KIITEE Biology Sample Paper – 5

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. Bryophytes such as the moss *Funaria* are often called the "amphibians of the plant kingdom" because they:

(A) Produce seeds enclosed within fruits

(B) Live on land but still need external water for fertilisation

(C) Possess well-developed conducting tissues (xylem and phloem)

(D) Have true roots, stems and leaves

Q2. The common mushroom (*Agaricus*) belongs to the class Basidiomycetes. The sexual spores produced by these fungi, borne externally on club-shaped structures, are:

(A) Ascospores

(B) Zoospores

(C) Basidiospores

(D) Conidia

Q3. Which is the largest phylum of the animal kingdom, characterised by a chitinous exoskeleton and jointed appendages?

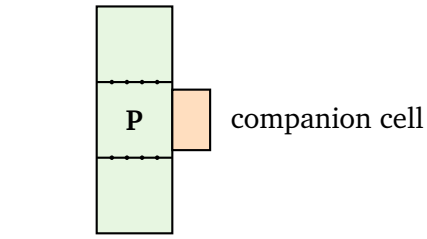
(A) Arthropoda

(B) Mollusca

(C) Chordata

(D) Annelida

Q4. The phloem shown below conducts food in plants. The living but enucleate conducting cells (**P**), kept functional by adjacent companion cells, are the:



(A) Tracheids

(B) Vessel elements

(C) Sieve tube elements

(D) Xylem fibres

Q5. The loose connective tissue present beneath the skin and between organs, acting as a packing material and containing fibroblasts and mast cells in a gel-like matrix, is:

(A) Adipose tissue

(B) Cartilage

(C) Tendon

(D) Areolar tissue

Q6. Which of the following is a tap root modified for the storage of food?

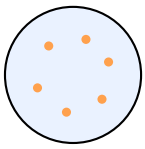
(A) Carrot

(B) Ginger

(C) Potato

(D) Onion

Q7. The single-membrane vesicle shown below is packed with hydrolytic enzymes and digests worn-out organelles of its own cell, earning it the name “suicidal bag”. It is the:



vesicle with hydrolytic enzymes

(A) Ribosome

(B) Lysosome

(C) Peroxisome

(D) Golgi body

Q8. Amino acids that the human body cannot synthesise and so must obtain from the diet are called essential amino acids. Which of the following is an essential amino acid?

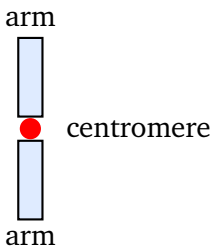
(A) Glycine

(B) Alanine

(C) Serine

(D) Lysine

Q9. In the chromosome shown below, the centromere lies exactly in the middle so that the two arms are of equal length. Such a chromosome is described as:



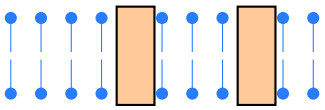
(A) Metacentric

(B) Acrocentric

(C) Telocentric

(D) Sub-metacentric

Q10. The fluid-mosaic model of the plasma membrane (Singer and Nicolson, 1972), depicted below, describes the membrane as:



lipid bilayer with embedded proteins

(A) A rigid protein layer sandwiched between two lipid sheets

(B) A single layer of phospholipids without any protein

(C) A lipid bilayer in which proteins are embedded and can move laterally

(D) A static double layer made of cellulose

Q11. The swelling of dry wooden door frames in the rainy season and the soaking-up of water by dry seeds before germination are both examples of:

(A) Osmosis

(B) Active transport

(C) Plasmolysis

(D) Imbibition

Q12. The uptake of mineral ions by root cells against their concentration gradient, requiring the expenditure of metabolic energy (ATP), is an example of:

(A) Passive diffusion

(B) Active absorption

(C) Simple osmosis

(D) Imbibition

Q13. In C_3 plants, when the oxygen level is high, RuBisCO fixes O_2 instead of CO_2 and starts the wasteful photorespiratory pathway. The first 2-carbon product formed in this pathway is:

(A) Phosphoglycolate (2-carbon)

(B) 3-phosphoglycerate (3-carbon)

(C) Oxaloacetate (4-carbon)

(D) Pyruvate (3-carbon)

Q14. During fermentation in yeast (*Saccharomyces*), pyruvic acid is converted in the absence of oxygen into:

