept — Greenhouse gases: Certain gases trap outgoing heat (infrared) radiation and warm the Earth, causing global warming.

Step 1 — List the main greenhouse gases: The chief ones are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and water vapour (also CFCs).

Step 2 — Test the options: Only option C contains gases that are all greenhouse gases.

Why other options are wrong:

- Options A and B include O_2, N_2 and argon, which are not greenhouse gases.
- Option D lists SO_2, NO_2 and CO, which are pollutants linked mainly to acid rain and smog, not the standard greenhouse group.

Final Answer: CO_2, CH_4, N_2O and water vapour are all greenhouse gases $\Rightarrow$ C

Answer: (C) Go Back to Q40

Answer Key

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