KIITEE Biology Sample Paper – 2

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. According to the rules of binomial nomenclature laid down by the ICBN, which of the following is followed when writing a scientific name?

(A) Both the genus name and the species epithet begin with capital letters

(B) The genus name begins with a capital letter and the species epithet with a small letter, and both are printed in italics

(C) The species epithet is written first, followed by the genus name

(D) The name is written in bold and is never underlined when handwritten

Q2. Among archaebacteria, those found in marshy areas and in the gut of ruminant animals, where they produce methane from organic substrates, are the:

(A) Extreme halophiles

(B) Thermoacidophiles

(C) Methanogens

(D) Heliobacteria

Q3. In sponges (Phylum Porifera), water enters through minute pores (ostia) and circulates through a network of chambers that helps in food gathering and respiration. This arrangement is called the:

(A) Canal (water-current) system

(B) Water vascular system

(C) Tracheal system

(D) Haversian system

Q4. The meristem located at the base of leaves or internodes, as in grasses, which helps the cut grass regrow rapidly, is the:

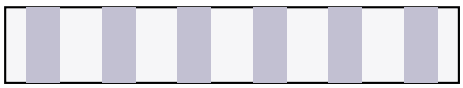
(A) Apical meristem

(B) Lateral meristem

(C) Secondary meristem

(D) Intercalary meristem

Q5. The muscle fibre shown below, with its regularly repeating dark and light bands, is attached to bones and is under voluntary control. Which set of features correctly describes it?



striated muscle fibre (dark and light bands)

(A) Spindle-shaped, uninucleate and involuntary

(B) Branched, uninucleate, with intercalated discs

(C) Cylindrical, multinucleate, with alternating dark and light bands, voluntary

(D) Unstriated and located in the walls of blood vessels

Q6. When the ovules are attached to a central axis in a multilocular (multi-chambered) ovary, as in tomato and lemon, the type of placentation is:

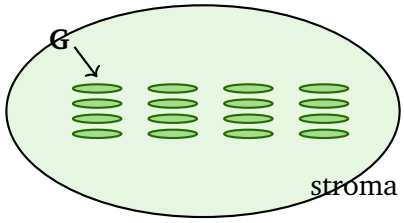
(A) Axile

(B) Parietal

(C) Marginal

(D) Free central

Q7. In the chloroplast shown, the stacked coin-like structures labelled **G**, which contain chlorophyll and carry out the light reaction of photosynthesis, are the:



(A) Stroma lamellae

(B) Grana

(C) Cristae

(D) Plastoglobuli

Q8. The local coiling of a polypeptide chain into an α-helix or its folding into a β-pleated sheet, stabilised by hydrogen bonds, represents which level of protein structure?

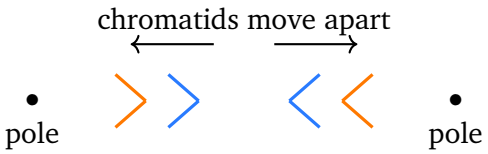
(A) Primary structure

(B) Tertiary structure

(C) Quaternary structure

(D) Secondary structure

Q9. The stage of mitosis represented below, in which the centromeres split and the sister chromatids are pulled apart towards opposite poles of the spindle, is:



(A) Anaphase

(B) Metaphase

(C) Prophase

(D) Telophase

Q10. The cell theory, stating that all living organisms are composed of cells and that new cells arise from pre-existing cells, was given and later completed by:

(A) Robert Hooke alone

(B) Robert Brown and Purkinje

(C) Schleiden and Schwann, with the addition by Rudolf Virchow

(D) Watson and Crick

Q11. During osmosis, water always moves from a region of higher water potential to one of lower water potential. The water potential of pure water at standard temperature and pressure is taken as:

(A) Always a large positive value

(B) Zero, and it becomes negative when a solute is added

(C) Always greater than that of any solution

(D) Equal to the surrounding atmospheric pressure

Q12. Nitrogen is a major macronutrient absorbed by plants. Its deficiency is most directly recognised by:

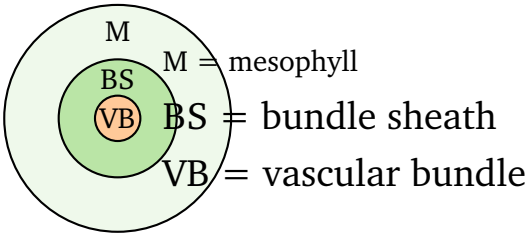
(A) Death of the stem tip only

(B) Excess accumulation of starch in the roots

(C) Deep dark-green colouration of the young leaves

(D) Chlorosis (yellowing) starting in the older leaves, with stunted growth

Q13. The leaf cross-section below shows Kranz anatomy of a C_4 plant, with a wreath of bundle-sheath cells (BS) around the vascular bundle (VB) and mesophyll (M) outside. In such plants the first fixation of CO_2 into the 4-carbon acid oxaloacetate occurs in the:



(A) Bundle-sheath cells

(B) Guard cells

(C) Mesophyll cells

(D) Epidermal cells

Q14. One complete turn of the Krebs (citric acid) cycle, which oxidises a single molecule of acetyl-CoA, directly yields:

(A) 3 NADH, 1 $FADH_2$, 1 GTP and 2 CO_2

(B) 2 NADH, 2 $FADH_2$ and 1 ATP

(C) 4 NADH, 1 $FADH_2$ and 3 CO_2

(D) 1 NADH, 1 $FADH_2$ and 4 CO_2

Q15. Salivary amylase (ptyalin), present in human saliva, begins the digestion of starch in the mouth, breaking it down chiefly into the disaccharide:

(A) Glucose directly

(B) Maltose

(C) Amino acids

(D) Fatty acids and glycerol

Q16. The volume of air inspired or expired during a single normal, quiet breath, amounting to about 500 mL in a healthy adult, is termed the:

(A) Vital capacity

(B) Residual volume

(C) Inspiratory reserve volume

(D) Tidal volume

Q17. A person belonging to blood group AB, who is the universal recipient, characteristically has:

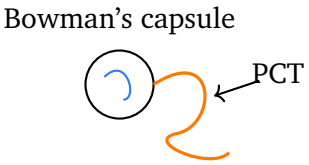
(A) Both A and B antigens on the red cells and no anti-A or anti-B antibodies in the plasma

(B) Neither A nor B antigen, but both anti-A and anti-B antibodies

(C) Only the A antigen and the anti-B antibody

(D) Only the B antigen and the anti-A antibody

Q18. In the nephron diagram below, the coiled segment marked **PCT** (proximal convoluted tubule), lined by brush-bordered cells, reabsorbs:



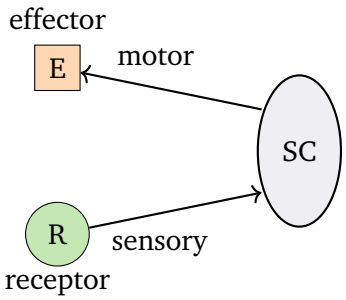
(A) Urea and creatinine selectively back into the blood

(B) Only the excess potassium ions

(C) Nearly all of the glucose and amino acids, along with most of the water and salts

(D) Nothing; it only secretes wastes into the filtrate

Q19. In the reflex arc shown, a stimulus at the receptor (R) produces an automatic response at the effector (E) through the spinal cord (SC). The impulse travels from the receptor to the spinal cord along the:



(A) Efferent (motor) neuron

(B) Afferent (sensory) neuron

(C) Effector muscle fibre

(D) Interneuron of the cerebrum

Q20. Visible enlargement of the thyroid gland, known as simple (endemic) goitre, in adults is most commonly caused by a dietary deficiency of:

(A) Iron

(B) Calcium

(C) Vitamin C

(D) Iodine

Q21. Which of the following is a synovial (freely movable) joint that permits movement in almost all planes?

(A) The ball-and-socket joint at the shoulder

(B) The fibrous suture joint between skull bones

(C) The cartilaginous joint between adjacent vertebrae

(D) The hinge joint, which permits free rotation in all directions

Q22. The process by which haploid microspores (pollen grains) are formed from a diploid microspore mother cell through meiosis, inside the anther, is called:

(A) Megasporogenesis

(B) Microgametogenesis

(C) Microsporogenesis

(D) Sporophytic budding

Q23. During spermatogenesis in the testis, a diploid primary spermatocyte gives rise to haploid secondary spermatocytes by undergoing:

(A) A mitotic division

(B) Amitosis

(C) Binary fission

(D) The first meiotic (reductional) division

Q24. In a regular 28-day human menstrual cycle, ovulation (release of the secondary oocyte from the ovary) normally takes place around:

(A) The 1st day

(B) The 14th day

(C) The 21st day

(D) The 28th day

Q25. In the assisted reproductive technique of in-vitro fertilisation (IVF), popularly called the test-tube baby programme, fertilisation is carried out:

(A) Outside the body in laboratory glassware, after which the early embryo is transferred to the uterus

(B) Inside the fallopian tube by directly injecting sperm into it

(C) Inside the uterus following natural mating

(D) By transferring a mature ovum back into the ovary

Q26. The Punnett square below shows a monohybrid cross between two heterozygous tall pea plants (Tt $\times$ Tt). This cross illustrates Mendel's law of segregation, which states that:

	T	t
T	TT	Tt
t	Tt	tt

(A) Alleles of two different genes assort independently of each other

(B) One of the two alleles disappears permanently in the offspring

(C) The two alleles of a gene separate during gamete formation, each gamete receiving only one allele

(D) Both alleles of a gene always pass together into the same gamete

Q27. In the four-o'clock plant (*Mirabilis jalapa*), the F_1 heterozygotes (Rr) self-pollinate to give the F_2 shown. A cross between red (RR) and white (rr) gives pink (Rr) flowers because:

	R	r
R	RR	Rr
r	Rr	rr

RR = red
Rr = pink
rr = white

(A) Red is completely dominant over white

(B) Neither allele is completely dominant, so the heterozygote (Rr) shows an intermediate pink colour

(C) The white allele is lost during fertilisation

(D) Pink is produced by a separate third allele

Q28. The inheritance of the human ABO blood group illustrates codominance because:

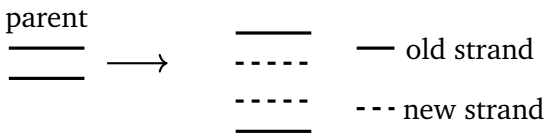
(A) The allele i is dominant over both I^A and I^B

(B) Only one of the two alleles is expressed in the heterozygote

(C) The gene has only two alleles in the population

(D) In group AB, both the I^A and the I^B alleles are fully and equally expressed together

Q29. The classic experiment of Meselson and Stahl, using ^{15}N and ^{14}N labelling, demonstrated that DNA replication follows the scheme shown below, in which each daughter molecule has one old (parental) strand and one newly made strand. This mode of replication is described as:



(A) Semiconservative

(B) Conservative

(C) Dispersive

(D) Template-independent

Q30. Haemophilia is an X-linked recessive disorder. If a carrier mother (X^HX^h) marries a normal man (X^HY), the expected outcome among their children is:

(A) All of the sons are haemophilic

(B) All of the daughters are haemophilic

(C) About half of the sons are haemophilic, while the daughters are phenotypically normal

(D) Only the daughters are affected and never the sons

Q31. Which of the following statements expresses Lamarck's theory of evolution rather than Darwin's?