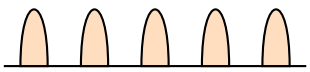
(A) Lactic acid and CO_2

(B) Lactic acid only

(C) Ethanol and CO_2

(D) Acetyl CoA and CO_2

Q15. The inner lining of the small intestine bears the finger-like projections shown below, which greatly increase the surface area for absorption of digested food. These projections are the:



projections into the intestinal lumen

(A) Rugae

(B) Gastric pits

(C) Haustra

(D) Villi

Q16. When bicarbonate ions diffuse out of the red blood cells into the plasma, chloride ions move into the red cells to maintain ionic balance. This phenomenon is known as the:

(A) Sodium–potassium pump

(B) Chloride shift (Hamburger's phenomenon)

(C) Bohr effect

(D) Haldane effect

Q17. The heartbeat is initiated by a specialised patch of nodal tissue in the wall of the right atrium that sets the rhythm of the heart. This natural pacemaker is the:

(A) Sino-atrial (SA) node

(B) Atrio-ventricular (AV) node

(C) Bundle of His

(D) Purkinje fibres

Q18. The release of urine from the urinary bladder, triggered when stretch receptors signal that the bladder is full, is called:

(A) Filtration

(B) Osmoregulation

(C) Micturition

(D) Deamination

Q19. The part of the human brain that controls vital involuntary activities such as respiration, heartbeat and the regulation of blood pressure is the:

(A) Cerebrum

(B) Cerebellum

(C) Hypothalamus

(D) Medulla oblongata

Q20. Parathyroid hormone (PTH) raises the level of calcium in the blood. It achieves this chiefly by:

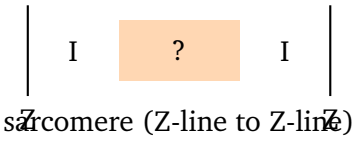
(A) Depositing calcium into the bones

(B) Stimulating the release of calcium from bones and its reabsorption from kidney and gut

(C) Increasing the excretion of calcium in the urine

(D) Reducing the absorption of calcium from the intestine

Q21. The sarcomere shown below is the functional unit of muscle contraction, lying between two Z-lines. The central dark band, where the thick myosin filaments are located, is the:



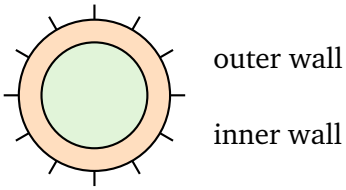
(A) I-band

(B) Z-line

(C) A-band

(D) M-line

Q22. In the pollen grain shown below, the hard, sculptured outer wall made of the highly resistant biopolymer sporopollenin is the:



(A) Exine

(B) Intine

(C) Tapetum

(D) Nucellus

Q23. In the human testis, sperms are produced inside coiled tubules, while testosterone is secreted by the interstitial cells lying between them. Sperm production (spermatogenesis) takes place in the:

(A) Epididymis

(B) Vas deferens

(C) Prostate gland

(D) Seminiferous tubules

Q24. After ovulation, the ruptured Graafian follicle is transformed into a yellowish endocrine body that secretes large amounts of progesterone to maintain the uterine lining. This body is the:

(A) Corpus albicans

(B) Corpus luteum

(C) Corpus callosum

(D) Primary follicle

Q25. The Copper-T, an intra-uterine device, prevents pregnancy chiefly by:

(A) Releasing copper ions that suppress sperm motility and fertilising capacity

(B) Permanently blocking both fallopian tubes

(C) Acting on the pituitary to stop ovulation

(D) Dissolving the sperm-producing tubules of the testis

Q26. A dihybrid plant (RrYy) is test-crossed with a homozygous recessive plant (rryy), as shown. The expected phenotypic ratio among the offspring is:

	ry
RY	RrYy
Ry	Rryy
rY	rrYy
ry	rryy

(A) 9 : 3 : 3 : 1

(B) 3 : 1

(C) 1 : 2 : 1

(D) 1 : 1 : 1 : 1

Q27. A single gene that controls and influences several different phenotypic traits at the same time exhibits the phenomenon of:

(A) Epistasis

(B) Codominance

(C) Pleiotropy

(D) Incomplete dominance

Q28. A man carries a recessive X-linked gene on his single X chromosome. This gene will be transmitted to:

(A) All of his sons

(B) All of his daughters (who become carriers)

(C) None of his children

(D) Only half of his sons

Q29. In the *lac* operon of *E. coli*, lactose acts as an inducer that switches on the operon by:

(A) Binding to the repressor protein and inactivating it, so RNA polymerase can transcribe the structural genes

