KIITEE Biology Sample Paper – 1

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 Whittaker's five-kingdom system, organisms that are exclusively prokaryotic are placed in the kingdom:

(A) Protista

(B) Monera

(C) Fungi

(D) Plantae

Q2. The correct sequence of taxonomic categories arranged from the most inclusive to the least inclusive is:

(A) Order $\rightarrow$ Class $\rightarrow$ Family $\rightarrow$ Genus

(B) Class $\rightarrow$ Order $\rightarrow$ Family $\rightarrow$ Genus

(C) Family $\rightarrow$ Order $\rightarrow$ Class $\rightarrow$ Genus

(D) Genus $\rightarrow$ Family $\rightarrow$ Order $\rightarrow$ Class

Q3. A lichen is a symbiotic association between two partners. These two partners are:

(A) Two different fungi

(B) A fungus and a moss

(C) A bacterium and an alga

(D) An alga and a fungus

Q4. Which of the following is a complex permanent tissue in plants that conducts water and minerals from roots to the rest of the plant?

(A) Collenchyma

(B) Parenchyma

(C) Phloem

(D) Xylem

Q5. The inner lining of the small intestine, specialised for absorption and secretion, is made of:

(A) Squamous epithelium

(B) Cuboidal epithelium

(C) Columnar epithelium

(D) Ciliated epithelium

Q6. Blood is regarded as a special type of connective tissue mainly because:

(A) Its cells divide rapidly and continuously

(B) Its cells are suspended in a fluid intercellular matrix (plasma)

(C) It is lined by a layer of epithelium

(D) It is made up of contractile protein fibres

Q7. Which of the following biomolecules is a polysaccharide that serves as the chief storage carbohydrate in plants?

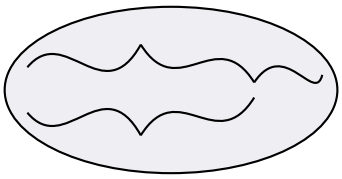
(A) Glucose

(B) Sucrose

(C) Starch

(D) Glycogen

Q8. The cell organelle shown below, bounded by a double membrane with infoldings of the inner membrane, is the principal site of aerobic ATP synthesis. It is the:



double-membrane organelle

(A) Golgi apparatus

(B) Mitochondrion

(C) Ribosome

(D) Lysosome

Q9. Replication (synthesis) of DNA, doubling the genetic material before cell division, takes place during which phase of the cell cycle?

(A) S phase

(B) G_1 phase

(C) G_2 phase

(D) M phase

Q10. Enzymes accelerate the rate of a biochemical reaction primarily by:

(A) Increasing the temperature of the medium

(B) Lowering the activation energy of the reaction

(C) Changing the equilibrium constant of the reaction

(D) Being consumed in stoichiometric amounts

Q11. In a chloroplast, the light reactions of photosynthesis (capture of light and splitting of water) occur on the:

(A) Outer membrane

(B) Stroma matrix

(C) Thylakoid membranes

(D) Inter-membrane space

Q12. The upward movement of water (ascent of sap) in tall trees is best explained by the transpiration-pull theory, in which the driving force is generated by:

(A) Evaporation of water from the leaf surface

(B) Active pumping by xylem cells

(C) Capillary rise in vessels

(D) Root pressure alone

Q13. During glycolysis, the net number of ATP molecules produced by the breakdown of one molecule of glucose to two molecules of pyruvate is:

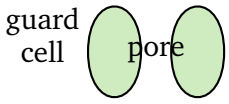
(A) 2

(B) 4

(C) 36

(D) 38

Q14. The structure shown below, formed by a pair of bean-shaped cells that regulate gaseous exchange and transpiration in a leaf, is the:



(A) Lenticel

(B) Stoma

(C) Hydathode

(D) Trichome

Q15. The enzyme pepsin, secreted in the stomach, acts in an acidic medium to digest:

(A) Proteins

(B) Fats

(C) Starch

(D) Nucleic acids

Q16. The majority of carbon dioxide in human blood is transported from the tissues to the lungs in the form of:

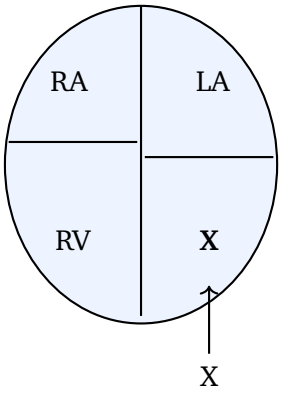
(A) Dissolved gas in plasma

(B) Carbaminohaemoglobin only

(C) Bicarbonate ions

(D) Carbon monoxide

Q17. In the human heart diagram below, the chamber labelled **X** has the thickest muscular wall because it pumps oxygenated blood through the aorta to the entire body. Chamber **X** is the:



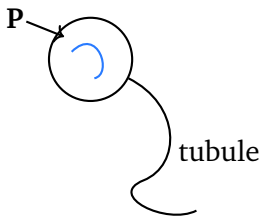
(A) Right ventricle

(B) Left ventricle

(C) Left atrium

(D) Right atrium

Q18. In the nephron shown, ultrafiltration of blood plasma takes place at the tuft of capillaries enclosed within Bowman's capsule, labelled **P**. Structure **P** is the:



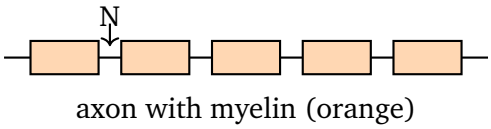
(A) Glomerulus

(B) Loop of Henle

(C) Collecting duct

(D) Distal tubule

Q19. In the myelinated neuron shown, the small gaps in the myelin sheath where the axon membrane is exposed, allowing rapid (saltatory) conduction, are labelled **N**. These gaps are called:



axon with myelin (orange)

(A) Synaptic knobs

(B) Dendrites

(C) Nodes of Ranvier

(D) Schwann bodies

Q20. The hormone insulin, which lowers blood glucose levels, is secreted by the:

(A) Adrenal cortex

(B) β-cells of the islets of Langerhans

(C) Anterior pituitary

(D) Thyroid gland

Q21. According to the sliding-filament theory of muscle contraction, during contraction:

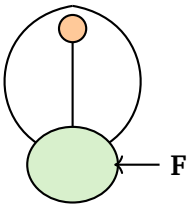
(A) Actin filaments slide over myosin, shortening the sarcomere

(B) Both actin and myosin filaments themselves shorten in length

(C) The A-band shortens while the I-band lengthens

(D) Myosin filaments break down into actin filaments

Q22. In the longitudinal section of a flower shown, the part labelled **F** matures into the fruit after fertilisation. Part **F** is the:



(A) Stigma

(B) Style

(C) Anther

(D) Ovary

Q23. In human females, fertilisation of the ovum by the sperm normally occurs in the:

(A) Uterus

(B) Ovary

(C) Ampulla of the fallopian tube

(D) Cervix

Q24. Which of the following is a surgical method of contraception (sterilisation) in human males?

(A) Vasectomy

(B) Use of oral contraceptive pills

(C) The rhythm (periodic abstinence) method

(D) Use of an intra-uterine device (IUD)

Q25. In angiosperms, the primary endosperm nucleus formed during double fertilisation is:

(A) Tetraploid (4n)

(B) Diploid (2n)

(C) Haploid (n)

(D) Triploid (3n)

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

	T	t
T	TT	Tt
t	Tt	tt

(A) 3 : 1

(B) 1 : 1

(C) 9 : 7

(D) 2 : 1

Q27. In a typical dihybrid cross between two plants heterozygous for two independently assorting genes (RrYy $\times$ RrYy), the phenotypic ratio in the F_2 generation is:

(A) 3 : 1

(B) 1 : 2 : 1

(C) 9 : 3 : 3 : 1

(D) 1 : 1 : 1 : 1

Q28. Red–green colour blindness in humans is a recessive X-linked trait. It is more common in males because:

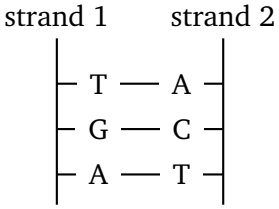
(A) The Y chromosome carries a dominant allele for it

(B) It is carried on the autosomes of males only

(C) Males inherit two copies of the defective gene

(D) Males have a single X chromosome, so one recessive allele is enough to express it

Q29. In the segment of a DNA double helix shown, complementary base pairing holds the two strands together. The base that pairs with adenine (A) through two hydrogen bonds is:



(A) Thymine (T)

(B) Guanine (G)

(C) Cytosine (C)

(D) Uracil (U)

Q30. The genetic code is a triplet code. The total number of possible codons that can be formed from the four kinds of nitrogenous bases, taken three at a time, is:

(A) 16

(B) 64

(C) 20

(D) 32

Q31. According to Darwin's theory of natural selection, the central mechanism driving evolution is:

(A) Inheritance of characters acquired during an individual's lifetime

(B) Sudden large mutations creating new species in one generation

(C) Differential reproductive success of individuals best suited to the environment