(A) Variations arise randomly and natural selection acts upon them

(B) Characters acquired by an individual during its lifetime are passed on to its offspring

(C) The individuals best fitted to the environment survive and reproduce more

(D) Evolution proceeds through differential reproductive success

Q32. Typhoid fever in humans, often confirmed by the Widal test, is caused by the bacterium:

(A) *Vibrio cholerae*

(B) *Mycobacterium tuberculosis*

(C) *Plasmodium vivax*

(D) *Salmonella typhi*

Q33. Biogas, a fuel rich in methane, is generated from cattle dung (gobar) and sewage sludge mainly through the activity of:

(A) Methanogenic (methane-producing) archaebacteria

(B) Lactic acid bacteria

(C) Nitrifying bacteria

(D) Baker's yeast (*Saccharomyces*)

Q34. Which of the following is an example of passively acquired immunity?

(A) Antibodies generated in the body after recovering from chickenpox

(B) Immunity developed after vaccination with a killed microbe

(C) Ready-made antibodies received by a foetus from the mother across the placenta

(D) Memory cells formed following a natural infection

Q35. In recombinant DNA technology, the enzyme that joins together two DNA fragments by sealing the breaks in the sugar-phosphate backbone is:

(A) A restriction endonuclease

(B) DNA ligase

(C) DNA helicase

(D) RNA polymerase

Q36. The polymerase chain reaction (PCR) repeatedly copies a DNA segment using a heat-stable enzyme that survives the high denaturation temperature. This enzyme is:

(A) DNA ligase

(B) Reverse transcriptase

(C) A restriction enzyme

(D) Taq DNA polymerase

Q37. Humulin, the first recombinant human insulin approved for diabetics, was produced commercially by:

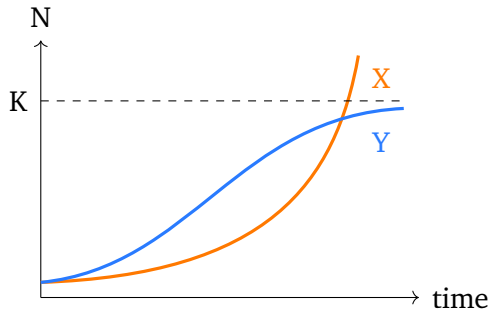
(A) Expressing the genes for the A and B polypeptide chains separately in *E. coli*, then joining the chains by disulphide bonds

(B) Extracting it directly from the pancreas of slaughtered cattle and pigs

(C) Culturing whole human pancreatic cells in a fermenter

(D) Chemically synthesising the entire hormone without using any microbe

Q38. In the population-growth graph below, curve **X** is J-shaped (exponential) and curve **Y** is S-shaped (sigmoid/logistic). The logistic curve **Y** eventually levels off because:



(A) Food and space remain unlimited throughout

(B) Resources become limiting, so the population reaches the carrying capacity (K) of the habitat

(C) The birth (natality) rate keeps rising without any limit

(D) There is no environmental resistance acting on the population

Q39. In the carbon cycle, atmospheric carbon dioxide is withdrawn from the air and fixed into organic compounds chiefly by the process of:

(A) Respiration

(B) Combustion of fossil fuels

(C) Photosynthesis

(D) Decomposition of dead matter

Q40. Which of the following is recognised as a biodiversity hotspot lying within India?

(A) The Thar Desert

(B) The Gangetic plains

(C) The deserts of Rajasthan

(D) The Western Ghats and Sri Lanka region

Detailed Solutions

Q1.

Solution

Concept — Binomial nomenclature: Carolus Linnaeus introduced the two-word naming system, and the rules are codified by the International Code (ICBN for plants).

Step 1 — Recall the two parts: A scientific name has two components, the generic name (genus) written first and the specific epithet (species) written second.

Step 2 — Apply the writing rules: The genus name always begins with a capital letter, the specific epithet always begins with a small letter, and the whole name is printed in italics (or underlined separately when handwritten).

Why other options are wrong:

- Option A is wrong because the species epithet must start with a small letter, not a capital.
- Option C is wrong because the genus name is written first, not the species epithet.
- Option D is wrong because the name is italicised in print and underlined separately when handwritten.

Final Answer: Genus capital, species small, both italicised $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Archaebacteria: Archaebacteria live in extreme habitats and include halophiles, thermoacidophiles and methanogens.

Step 1 — Identify the habitat described: The question mentions marshy areas and the gut of ruminants, where organic matter is broken down without oxygen.

Step 2 — Match to the group: The archaebacteria that produce methane (CH_4) from such substrates are the methanogens; they are responsible for biogas and gobar gas.

Why other options are wrong:

- Option A (halophiles) live in extremely salty waters.
- Option B (thermoacidophiles) live in hot, acidic springs.
- Option D (heliobacteria) are photosynthetic eubacteria, not the methane producers described.

Final Answer: Methane-producing archaebacteria are methanogens $\Rightarrow$ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Porifera: Sponges are the simplest multicellular animals, with a unique system of pores and channels for water movement.