(B) Binding directly to the operator and blocking transcription

(C) Destroying the structural genes z, y and a

(D) Increasing the affinity of the repressor for the operator

Q30. A human individual having only 45 chromosomes (44 autosomes + a single X, i.e. XO), who is sterile with underdeveloped ovaries, is said to have:

(A) Down syndrome

(B) Klinefelter syndrome

(C) Haemophilia

(D) Turner syndrome

Q31. The wings of a butterfly and the wings of a bird perform the same function (flight) but differ completely in their internal structure and origin. Such organs are:

(A) Homologous organs

(B) Vestigial organs

(C) Analogous organs

(D) Atavistic organs

Q32. Ascariasis, an intestinal disease causing internal bleeding, blockage of the intestinal passage and muscular pain, is caused by the roundworm:

(A) *Wuchereria bancrofti*

(B) *Ascaris lumbricoides*

(C) *Taenia solium*

(D) *Entamoeba histolytica*

Q33. The microorganism added to bread dough to make it rise (leavening), by producing carbon dioxide during fermentation, is:

(A) *Saccharomyces cerevisiae*

(B) *Lactobacillus*

(C) *Aspergillus niger*

(D) *Clostridium butylicum*

Q34. An exaggerated response of the immune system to certain allergens such as pollen or dust mites, with symptoms like sneezing and watering of the eyes, is an allergy. The chemicals mainly released by mast cells during an allergic reaction are:

(A) Interferons

(B) Antibodies of the IgG class

(C) Lysozyme

(D) Histamine and serotonin

Q35. Large-scale production of a biotechnological product requires a vessel in which cells or enzymes are grown under controlled conditions. The most commonly used type, fitted with a stirrer for mixing and aeration, is the:

(A) Laminar air-flow chamber

(B) Autoclave

(C) Stirred-tank bioreactor

(D) Thermal cycler

Q36. In recombinant DNA technology, a gene (for example one conferring antibiotic resistance) that helps in identifying and selecting host cells which have taken up the vector is called a:

(A) Structural gene

(B) Selectable marker

(C) Promoter

(D) Origin of replication

Q37. Golden rice is a genetically modified variety developed to combat a widespread nutritional deficiency. It is enriched with:

(A) Beta-carotene (pro-vitamin A)

(B) Vitamin C

(C) Iron alone

(D) Essential fatty acids

Q38. The association between the clownfish and the sea anemone, in which the fish gets shelter and protection while the anemone is neither benefited nor harmed, is an example of:

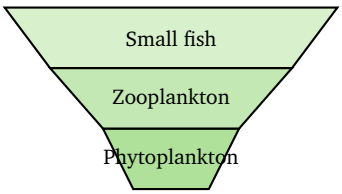
(A) Mutualism

(B) Parasitism

(C) Predation

(D) Commensalism

Q39. The pyramid of biomass for a pond ecosystem, shown below, is inverted (apex downward). This is because:



(A) The consumers are physically larger than the producers

(B) The energy content increases at each higher trophic level

(C) The small standing-crop biomass of phytoplankton supports a larger biomass of consumers at any instant

(D) There are no decomposers present in water

Q40. Species that are found exclusively in one particular geographical area and nowhere else in the world are described as:

(A) Extinct species

(B) Endemic species

(C) Introduced (exotic) species

(D) Keystone species

Detailed Solutions

Q1.

Solution

Concept — Bryophytes: Bryophytes (mosses, liverworts) are simple non-vascular land plants that need a film of water to complete reproduction.

Step 1 — Why the "amphibian" name: Like amphibians, they live on land but cannot reproduce without water.

Step 2 — The reason in detail: Their male gametes (antherozoids) are flagellated and must swim through a film of water to reach the egg, so fertilisation depends on external water.

Why other options are wrong:

- Option A: bryophytes are seedless; they reproduce by spores.
- Option C: they lack true vascular tissue (no xylem/phloem).
- Option D: they have rhizoids, not true roots, stems or leaves.

Final Answer: They need external water for fertilisation $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Basidiomycetes: This class of fungi (mushrooms, bracket fungi, rusts, smuts) produces sexual spores on a club-shaped cell called the basidium.

Step 1 — Name the spore: The sexual spores produced exogenously on a basidium are called basidiospores.

Step 2 — Confirm the feature: In *Agaricus*, the basidia line the gills and bear four basidiospores each.

Why other options are wrong:

- Option A (ascospores) are produced by Ascomycetes inside an ascus.
- Option B (zoospores) are motile asexual spores of some lower fungi.
- Option D (conidia) are asexual spores, not sexual.