(D) An inner drive of organisms towards greater complexity

Q32. Malaria in humans is caused by a protozoan parasite transmitted by the female *Anopheles* mosquito. This parasite belongs to the genus:

(A) *Plasmodium*

(B) *Trypanosoma*

(C) *Leishmania*

(D) *Entamoeba*

Q33. The conversion of milk into curd, which also enriches it with vitamin B_{12}, is brought about by:

(A) *Penicillium notatum*

(B) *Saccharomyces cerevisiae*

(C) *Aspergillus niger*

(D) Lactic acid bacteria (*Lactobacillus*)

Q34. The antibiotic penicillin, the first to be discovered, is obtained from the fungus:

(A) *Streptomyces*

(B) *Rhizobium*

(C) *Lactobacillus*

(D) *Penicillium notatum*

Q35. In genetic engineering, the enzymes used as "molecular scissors" to cut DNA at specific recognition sequences are:

(A) DNA ligases

(B) DNA polymerases

(C) Restriction endonucleases

(D) Helicases

Q36. The insect-resistant variety of cotton known as Bt cotton has been made by introducing a gene that codes for a toxic crystal protein. This gene is obtained from the bacterium:

(A) *Agrobacterium tumefaciens*

(B) *Escherichia coli*

(C) *Rhizobium leguminosarum*

(D) *Bacillus thuringiensis*

Q37. In recombinant DNA technology, a small circular self-replicating piece of DNA in bacteria, widely used as a cloning vector to carry foreign genes, is a:

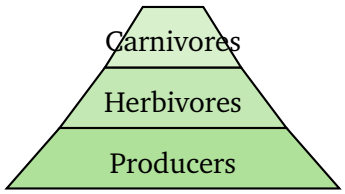
(A) Lysosome

(B) Ribosome

(C) Centromere

(D) Plasmid

Q38. In the energy pyramid of a food chain shown below, only a small fraction of energy is transferred from one trophic level to the next. According to Lindeman's ten per cent law, the energy passed on to the next level is about:



(A) 1%

(B) 10%

(C) 50%

(D) 90%

Q39. The close association between a pollinating insect and the flower it pollinates, in which both partners benefit, is an example of:

(A) Predation

(B) Competition

(C) Mutualism

(D) Parasitism

Q40. The thinning of the stratospheric ozone layer (the “ozone hole”) is caused chiefly by the release of:

(A) Carbon dioxide

(B) Methane

(C) Sulphur dioxide

(D) Chlorofluorocarbons (CFCs)

Detailed Solutions

Q1.

Solution

Concept — Five-kingdom classification: R.H. Whittaker (1969) grouped organisms by cell type, body organisation and mode of nutrition into Monera, Protista, Fungi, Plantae and Animalia.

Step 1 — Identify the prokaryotic kingdom: Prokaryotes lack a true membrane-bound nucleus and organelles. Among the five kingdoms, only Monera (bacteria, cyanobacteria) is wholly prokaryotic.

Step 2 — Confirm the rest are eukaryotic: Protista, Fungi, Plantae and Animalia are all eukaryotic, with a true nucleus.

Why other options are wrong:

- Option A (Protista) are unicellular eukaryotes.
- Option C (Fungi) are eukaryotic with chitinous walls.
- Option D (Plantae) are multicellular eukaryotes.

Final Answer: Exclusively prokaryotic organisms belong to Monera $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Taxonomic hierarchy: The categories, from most inclusive (broadest) to least inclusive, are Kingdom $\rightarrow$ Phylum/Division $\rightarrow$ Class $\rightarrow$ Order $\rightarrow$ Family $\rightarrow$ Genus $\rightarrow$ Species.

Step 1 — Order the given categories: Among Class, Order, Family and Genus, the broadest is Class and the narrowest is Genus.

Step 2 — Write the descending sequence: Class $\rightarrow$ Order $\rightarrow$ Family $\rightarrow$ Genus.

Why other options are wrong:

- Option A places Order above Class, which is inverted.
- Option C places Family above Order and Class, which is wrong.
- Option D is in ascending (narrow-to-broad) order.

Final Answer: Class $\rightarrow$ Order $\rightarrow$ Family $\rightarrow$ Genus $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Lichens: A lichen is a mutualistic, self-supporting association between a photosynthetic partner and a fungal partner.

Step 1 — Identify the two partners: The photosynthetic partner (phycobiont) is an alga (or cyanobacterium); the fungal partner (mycobiont) is a fungus.

Step 2 — Note the roles: The alga prepares food by photosynthesis, while the fungus absorbs water and minerals and gives shelter.