Step 1 — Trace the water path: Water enters through tiny pores (ostia), passes through chambers lined by collar cells (choanocytes), and leaves through a large opening (osculum).

Step 2 — Name the system: This network that helps in food gathering, respiration and waste removal is called the canal (water-current) system, a defining feature of Porifera.

Why other options are wrong:

- Option B (water vascular system) belongs to echinoderms, not sponges.
- Option C (tracheal system) is the air-tube breathing system of insects.
- Option D (Haversian system) is a microscopic unit of bone in vertebrates.

Final Answer: The pore-and-channel system of sponges is the canal system $\Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Meristematic tissues: Meristems are classed by position as apical (tip), intercalary (base of internodes/leaves) and lateral (sides).

Step 1 — Locate the meristem described: The meristem at the base of leaves or internodes, as in grasses, is the intercalary meristem.

Step 2 — Relate to function: It allows the plant to regrow length quickly after grazing or mowing, which is why grass regrows after cutting.

Why other options are wrong:

- Option A (apical meristem) lies at the tips of root and shoot.
- Option B (lateral meristem) increases girth, not length.
- Option C (secondary meristem) is a general term for cambia, not the basal position described.

Final Answer: The meristem at the base of internodes is intercalary $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Muscle types: The three muscle types are striated (skeletal), smooth (unstriated) and cardiac, each with distinct structure.

Step 1 — Read the diagram: The fibre shows regularly repeating dark and light bands (striations), the hallmark of skeletal muscle.

Step 2 — List its features: Skeletal muscle fibres are long and cylindrical, multinucleate, show alternating dark (A) and light (I) bands, and are under voluntary (conscious) control.

Why other options are wrong:

- Option A describes smooth muscle (spindle-shaped, uninucleate, involuntary).
- Option B describes cardiac muscle (branched, with intercalated discs).
- Option D describes smooth muscle of blood-vessel walls, which lacks striations.

Final Answer: Cylindrical, multinucleate, striated and voluntary $\Rightarrow$ C

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Placentation: Placentation is the arrangement of ovules on the placenta within the ovary; common types are marginal, axile, parietal, free-central and basal.

Step 1 — Note the ovary structure: The ovary is multilocular (has several chambers) and the ovules are attached to a central axis.

Step 2 — Identify the type: When ovules are borne on a central axis in a multilocular ovary, the placentation is axile, as seen in tomato, lemon and china rose.

Why other options are wrong:

- Option B (parietal) has ovules on the inner ovary wall in a unilocular ovary.
- Option C (marginal) has ovules along one margin, as in pea.
- Option D (free-central) has ovules on a central axis but without septa (no chambers).

Final Answer: Ovules on a central axis in a multilocular ovary is axile placentation $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Chloroplast structure: The chloroplast has a fluid stroma in which flattened sacs called thylakoids are stacked into coin-pile structures.

Step 1 — Read the diagram: The structure labelled G is a stack of disc-like thylakoids resembling a pile of coins.

Step 2 — Name and link to function: Such a stack is a granum (plural grana); the chlorophyll in the thylakoid membranes here carries out the light reaction of photosynthesis.

Why other options are wrong:

- Option A (stroma lamellae) are the unstacked membranes connecting grana, not the stacks themselves.
- Option C (cristae) are infoldings of the mitochondrial inner membrane, not of the chloroplast.
- Option D (plastoglobuli) are small lipid droplets in the stroma, not the

stacked discs.

Final Answer: The coin-pile stacks of thylakoids are the grana $\Rightarrow$ B

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Levels of protein structure: Protein structure is described at four levels: primary, secondary, tertiary and quaternary.

Step 1 — Define each level briefly: Primary is the amino-acid sequence; secondary is local folding such as the α-helix and β-pleated sheet; tertiary is the overall 3-D shape; quaternary is the assembly of several chains.

Step 2 — Match the description: The α-helix and β-pleated sheet, held by hydrogen bonds, are features of the secondary structure.

Why other options are wrong:

- Option A (primary) is just the linear order of amino acids.
- Option B (tertiary) is the complete folded 3-D shape of one chain.
- Option C (quaternary) is the joining of two or more polypeptide subunits.

Final Answer: The α-helix and β-sheet represent the secondary structure $\Rightarrow$ D

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Mitosis stages: Mitosis proceeds through prophase, metaphase, anaphase and telophase.

Step 1 — Read the diagram: The figure shows the two centromeres split and the sister chromatids moving away from the centre towards the two opposite poles.

Step 2 — Identify the stage: The separation of sister chromatids and their movement to opposite poles is the defining event of anaphase.

Why other options are wrong:

- Option B (metaphase): chromosomes are lined up at the equator, not yet separated.

- Option C (prophase): chromosomes are condensing and the spindle is forming.
- Option D (telophase): chromosomes have reached the poles and nuclei are reforming.

Final Answer: Splitting and poleward movement of chromatids is anaphase $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Cell theory: The cell theory developed through the contributions of several biologists in the nineteenth century.

Step 1 — The original proposers: Matthias Schleiden (1838) said all plants are made of cells, and Theodor Schwann (1839) said all animals are made of cells; together they proposed the cell theory.

Step 2 — The key addition: Rudolf Virchow (1855) added the idea "omnis cellula e cellula", that new cells arise only from pre-existing cells, completing the theory.

Why other options are wrong:

- Option A (Robert Hooke) only first observed and named dead cork "cells".
- Option B (Brown, Purkinje) described the nucleus and protoplasm but did not frame the theory.
- Option D (Watson and Crick) gave the structure of DNA, unrelated to the cell theory.