Final Answer: Basidiomycetes produce basidiospores $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Animal phyla: Arthropoda is the largest phylum, including insects, crustaceans, arachnids and myriapods; more than two-thirds of all known animal species are arthropods.

Step 1 — Identify the key features: Chitinous exoskeleton, jointed appendages and a segmented body define the arthropods.

Step 2 — Compare sizes: No other phylum approaches arthropods in species number, largely due to the insects.

Why other options are wrong:

- Option B (Mollusca) is the second largest, but far smaller.
- Option C (Chordata) includes vertebrates, a much smaller group.
- Option D (Annelida) are the segmented worms, a small phylum.

Final Answer: The largest animal phylum is Arthropoda $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Phloem: Phloem conducts food (sugars). Its main conducting cells are sieve tube elements, joined end to end with perforated sieve plates.

Step 1 — Read the diagram: The vertical file of cells (P) with dotted sieve plates is the sieve tube; the slim cell beside it is the companion cell.

Step 2 — Note the special feature: A mature sieve tube element loses its nucleus, so it depends on the nucleated companion cell to stay alive and functional.

Why other options are wrong:

- Options A and B (tracheids, vessels) are water-conducting xylem cells.
- Option D (xylem fibres) provide mechanical support in xylem.

Final Answer: The enucleate food-conducting cells are sieve tube elements $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Loose connective tissue: Areolar tissue is a loose connective tissue that fills spaces, supports organs and joins skin to muscles.

Step 1 — Identify the cells: Its matrix contains fibroblasts (make fibres), mast cells (release histamine/heparin) and macrophages.

Step 2 — Note the role: It acts as a packing tissue beneath the skin and between organs.

Why other options are wrong:

- Option A (adipose) stores fat in adipocytes.
- Option B (cartilage) is a firm, specialised connective tissue.
- Option C (tendon) is dense connective tissue joining muscle to bone.

Final Answer: The loose packing tissue with fibroblasts and mast cells is areolar tissue $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Root modifications: Some tap roots swell with stored food. The carrot is a classic conical storage tap root.

Step 1 — Test each plant: Carrot is a swollen tap root; ginger is an underground stem (rhizome); potato is a stem tuber; onion is a modified bulb (condensed stem with fleshy leaves).

Step 2 — Pick the root: Only the carrot among these is a modified *root*.

Why other options are wrong:

- Option B (ginger) is a stem, not a root.
- Option C (potato) is a stem tuber with eyes (buds).
- Option D (onion) is a modified shoot (bulb).

Final Answer: The storage tap root is the carrot $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Lysosome: A lysosome is a single membrane-bound vesicle, budded from the Golgi, that is filled with powerful hydrolytic (digestive) enzymes.

Step 1 — Read the diagram: The figure shows one membrane enclosing many enzyme particles, the diagnostic look of a lysosome.

Step 2 — Link to function: It carries out autophagy (digesting worn-out organelles) and can rupture to digest the whole cell, hence "suicidal bag".

Why other options are wrong:

- Option A (ribosome) is non-membranous and makes protein.
- Option C (peroxisome) handles peroxide/fatty-acid metabolism.
- Option D (Golgi body) packages and sorts, it is not the digestive sac.

Final Answer: The enzyme-filled "suicidal bag" is the lysosome $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Essential amino acids: Of the 20 amino acids, those the body cannot synthesise must come from food; these are the essential amino acids (e.g. lysine, valine, leucine, methionine).

Step 1 — Classify the options: Glycine, alanine and serine are non-essential (the body can make them).

Step 2 — Identify the essential one: Lysine cannot be synthesised by humans and must be obtained from the diet.

Why other options are wrong:

- Options A, B and C (glycine, alanine, serine) are all non-essential amino acids.

Final Answer: The essential amino acid here is lysine $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Chromosome shape: Chromosomes are classified by the position of the centromere, which decides the relative lengths of the two arms.

Step 1 — Read the diagram: The centromere lies in the exact middle, giving two arms of equal length.

Step 2 — Name the type: A centromere in the middle with equal arms defines a metacentric chromosome (it looks "V"-shaped at anaphase).

Why other options are wrong:

- Option B (acrocentric) has the centromere near one end (very unequal arms).
- Option C (telocentric) has a terminal centromere (one arm).
- Option D (sub-metacentric) has the centromere slightly off centre (unequal arms).

Final Answer: Equal arms with a central centromere ⇒ metacentric ⇒ $\boxed{A}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Fluid-mosaic model: Singer and Nicolson described the membrane as a fluid lipid bilayer studded with proteins that can move about (a "mosaic").