Why other options are wrong:

- Option A (two fungi) lacks a photosynthetic partner.
- Option B (fungus + moss) is not a lichen.
- Option C names a bacterium and an alga, but a fungus must be present.

Final Answer: A lichen is an alga + a fungus $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Plant tissues: Complex permanent tissues are made of more than one cell type working as a unit; xylem and phloem are the two conducting (vascular) tissues.

Step 1 — Match function to tissue: Conduction of water and dissolved minerals upward from the roots is the function of xylem.

Step 2 — Confirm it is complex: Xylem is composed of tracheids, vessels, xylem fibres and xylem parenchyma, so it is a complex tissue.

Why other options are wrong:

- Options A (collenchyma) and B (parenchyma) are simple tissues.
- Option C (phloem) conducts food, not water.

Final Answer: Water and minerals are conducted by xylem $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Epithelial tissues: The shape of epithelial cells is matched to function; tall columnar cells suit absorption and secretion.

Step 1 — Identify the lining of the small intestine: The mucosa of the small intestine is lined by simple columnar epithelium, often with microvilli, increasing surface area for absorption.

Step 2 — Relate structure to function: Tall cells house abundant cytoplasm and organelles for active secretion and absorption.

Why other options are wrong:

- Option A (squamous) lines areas needing diffusion, e.g. alveoli.
- Option B (cuboidal) lines ducts and tubules.
- Option D (ciliated) lines the respiratory tract.

Final Answer: The intestinal lining is columnar epithelium $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Connective tissue: Connective tissues have cells embedded in an abundant intercellular matrix; in blood this matrix is fluid.

Step 1 — Identify the matrix of blood: Blood cells (RBCs, WBCs, platelets) are suspended in a liquid matrix called plasma.

Step 2 — Classify accordingly: Because cells lie in a non-living intercellular matrix (plasma), blood is a fluid connective tissue.

Why other options are wrong:

- Option A: rapid division is not the defining feature.
- Option C: epithelial lining does not define connective tissue.
- Option D describes muscle tissue, not blood.

Final Answer: Blood is connective tissue because its cells lie in a fluid plasma matrix $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Carbohydrates: Carbohydrates are classed as monosaccharides, disaccharides and polysaccharides; storage forms are polysaccharides.

Step 1 — Identify the plant storage polysaccharide: In plants, glucose is stored as starch (amylose + amylopectin).

Step 2 — Eliminate non-storage / non-polysaccharide options: Glucose is a monosaccharide; sucrose is a disaccharide; glycogen is the animal (not plant) storage polysaccharide.

Why other options are wrong:

- Option A (glucose) is a single sugar unit.
- Option B (sucrose) is a disaccharide.
- Option D (glycogen) stores carbohydrate in animals.

Final Answer: Starch is the plant storage polysaccharide $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Cell organelles: The double-membrane organelle whose inner membrane is folded into cristae and which carries out oxidative phosphorylation is the mitochondrion.

Step 1 — Read the diagram: The figure shows an organelle with a smooth outer boundary and folded inner membranes (cristae) — diagnostic of a mitochondrion.

Step 2 — Link to function: The cristae bear the electron transport chain, so the mitochondrion is the chief site of aerobic ATP synthesis (the "powerhouse").

Why other options are wrong:

- Option A (Golgi) is a stack of flattened cisternae for packaging.
- Option D (lysosome) is a single-membrane digestive sac.
- Option C (ribosome) is a non-membranous protein factory.

Final Answer: The double-membrane ATP-making organelle is the mitochondrion $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Cell cycle: Interphase is divided into G_1, S and G_2. DNA is synthesised only in the S (synthesis) phase.

Step 1 — Identify when DNA doubles: During S phase each chromosome is replicated, so the DNA content doubles from 2C to 4C.

Step 2 — Contrast the other phases: G_1 and G_2 are growth phases; M phase is division, not synthesis.

Why other options are wrong:

- Option B (G_1): cell grows, DNA not yet replicated.
- Option C (G_2): replication is already complete.
- Option D (M): chromosomes separate, no synthesis.

Final Answer: DNA replication occurs in the S phase $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Enzyme action: Enzymes are biological catalysts that speed up reactions by providing an alternative pathway with a lower energy barrier.

Step 1 — Identify the mechanism: By binding the substrate at the active site, the enzyme stabilises the transition state and lowers the activation energy.

Step 2 — Note what does not change: A catalyst does not shift the equilibrium and is recovered unchanged at the end.