Final Answer: Schleiden and Schwann, completed by Virchow $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Water potential: Water potential (Ψ) measures the free energy of water and decides the direction of water movement.

Step 1 — Take the reference: By convention, the water potential of pure water at standard temperature and pressure is set at zero.

Step 2 — Effect of adding solute: Dissolving a solute lowers the free energy of water, so the solution's water potential becomes negative; water then moves into it by osmosis.

Why other options are wrong:

- Option A is wrong because pure water is taken as zero, not a large positive value.
- Option C is wrong because some solutions can have higher potential than another more concentrated solution.
- Option D is wrong because water potential is not simply equal to atmospheric pressure.

Final Answer: Pure water has $\Psi = 0$, becoming negative on adding solute $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Mineral deficiency: Nitrogen is a macronutrient needed for proteins, nucleic acids and chlorophyll; it is mobile within the plant.

Step 1 — Predict the symptom: Because nitrogen is part of chlorophyll, its shortage causes yellowing (chlorosis) and reduced growth.

Step 2 — Note where it appears first: Since nitrogen is a mobile element, it is shifted from old to young leaves, so the deficiency symptoms appear first in the older (lower) leaves.

Why other options are wrong:

- Option A (death of stem tip) is typical of deficiency of immobile elements like calcium or boron.
- Option B (starch accumulation in roots) is not a recognised nitrogen-deficiency symptom.

- Option C is the opposite of the truth; deficiency causes pale, not dark green, leaves.

Final Answer: Nitrogen deficiency shows chlorosis of older leaves and stunting $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — C_4 pathway and Kranz anatomy: C_4 plants split CO_2 fixation between two cell types arranged in a wreath (Kranz) pattern.

Step 1 — Read the diagram: Mesophyll cells (M) lie outside, surrounding a ring of bundle-sheath cells (BS) that enclose the vascular bundle (VB).

Step 2 — Locate the first fixation: The enzyme PEP carboxylase in the mesophyll cells fixes CO_2 into the 4-carbon acid oxaloacetate; the 4-carbon acid is later decarboxylated in the bundle sheath for the Calvin cycle.

Why other options are wrong:

- Option A (bundle-sheath cells) is where the Calvin cycle runs, not the first 4-carbon fixation.
- Option B (guard cells) regulate stomata and are not the fixation site.
- Option D (epidermal cells) are protective and lack the C_4 machinery.

Final Answer: Primary CO_2 fixation into oxaloacetate occurs in mesophyll cells $\Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Krebs cycle yield: Each acetyl-CoA entering the citric acid cycle is fully oxidised, releasing reduced coenzymes and CO_2.

Step 1 — Count the reduced coenzymes: One turn produces 3 NADH (at isocitrate, α-ketoglutarate and malate steps) and 1 $FADH_2$ (at the succinate step).

Step 2 — Count direct ATP and carbon loss: It also makes 1 GTP (equivalent to 1 ATP) by substrate-level phosphorylation and releases 2 CO_2.

Why other options are wrong:

- Option B understates NADH (only 2) and overstates $FADH_2$.
- Option C gives 4 NADH and 3 CO_2, which is incorrect for one turn.
- Option D gives only 1 NADH and 4 CO_2, which is far too low and too high respectively.

Final Answer: One turn yields 3 NADH, 1 $FADH_2$, 1 GTP and 2 CO_2 $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Carbohydrate digestion: Starch digestion begins in the mouth by the action of salivary amylase (ptyalin).

Step 1 — Identify the substrate and product: Amylase hydrolyses the bonds in starch, breaking it into shorter chains and finally into the disaccharide maltose.

Step 2 — Note where it stops: About 30% of starch is converted to maltose in the mouth; further breakdown to glucose occurs later in the small intestine.

Why other options are wrong:

- Option A (glucose directly) is wrong; that needs the intestinal enzyme maltase.
- Option C (amino acids) come from protein digestion, not starch.
- Option D (fatty acids and glycerol) come from fat digestion.

Final Answer: Salivary amylase converts starch chiefly to maltose $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Respiratory volumes: The lungs handle several measurable air volumes; the basic one is the air of a normal breath.

Step 1 — Match the description: The air inhaled or exhaled in one normal quiet breath, about 500 mL, is the tidal volume.

Step 2 — Contrast with others: Vital capacity is the maximum that can be ex-

changed; residual volume is the air left after forced expiration.

Why other options are wrong:

- Option A (vital capacity) is much larger (around 3500–4500 mL).
- Option B (residual volume) is the air that always remains in the lungs (around 1200 mL).
- Option C (inspiratory reserve volume) is the extra air inhaled with a forced breath.

Final Answer: The 500 mL of normal breathing is the tidal volume $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — ABO blood group system: Blood group depends on the antigens on the red cells and the antibodies in the plasma.

Step 1 — Antigens of group AB: Group AB red cells carry both the A antigen and the B antigen on their surface.

Step 2 — Antibodies of group AB: Because both antigens are present, the plasma carries neither anti-A nor anti-B antibody, which is why AB is the universal recipient.

Why other options are wrong:

- Option B describes group O (no antigen, both antibodies).
- Option C describes group A (A antigen, anti-B antibody).
- Option D describes group B (B antigen, anti-A antibody).

Final Answer: Group AB has both antigens and no antibodies $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Proximal convoluted tubule: The PCT is the first coiled segment after Bowman's capsule and is the main site of reabsorption.

Step 1 — Read the diagram: The brush-bordered coiled tubule (PCT) follows the glomerular capsule and has a very large surface area.