Step 1 — Read the diagram: Two rows of phospholipids form the bilayer; protein blocks are embedded across it.

Step 2 — State the key idea: The bilayer is quasi-fluid, so embedded proteins and lipids can move laterally within the membrane.

Why other options are wrong:

- Option A is the older, rigid "sandwich" (Davson–Danielli) model.
- Option B wrongly removes the proteins.
- Option D wrongly makes the membrane a rigid cellulose layer.

Final Answer: A lipid bilayer with laterally mobile embedded proteins ⇒ $\boxed{C}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Imbibition: Imbibition is the absorption of water by solid hydrophilic colloids (like cellulose, starch, proteins), causing them to swell.

Step 1 — Match the examples: Swelling of wood and the soaking-up of water by dry seeds are both swelling of dry colloids, i.e. imbibition.

Step 2 — Note the driving force: It is driven by the matric potential of the dry material; no membrane is required.

Why other options are wrong:

- Option A (osmosis) needs a semipermeable membrane separating two solutions.
- Option B (active transport) needs ATP and carriers.
- Option C (plasmolysis) is shrinkage of a cell in a hypertonic solution.

Final Answer: Swelling of dry wood and seeds is imbibition $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Mineral uptake: Roots take up many ions against a concentration gradient, which needs energy.

Step 1 — Identify the process: Movement of ions against the gradient using metabolic energy (ATP) and membrane carriers is active absorption (active transport).

Step 2 — Confirm the energy need: Because it works "uphill", it stops if respiration (ATP supply) is blocked.

Why other options are wrong:

- Option A (passive diffusion) goes down the gradient without energy.
- Option C (osmosis) is water movement, not ion uptake.
- Option D (imbibition) is swelling of dry colloids.

Final Answer: Uphill, energy-requiring ion uptake is active absorption $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Photorespiration: In C_3 plants RuBisCO can fix O_2 instead of CO_2 when O_2 is high, beginning the wasteful C_2 (photorespiratory) pathway.

Step 1 — Trace the first product: RuBisCO joins O_2 to RuBP, giving one molecule of 3-PGA (3-C) and one molecule of phosphoglycolate (2-C).

Step 2 — Identify the 2-C product: The 2-carbon compound formed is phosphoglycolate.

Why other options are wrong:

- Option B (3-PGA) is a 3-carbon product, not the 2-carbon one asked.
- Option C (oxaloacetate) is the 4-C product of the C_4 pathway.
- Option D (pyruvate) is a 3-C product of glycolysis.

Final Answer: The first 2-carbon product is phosphoglycolate $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Fermentation: In the absence of oxygen, pyruvate is reduced to regenerate NAD^+. The product depends on the organism.

Step 1 — Identify the yeast pathway: In yeast, pyruvate is decarboxylated and reduced to ethanol, releasing CO_2 (alcoholic fermentation).

Step 2 — Contrast with muscle: In animal muscle, pyruvate is instead converted to lactic acid (no CO_2).

Why other options are wrong:

- Options A and B (lactic acid) describe muscle/bacterial fermentation, not yeast.
- Option D (acetyl CoA) forms only in aerobic respiration in mitochondria.

Final Answer: Yeast fermentation gives ethanol and CO_2 $\Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Intestinal absorption: The small intestine is folded and lined with finger-like villi (and microvilli on each cell) to maximise absorptive surface area.

Step 1 — Read the diagram: The projections rising into the lumen are the villi.

Step 2 — Link to function: Each villus contains blood capillaries and a lacteal, so digested food is absorbed efficiently over the huge area.

Why other options are wrong:

- Option A (rugae) are folds of the empty stomach.
- Option B (gastric pits) open into the gastric glands of the stomach.
- Option C (haustra) are pouches of the large intestine.

Final Answer: The absorptive finger-like projections are the villi $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — CO_2 transport: In the tissues, CO_2 enters RBCs and is converted to bicarbonate (HCO_3^-), which then diffuses out into plasma.

Step 1 — Identify the ionic exchange: As HCO_3^- leaves the RBC, Cl^- moves in to keep the charge balanced.

Step 2 — Name it: This inward movement of chloride is the chloride shift, or Hamburger's phenomenon.

Why other options are wrong:

- Option A (Na–K pump) is active transport across nerve/cell membranes.
- Option C (Bohr effect) is the fall in haemoglobin's O_2 affinity at low pH.
- Option D (Haldane effect) relates deoxygenation to higher CO_2 carriage.