Why other options are wrong:

- Option A: enzymes do not raise temperature.
- Option C: equilibrium constant is unchanged by a catalyst.
- Option D: enzymes are not consumed stoichiometrically.

Final Answer: Enzymes act by lowering the activation energy $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Photosynthesis: The light reactions need chlorophyll-bearing membranes; these are the thylakoids inside the chloroplast.

Step 1 — Locate the photosystems: Photosystems I and II, the electron transport chain and ATP synthase are embedded in the thylakoid membranes.

Step 2 — Separate from the dark reaction: The light-independent (Calvin) reactions occur in the stroma, not on the thylakoid.

Why other options are wrong:

- Options A and D (outer membrane, inter-membrane space) have no photosystems.
- Option B (stroma) is the site of the dark reactions.

Final Answer: The light reactions occur on the thylakoid membranes $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Ascent of sap: The cohesion–tension (transpiration-pull) theory holds that water lost by transpiration creates a tension transmitted down continuous water columns in the xylem.

Step 1 — Identify the driving force: Evaporation of water from the mesophyll cell walls through the stomata generates the pull.

Step 2 — Role of cohesion: Cohesion between water molecules and adhesion to vessel walls keep the column unbroken, so the pull lifts water up.

Why other options are wrong:

- Option D (root pressure) is minor and absent in fast transpiration.
- Option B: xylem does not actively pump.
- Option C: capillarity alone cannot lift water in tall trees.

Final Answer: The pull is created by evaporation (transpiration) from the leaf $\Rightarrow$ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Glycolysis: Glycolysis breaks one glucose into two pyruvate, consuming 2 ATP and producing 4 ATP.

Step 1 — Count ATP used and made: Investment phase uses 2 ATP; payoff phase makes 4 ATP (substrate-level).

Step 2 — Compute the net: Net ATP $= 4 - 2 = 2$ ATP per glucose.

Why other options are wrong:

- Option B (4) is the gross, not net, ATP.
- Options C and D (36, 38) are the totals for complete aerobic respiration, not glycolysis alone.

Final Answer: Net ATP from glycolysis is 2 $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Stomata: A stoma is a microscopic pore in the epidermis bordered by two guard cells that open and close it.

Step 1 — Read the diagram: The figure shows two bean-shaped guard cells enclosing a central pore — the defining structure of a stoma.

Step 2 — Link to function: Guard cells swell or shrink with turgor changes to open or close the pore, regulating gaseous exchange and transpiration.

Why other options are wrong:

- Option A (lenticel) is a corky pore in woody stems.
- Option C (hydathode) releases liquid water (guttation).
- Option D (trichome) is an epidermal hair.

Final Answer: The guard-cell-bordered pore is a stoma $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Gastric digestion: The stomach secretes HCl and the proenzyme pepsinogen, which is activated to pepsin in acidic pH.

Step 1 — Identify the substrate: Pepsin is a protease; it hydrolyses proteins into smaller peptides.

Step 2 — Confirm the conditions: Pepsin works best at the low pH (≈ 1.8) created by gastric HCl.

Why other options are wrong:

- Option C (starch) is digested by amylase.
- Option B (fats) is digested by lipase.
- Option D (nucleic acids) is digested by nucleases.

Final Answer: Pepsin digests proteins $\Rightarrow$ A

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Transport of CO_2: Carbon dioxide is carried in three ways, but the major share travels as bicarbonate ions in the plasma.

Step 1 — Recall the proportions: About 70% of CO_2 is transported as bicarbonate (HCO_3^-), about 20–25% as carbamino-haemoglobin, and a small fraction dissolved in plasma.

Step 2 — Identify the largest fraction: The bicarbonate form accounts for the majority.

Why other options are wrong:

- Option A (dissolved gas) is only about 7%.
- Option B (carbamino-Hb) is a minor share.
- Option D (CO) is a poison, not a transport form of CO_2.

Final Answer: Most CO_2 is carried as bicarbonate ions $\Rightarrow$ C

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Heart chambers: The left ventricle pumps oxygenated blood into the aorta to reach the whole body, so it has the thickest, most muscular wall.

Step 1 — Read the diagram: Chamber X is the lower chamber on the body's left side (drawn on the right of the figure) feeding the aorta.

Step 2 — Relate wall thickness to workload: High systemic pressure requires thick myocardium, identifying X as the left ventricle.

Why other options are wrong:

- Option A (right ventricle) pumps only to the lungs, with a thinner wall.
- Options C and D (atria) are thin-walled receiving chambers.