Step 2 — State what it reabsorbs: The PCT reabsorbs nearly 100% of glucose and amino acids, together with about 70–80% of the filtered water, sodium and other useful salts, back into the blood.

Why other options are wrong:

- Option A is wrong; urea and creatinine are largely excreted, not selectively reabsorbed here.
- Option B is wrong; the PCT reabsorbs far more than just potassium.
- Option D is wrong; the PCT both reabsorbs and secretes, it is not purely secretory.

Final Answer: The PCT reabsorbs all glucose/amino acids and most water and salts $\Rightarrow$ C

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Reflex arc: A spinal reflex follows the path receptor $\rightarrow$ afferent neuron $\rightarrow$ spinal cord $\rightarrow$ efferent neuron $\rightarrow$ effector.

Step 1 — Read the diagram: The arrow from the receptor (R) to the spinal cord (SC) is labelled "sensory".

Step 2 — Name the neuron: The neuron carrying impulses from the receptor into the spinal cord is the afferent (sensory) neuron; the motor neuron then carries the response out to the effector.

Why other options are wrong:

- Option A (efferent/motor neuron) carries the impulse away from the spinal cord to the effector.
- Option C (effector muscle) is the responding organ, not a conducting pathway.

- Option D (interneuron of the cerebrum) is wrong; a spinal reflex does not need the cerebrum.

Final Answer: Receptor to spinal cord is carried by the afferent (sensory) neuron $\Rightarrow$ B

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Thyroid and iodine: The thyroid gland uses iodine to make the hormone thyroxine (T_4).

Step 1 — Trace the cause: When dietary iodine is too low, the gland cannot make enough thyroxine.

Step 2 — Explain the enlargement: Low thyroxine triggers extra TSH from the pituitary, which makes the gland enlarge in an attempt to trap more iodine, producing a visible goitre.

Why other options are wrong:

- Option A (iron) deficiency causes anaemia, not goitre.
- Option B (calcium) deficiency affects bones and clotting.
- Option C (vitamin C) deficiency causes scurvy.

Final Answer: Simple goitre is caused by iodine deficiency $\Rightarrow$ D

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Joints: Joints are fibrous (immovable), cartilaginous (slightly movable) or synovial (freely movable).

Step 1 — Identify the freely movable type: Synovial joints have a fluid-filled cavity that allows free movement; the ball-and-socket type permits movement in all planes.

Step 2 — Give the example: The shoulder joint, where the head of the humerus fits into the glenoid cavity, is a ball-and-socket synovial joint.

Why other options are wrong:

- Option B (skull sutures) are fibrous, immovable joints.
- Option C (between vertebrae) are cartilaginous, only slightly movable.
- Option D is self-contradictory; a hinge joint allows movement in only one plane, not all directions.

Final Answer: The shoulder ball-and-socket joint is a freely movable synovial joint $\Rightarrow$ A

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Pollen formation: Inside the anther, special diploid cells undergo meiosis to form pollen.

Step 1 — Identify the cells: The diploid microspore mother cells (pollen mother cells) in the microsporangium divide by meiosis.

Step 2 — Name the process: The formation of haploid microspores (which mature into pollen grains) from these mother cells is called microsporogenesis.

Why other options are wrong:

- Option A (megasporogenesis) is the formation of megaspores in the ovule.
- Option B (microgametogenesis) is the later development of the pollen into male gametes.
- Option D (sporophytic budding) is not a real term for this process.

Final Answer: Formation of microspores from the mother cell is microsporogenesis $\Rightarrow$ C

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Spermatogenesis: Sperm formation involves a reduction in chromosome number from diploid to haploid.

Step 1 — Trace the cells: A diploid primary spermatocyte (2n) is the cell that must halve its chromosome number.

Step 2 — Name the division: It does so by the first meiotic (reductional) division,

producing two haploid secondary spermatocytes; meiosis II then gives spermatids.

Why other options are wrong:

- Option A (mitosis) keeps the chromosome number the same and cannot make haploid cells.
- Option B (amitosis) is direct division seen in some lower organisms, not in spermatogenesis.
- Option C (binary fission) is asexual division of single-celled organisms.

Final Answer: Primary spermatocyte forms secondary spermatocytes by meiosis I $\Rightarrow$ D

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Menstrual cycle: The 28-day cycle has menstrual, follicular (proliferative), ovulatory and luteal (secretory) phases.

Step 1 — Locate ovulation: The mid-cycle surge of LH triggers the release of the secondary oocyte.

Step 2 — State the day: In a 28-day cycle this ovulation occurs around the 14th day.

Why other options are wrong:

- Option A (day 1) marks the start of menstruation, not ovulation.
- Option C (day 21) falls in the luteal phase, after ovulation.
- Option D (day 28) is the end of the cycle, just before the next period.

Final Answer: Ovulation in a 28-day cycle occurs around day 14 $\Rightarrow$ B

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — IVF: In-vitro fertilisation means fertilisation "in glass", performed outside the body.

Step 1 — Describe the procedure: Ova and sperm are collected and brought together in the laboratory, where fertilisation takes place outside the body.

Step 2 — Transfer step: The resulting early embryo (zygote or blastomere stage) is then transferred into the fallopian tube (ZIFT) or uterus (IUT) to continue development.

Why other options are wrong:

- Option B describes intra-fallopian injection, which is not IVF.
- Option C describes normal in-body conception, not IVF.
- Option D is biologically meaningless; an ovum is not returned to the ovary.

Final Answer: IVF fertilises outside the body, then transfers the embryo $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Law of segregation: Mendel's first law concerns how the two alleles of a single gene behave during gamete formation.

Step 1 — Read the cross: In Tt $\times$ Tt, each parent is heterozygous and produces two kinds of gametes, T and t, in equal numbers.

Step 2 — State the law: The two alleles of a gene separate (segregate) during gamete formation so that each gamete receives only one allele of the pair; this gives the 1 TT : 2 Tt : 1 tt genotype ratio.

Why other options are wrong:

- Option A states the law of independent assortment, which concerns two different genes.
- Option B is wrong; the recessive allele is hidden in F_1 but reappears, it does not disappear.
- Option D is the opposite of segregation; alleles do not both enter one gamete.

Final Answer: Alleles separate so each gamete carries only one $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — Incomplete dominance: Sometimes neither allele is fully dominant and the heterozygote shows a blended, intermediate phenotype.

Step 1 — Read the cross: Red (RR) $\times$ white (rr) gives F_1 that are all pink (Rr), an intermediate of the two.

Step 2 — Explain the F_2: Selfing the pink Rr gives 1 red (RR) : 2 pink (Rr) : 1 white (rr); the phenotype ratio equals the genotype ratio, the signature of incomplete dominance.

Why other options are wrong:

- Option A is wrong; if red were completely dominant, the heterozygote would be red, not pink.
- Option C is wrong; the white allele is not lost, since white reappears in F_2.
- Option D is wrong; only two alleles are involved, with no third allele needed.

Final Answer: The intermediate pink arises because neither allele is fully dominant $\Rightarrow$ B

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Codominance: In codominance both alleles of a heterozygote are expressed fully and independently, not blended.

Step 1 — Look at group AB: A person of group AB has the genotype I^AI^B.

Step 2 — See the expression: Both the I^A allele (A antigen) and the I^B allele (B antigen) are produced together on the red cells, so neither masks the other; this is codominance (with multiple alleles I^A, I^B, i).

Why other options are wrong:

- Option A is wrong; i is recessive to both I^A and I^B.
- Option B describes simple dominance, not codominance.
- Option C is wrong; the gene has three alleles (multiple allelism), not two.

Final Answer: In AB both I^A and I^B are fully expressed, showing codominance $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Mode of DNA replication: Replication could in principle be conservative, semiconservative or dispersive; Meselson and Stahl settled the question.

Step 1 — Read the diagram: The parent helix unwinds, and each daughter molecule is built from one old strand (solid) paired with one new strand (dashed).

Step 2 — Name the mode: Because each daughter conserves one parental strand and makes one fresh strand, replication is semiconservative, exactly as the $^{15}N/^{14}N$ experiment proved.

Why other options are wrong:

- Option B (conservative) would keep the whole parent helix intact and make a wholly new one.
- Option C (dispersive) would mix old and new pieces along each strand.
- Option D (template-independent) is wrong; replication strictly uses the parent strand as template.

Final Answer: One old plus one new strand per daughter means semiconservative $\Rightarrow$ A

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — X-linked recessive inheritance: Haemophilia is carried on the X chromosome; males (XY) need only one defective allele to be affected.

Step 1 — Write the cross: Carrier mother X^HX^h $\times$ normal father X^HY.

Step 2 — Work out the children: Daughters are X^HX^H or X^HX^h, so all are phenotypically normal (half are carriers); sons are X^HY (normal) or X^hY (haemophilic), so about half the sons are haemophilic.

Why other options are wrong:

- Option A is wrong; only half, not all, of the sons are affected.
- Option B is wrong; daughters here cannot be haemophilic since the father is normal.
- Option D is wrong; sons clearly can be affected in this cross.

Final Answer: Half the sons are haemophilic and daughters are normal $\Rightarrow$ C

Answer: (C) Go Back to Q30

Q31.

Solution

Concept — Lamarck vs Darwin: Lamarck stressed use/disuse and inheritance of acquired characters; Darwin stressed variation and natural selection.

Step 1 — Recall Lamarck's central idea: Lamarck held that traits an organism develops during its life (through use or disuse) are passed on to its offspring.

Step 2 — Match the statement: The statement about acquired characters being inherited is purely Lamarckian, not Darwinian.

Why other options are wrong:

- Option A (random variation acted on by selection) is Darwin's view.
- Option C (survival and greater reproduction of the fittest) is Darwin's view.
- Option D (differential reproductive success) is Darwin's view.

Final Answer: Inheritance of acquired characters is Lamarck's idea $\Rightarrow$ B

Answer: (B) Go Back to Q31

Q32.

Solution

Concept — Typhoid: Typhoid is a bacterial disease spread through contaminated food and water.

Step 1 — Identify the pathogen: The causative bacterium is *Salmonella typhi*, which infects the intestine and may spread to other organs.

Step 2 — Note the diagnosis: A sustained high fever with the Widal test turning positive confirms the infection.

Why other options are wrong:

- Option A (*Vibrio cholerae*) causes cholera.
- Option B (*Mycobacterium tuberculosis*) causes tuberculosis.
- Option C (*Plasmodium vivax*) is a protozoan causing malaria, not a bacterium.

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

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Biogas: Biogas is a mixture rich in methane, produced by microbial breakdown of organic waste without oxygen.

Step 1 — Identify the microbes: The key organisms are methanogenic archaebacteria (methanogens) such as *Methanobacterium*.

Step 2 — Describe the action: They act anaerobically on the slurry of cattle dung and sewage, releasing methane (the chief fuel gas).