Final Answer: The thick-walled systemic pump is the left ventricle $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Nephron: Each nephron begins with a Malpighian corpuscle: a tuft of capillaries (glomerulus) inside the cup-shaped Bowman's capsule.

Step 1 — Read the diagram: Structure P is the capillary tuft enclosed by Bowman's capsule — the glomerulus.

Step 2 — Link to function: High glomerular blood pressure forces plasma minus large proteins into the capsule — ultrafiltration.

Why other options are wrong:

- Option B (loop of Henle) concentrates urine, no filtration.
- Option C (collecting duct) carries out final water reabsorption.
- Option D (distal tubule) handles selective reabsorption/secretion.

Final Answer: Ultrafiltration occurs at the glomerulus $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Myelinated neuron: Myelin is laid down by Schwann cells in segments; the unmyelinated gaps between segments are the nodes of Ranvier.

Step 1 — Read the diagram: The gaps N lie between the orange myelin blocks where the axon membrane is exposed.

Step 2 — Link to function: The impulse jumps from node to node (saltatory conduction), speeding up transmission.

Why other options are wrong:

- Option A (synaptic knobs) are axon terminals.
- Option B (dendrites) receive impulses.
- Option D ("Schwann bodies") is not a real structure.

Final Answer: The gaps in myelin are the nodes of Ranvier $\Rightarrow$ C

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Endocrine pancreas: The islets of Langerhans contain α-cells (glucagon) and β-cells (insulin).

Step 1 — Identify the insulin source: Insulin, which lowers blood glucose, is secreted by the β-cells of the islets of Langerhans.

Step 2 — Recall its action: Insulin promotes cellular glucose uptake and glycogen formation, reducing blood sugar.

Why other options are wrong:

- Option A (adrenal cortex) secretes corticoids.
- Option D (thyroid) secretes thyroxine.
- Option C (anterior pituitary) secretes tropic hormones, not insulin.

Final Answer: Insulin comes from the β-cells of the islets of Langerhans $\Rightarrow$ B

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Sliding-filament theory: Muscle shortens when thin actin filaments slide over thick myosin filaments, without either filament changing its own length.

Step 1 — Describe the movement: Myosin cross-bridges attach to actin and pull it toward the centre of the sarcomere.

Step 2 — Note the band changes: The sarcomere and the I-band shorten while the A-band length stays constant.

Why other options are wrong:

- Option B: the filaments do not themselves shorten.
- Option C: the A-band does not shorten.
- Option D: myosin does not convert to actin.

Final Answer: Actin slides over myosin, shortening the sarcomere $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Fruit and seed formation: After fertilisation, the ovary wall develops into the fruit and the ovules develop into seeds.

Step 1 — Read the diagram: Part F is the swollen basal portion of the pistil (the ovary), below the style and stigma.

Step 2 — Trace the development: The ovary ripens into the fruit; the enclosed ovules become seeds.

Why other options are wrong:

- Option A (stigma) receives pollen.
- Option C (anther) produces pollen.
- Option B (style) connects stigma to ovary; it does not form the fruit.

Final Answer: The ovary matures into the fruit $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept — Human fertilisation: The sperm meets and fuses with the ovum in the upper part of the oviduct.

Step 1 — Locate the site: Fertilisation normally occurs in the ampulla, the widened region of the fallopian tube (oviduct).

Step 2 — Follow the zygote: The resulting zygote then moves to the uterus for implantation.

Why other options are wrong:

- Option A (uterus) is the site of implantation, not fertilisation.
- Option B (ovary) releases the ovum.
- Option D (cervix) is the lower opening of the uterus.

Final Answer: Fertilisation occurs in the ampulla of the fallopian tube $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Contraceptive methods: Methods are grouped as natural, barrier, IUD, hormonal and surgical (sterilisation).

Step 1 — Identify the male surgical method: Vasectomy cuts and ties the vas deferens, preventing sperm from entering the semen.

Step 2 — Classify the others: IUDs, pills and the rhythm method are non-surgical.

Why other options are wrong:

- Option D (IUD) is a device placed in the uterus (female).
- Option B (pills) are hormonal.
- Option C (rhythm method) is a natural method.

Final Answer: Vasectomy is the male surgical (sterilisation) method $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Double fertilisation: One male gamete fuses with the egg (syngamy) and the second fuses with the two polar nuclei (triple fusion).

Step 1 — Count the nuclei in triple fusion: The second male gamete (n) fuses with two polar nuclei (n + n), giving a $3n$ primary endosperm nucleus.

Step 2 — State the ploidy: Therefore the primary endosperm nucleus is triploid (3n).

Why other options are wrong:

- Option B (2n) is the zygote's ploidy.
- Option C (n) is the gamete ploidy.
- Option A (4n) would need an extra fusion.

Final Answer: The primary endosperm nucleus is triploid (3n) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept — Monohybrid cross: Crossing two heterozygotes (Tt $\times$ Tt) gives a genotypic ratio 1 TT : 2 Tt : 1 tt.

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

Step 2 — Convert to phenotype: TT, Tt and Tt are tall (T dominant); only tt is dwarf, giving 3 tall : 1 dwarf.

Why other options are wrong:

- Option B (1:1) is a test-cross ratio.
- Option C (9:7) is a complementary-gene ratio.
- Option D (2:1) ignores the homozygous tall.

Final Answer: The monohybrid phenotypic ratio is 3 : 1 $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Dihybrid cross: Two genes assorting independently in a RrYy × RrYy cross give the classic F_2 ratio.

Step 1 — Combine the two 3:1 ratios: Each gene gives 3:1; the joint ratio is $(3{:}1) \times (3{:}1)$.

Step 2 — Expand: This yields 9 : 3 : 3 : 1 for the four phenotype combinations.

Why other options are wrong:

- Option A (3:1) is a monohybrid ratio.
- Option B (1:2:1) is a monohybrid genotypic ratio.
- Option D (1:1:1:1) is a dihybrid test-cross ratio.

Final Answer: The dihybrid F_2 ratio is 9 : 3 : 3 : 1 $\Rightarrow$ C

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — X-linked recessive inheritance: Genes on the X chromosome are expressed differently in the two sexes because males are XY and females XX.

Step 1 — Apply to males: A male has only one X; a single recessive colour-blind allele on it has no second X to mask it, so the trait shows.

Step 2 — Compare with females: A female needs two recessive alleles (one on each X) to be colour-blind, which is rarer.

Why other options are wrong:

- Option A: the Y carries no such dominant allele.
- Option B: the gene is X-linked, not autosomal.
- Option C: males inherit only one copy, not two.

Final Answer: Males express it because their single X carries the recessive allele unmasked $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Complementary base pairing: In DNA, adenine pairs with thymine via two hydrogen bonds, and guanine pairs with cytosine via three.

Step 1 — Read the diagram: Each rung pairs a base on strand 1 with its complement on strand 2 (A–T, G–C, T–A).

Step 2 — Identify A's partner: Adenine pairs specifically with thymine (two H-bonds).

Why other options are wrong:

- Options B and C (G, C) pair with each other, not with A.
- Option D (uracil) replaces thymine in RNA, not DNA.

Final Answer: Adenine pairs with thymine $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Triplet genetic code: A codon is a sequence of three bases; with 4 possible bases at each of 3 positions, the number of codons is 4^3.

Step 1 — Set up the count: Positions $= 3$, choices per position $= 4$.

Step 2 — Compute:

$$4^3 = 4 \times 4 \times 4 = 64.$$

Why other options are wrong:

- Option A (16) is 4^2 (a doublet code).
- Option C (20) is the number of standard amino acids, not codons.
- Option D (32) has no biological basis here.

Final Answer: The number of possible triplet codons is 64 $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Darwinian natural selection: Variation exists in a population; individuals with favourable variations survive and reproduce more.

Step 1 — Identify the mechanism: "Survival of the fittest" means differential reproductive success of better-adapted individuals.

Step 2 — Note the outcome: Over generations, favourable traits accumulate, leading to evolution.

Why other options are wrong:

- Option A is Lamarck's inheritance of acquired characters.
- Option B is the mutation/saltation idea, not Darwin's.
- Option D is an internal-drive (orthogenesis) idea.

Final Answer: Evolution is driven by differential reproductive success $\Rightarrow$ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Vector-borne disease: Malaria is caused by a protozoan transmitted by the female *Anopheles* mosquito.

Step 1 — Identify the genus: The causative parasite is *Plasmodium* (e.g. *P. vivax*, *P. falciparum*).

Step 2 — Recall the cycle: *Plasmodium* multiplies in liver and red blood cells, causing recurrent fever.

Why other options are wrong:

- Option D (*Entamoeba*) causes amoebiasis.
- Option B (*Trypanosoma*) causes sleeping sickness.
- Option C (*Leishmania*) causes kala-azar.

Final Answer: Malaria is caused by *Plasmodium* $\Rightarrow$ A

Answer: (A) Go Back to Q32

Q33.

Solution

Concept — Useful microbes: Lactic acid bacteria ferment lactose to lactic acid, coagulating milk protein into curd.