Why other options are wrong:

- Option B (lactic acid bacteria) make curd, not biogas.
- Option C (nitrifying bacteria) convert ammonia to nitrate in the soil.
- Option D (yeast) is used in baking and brewing (alcoholic fermentation), not methane production.

Final Answer: Biogas is produced by methanogenic archaebacteria $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Active vs passive immunity: Active immunity means the body makes its own antibodies; passive immunity means ready-made antibodies are received from outside.

Step 1 — Recognise the passive case: Antibodies passed from mother to foetus across the placenta are made by the mother, not the foetus, so the foetus receives them ready-made.

Step 2 — Conclude: This is natural passive immunity, giving short-term protec-

tion without the foetus's own immune effort.

Why other options are wrong:

- Option A (antibodies after chickenpox) is active immunity from natural infection.
- Option B (vaccination) is active artificial immunity.
- Option D (memory cells after infection) is a feature of active immunity.

Final Answer: Maternal antibodies crossing the placenta are passive immunity $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — Enzymes in genetic engineering: Different enzymes cut, copy and join DNA; ligase is the joining enzyme.

Step 1 — Identify the joining role: DNA ligase seals nicks by forming phosphodiester bonds in the sugar-phosphate backbone.

Step 2 — Apply it: It is used to join the foreign DNA insert to the cut vector, completing the recombinant DNA molecule.

Why other options are wrong:

- Option A (restriction endonuclease) cuts DNA, it does not join it.
- Option C (DNA helicase) unwinds the double helix.
- Option D (RNA polymerase) synthesises RNA during transcription.

Final Answer: The enzyme that joins DNA fragments is DNA ligase $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — PCR: The polymerase chain reaction amplifies DNA through repeated cycles of denaturation, annealing and extension at high temperatures.

Step 1 — State the requirement: The extension step is carried out at a high temperature, so the polymerase used must remain active when heated.

Step 2 — Name the enzyme: Taq DNA polymerase, isolated from the thermophilic bacterium *Thermus aquaticus*, is heat-stable and is used in PCR.

Why other options are wrong:

- Option A (DNA ligase) joins fragments, it does not copy DNA in PCR.
- Option B (reverse transcriptase) makes DNA from RNA, used in RT-PCR setup but not the heat-stable copying enzyme here.
- Option C (restriction enzyme) cuts DNA, it does not synthesise it.

Final Answer: The heat-stable PCR enzyme is Taq DNA polymerase $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Recombinant insulin (Humulin): Human insulin has two short chains, A and B, joined by disulphide bridges; it was the first recombinant therapeutic protein.

Step 1 — Describe the method: The DNA sequences for the A chain and the B chain were prepared and introduced separately into *E. coli*, which produced the two chains.

Step 2 — Assemble the hormone: The separately made A and B chains were then extracted and combined by forming disulphide bonds to yield functional human insulin.

Why other options are wrong:

- Option B describes the older animal-pancreas extraction, not the recombinant method.
- Option C is wrong; whole human pancreatic cells are not cultured for Humulin.
- Option D is wrong; the hormone is made by a microbe, not by total chemical

synthesis.

Final Answer: A and B chains made separately in *E. coli*, then joined $\Rightarrow$ A

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Population growth models: Growth may be exponential (J-shaped) when resources are unlimited, or logistic (S-shaped) when resources are limited.

Step 1 — Read the graph: Curve X rises without bound (J-shaped exponential), while curve Y rises and then flattens at the line K (S-shaped logistic).

Step 2 — Explain the plateau: In nature food and space are finite, so environmental resistance slows growth; the population stabilises at the carrying capacity (K) the habitat can support.

Why other options are wrong:

- Option A is wrong; unlimited resources would give the J-curve, not a plateau.
- Option C is wrong; a continually rising natality would not allow the curve to level off.
- Option D is wrong; it is precisely environmental resistance that flattens the logistic curve.

Final Answer: The logistic curve flattens at the carrying capacity K $\Rightarrow$ B

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Carbon cycle: Carbon moves between the atmosphere, living organisms and the soil through fixation and release.

Step 1 — Identify the fixing step: Green plants and other autotrophs absorb atmospheric CO_2 and convert it into organic compounds (glucose).

Step 2 — Name the process: This removal and fixation of CO_2 into organic matter is photosynthesis, the main entry point of carbon into the living world.

Why other options are wrong:

- Option A (respiration) releases CO_2 back to the air, the opposite of fixation.
- Option B (combustion) also adds CO_2 to the atmosphere.
- Option D (decomposition) returns carbon to the air and soil, it does not fix it into plants.

Final Answer: Atmospheric CO_2 is fixed into organic matter by photosynthesis $\Rightarrow$ C

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Biodiversity hotspots: Hotspots are regions with exceptionally high species richness and many endemic species that are also under threat.

Step 1 — Recall India's hotspots: India has parts of four hotspots: the Western Ghats and Sri Lanka, the Eastern Himalayas (Indo-Burma), and Sundaland.

Step 2 — Pick the correct one: Among the choices, the Western Ghats and Sri Lanka region is a recognised biodiversity hotspot.

Why other options are wrong:

- Option A (Thar Desert) is an arid region with comparatively low biodiversity.
- Option B (Gangetic plains) are fertile but not classed as a hotspot.
- Option C (deserts of Rajasthan) are not biodiversity hotspots.

Final Answer: The Western Ghats and Sri Lanka region is a biodiversity hotspot $\Rightarrow$ D

Answer: (D) Go Back to Q40

Answer Key

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