Step 1 — Identify the microbe: *Lactobacillus* (LAB) added to warm milk forms curd and raises its vitamin B_{12} content.

Step 2 — Note the mechanism: The acid produced lowers pH, denaturing casein and setting the curd.

Why other options are wrong:

- Option B (*Saccharomyces*) is used in baking and brewing.
- Option C (*Aspergillus*) makes citric acid.
- Option A (*Penicillium*) makes penicillin.

Final Answer: Curd is formed by lactic acid bacteria (*Lactobacillus*) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — Antibiotics: Penicillin, discovered by Alexander Fleming, is produced by a blue-green mould.

Step 1 — Identify the source fungus: Penicillin is obtained from *Penicillium notatum* (now *P. chrysogenum*).

Step 2 — Note its action: It inhibits bacterial cell-wall synthesis, killing the bacteria.

Why other options are wrong:

- Option A (*Streptomyces*) yields streptomycin, not penicillin.
- Option C (*Lactobacillus*) makes curd.
- Option B (*Rhizobium*) fixes nitrogen.

Final Answer: Penicillin comes from *Penicillium notatum* $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Tools of rDNA technology: Restriction endonucleases recognise specific palindromic sequences and cut both DNA strands there.

Step 1 — Identify the "molecular scissors": These cutting enzymes are restriction endonucleases.

Step 2 — Note the product: They often leave sticky ends that help join the insert to a vector.

Why other options are wrong:

- Option A (ligase) joins DNA fragments ("molecular glue").
- Option B (polymerase) synthesises new strands.
- Option D (helicase) unwinds the helix.

Final Answer: The molecular scissors are restriction endonucleases $\Rightarrow$ C

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Bt crops: The *cry* genes coding for insecticidal crystal (Cry) proteins come from a soil bacterium.

Step 1 — Identify the source: The genes are isolated from *Bacillus thuringiensis* (Bt).

Step 2 — Note the action: The Cry protein, activated in the insect's alkaline gut, lyses gut cells and kills the larva.

Why other options are wrong:

- Option A (*Agrobacterium*) is a gene-transfer vector, not the toxin source.
- Option B (*E. coli*) is a lab cloning host.
- Option C (*Rhizobium*) fixes nitrogen.

Final Answer: The Bt gene is from *Bacillus thuringiensis* $\Rightarrow$ D

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Cloning vectors: A vector carries foreign DNA into a host and replicates it; plasmids are the most common.

Step 1 — Identify the structure: A plasmid is a small, circular, extrachromosomal, self-replicating DNA in bacteria.

Step 2 — Note its use: Foreign genes are inserted into the plasmid, which then multiplies inside the host cell.

Why other options are wrong:

- Option B (ribosome) makes proteins.
- Option C (centromere) holds sister chromatids together.
- Option A (lysosome) is a digestive organelle.

Final Answer: The circular self-replicating cloning vector is a plasmid $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept — Energy flow: Energy flow through a food chain is unidirectional and decreases at each step.

Step 1 — State the ten per cent law: Lindeman's law: only about 10% of the energy at one trophic level is stored as biomass available to the next level.

Step 2 — Apply to the pyramid: From producers to herbivores to carnivores, each step passes on roughly one-tenth of the energy.

Why other options are wrong:

- Option A (1%) understates the transfer.
- Options C and D (50%, 90%) greatly overstate it.

Final Answer: About 10% of energy passes to the next trophic level $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Population interactions: When both interacting species benefit, the relationship is mutualism (+/+).

Step 1 — Analyse the example: The insect gets nectar/food; the flower gets its pollen carried — both gain.

Step 2 — Classify: A two-way benefit is mutualism.

Why other options are wrong:

- Option A (predation) is +/−.
- Option B (competition) is −/−.
- Option D (parasitism) is +/−.

Final Answer: A pollinator–flower partnership is mutualism ⇒ C

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Ozone depletion: Stratospheric ozone is destroyed by chlorine and bromine radicals released from certain stable gases.

Step 1 — Identify the culprit: Chlorofluorocarbons (CFCs) release chlorine atoms under UV light, which catalytically break down ozone.

Step 2 — Note the effect: The resulting thinning lets more harmful UV-B reach the surface.

Why other options are wrong:

- Options A (CO_2) and B (methane) are greenhouse gases linked to warming, not ozone holes.
- Option C (SO_2) causes acid rain.

Final Answer: The ozone hole is caused mainly by chlorofluorocarbons (CFCs) ⇒ D

Answer: (D) Go Back to Q40

Answer Key

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