Final Answer: The Cl^-/HCO_3^- exchange is the chloride shift $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — Cardiac conduction: The heartbeat is myogenic and begins at the sino-atrial node, the heart's natural pacemaker.

Step 1 — Locate the SA node: It lies in the wall of the right atrium near the opening of the superior vena cava.

Step 2 — State its role: It fires rhythmic impulses (about 70–75 per minute) that set the heart rate.

Why other options are wrong:

- Option B (AV node) only relays the impulse after the SA node fires.
- Option C (bundle of His) conducts impulses into the ventricles.
- Option D (Purkinje fibres) spread the impulse through the ventricular walls.

Final Answer: The natural pacemaker is the SA node $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Micturition: Micturition is the act of voiding urine from the urinary bladder.

Step 1 — Trace the reflex: As the bladder fills, stretch receptors in its wall send signals to the CNS, triggering the micturition reflex.

Step 2 — The response: The bladder muscle contracts and the sphincter relaxes, releasing urine through the urethra.

Why other options are wrong:

- Option A (filtration) occurs in the glomerulus, not the bladder.
- Option B (osmoregulation) is balance of water and salts.
- Option D (deamination) is removal of amino groups in the liver.

Final Answer: Voiding of urine from a full bladder is micturition $\Rightarrow$ C

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Brainstem: The medulla oblongata is the lowest part of the brainstem and houses the centres for life-sustaining reflexes.

Step 1 — List its centres: It controls the respiratory, cardiac (heartbeat) and vasomotor (blood pressure) centres.

Step 2 — Note its importance: Damage to it is usually fatal because these functions stop.

Why other options are wrong:

- Option A (cerebrum) governs thought, memory and voluntary action.
- Option B (cerebellum) controls balance and coordination.
- Option C (hypothalamus) regulates temperature, hunger and the pituitary.

Final Answer: Respiration and heartbeat are controlled by the medulla oblongata $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Calcium balance: Parathyroid hormone (PTH) is the chief hormone that raises blood calcium; it is hypercalcemic.

Step 1 — Identify the main action: PTH stimulates bone-dissolving osteoclasts so that calcium is released from bone into the blood.

Step 2 — Add the supporting actions: It also increases calcium reabsorption in the kidney and (via vitamin D) absorption from the gut.

Why other options are wrong:

- Option A: depositing calcium into bone would lower blood calcium (that is calcitonin's effect).
- Option C: PTH reduces, not increases, urinary calcium loss.
- Option D: PTH increases, not decreases, gut absorption of calcium.

Final Answer: PTH raises blood calcium by releasing it from bone $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Sarcomere: The sarcomere, the contractile unit between two Z-lines, has a central dark A-band flanked by light I-bands.

Step 1 — Read the diagram: The dark central band marked "?" lies between the two I-bands.

Step 2 — Identify it: The dark band containing the thick myosin filaments is the A-band (anisotropic band).

Why other options are wrong:

- Option A (I-band) is the light region with only thin actin filaments.
- Option B (Z-line) bisects each I-band and bounds the sarcomere.
- Option D (M-line) is just the thin line in the middle of the A-band.

Final Answer: The dark myosin-containing central band is the A-band $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept — Pollen wall: A pollen grain has a two-layered wall: a tough outer exine and a thin inner intine.

Step 1 — Read the diagram: The hard, spiny outer wall is made of sporopollenin, the most resistant organic material known.

Step 2 — Name it: This outer wall is the exine; it resists high temperature, acids and enzymes, so pollen is well preserved as fossils.

Why other options are wrong:

- Option B (intine) is the thin inner cellulose-pectin wall.
- Option C (tapetum) is the nourishing layer of the anther, not the pollen wall.
- Option D (nucellus) is the tissue of the ovule, not the pollen.

Final Answer: The sporopollenin outer wall is the exine $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Testis structure: Each testicular lobule contains coiled seminiferous tubules where sperm are made; between the tubules lie the interstitial (Leydig) cells.

Step 1 — Locate spermatogenesis: The germ cells lining the seminiferous tubules divide and differentiate into spermatozoa.

Step 2 — Separate the hormone source: Testosterone comes from the Leydig cells between the tubules, not from the tubules themselves.

Why other options are wrong:

- Option A (epididymis) stores and matures sperm after they are made.
- Option B (vas deferens) carries sperm onward.
- Option C (prostate) only adds fluid to semen.

Final Answer: Sperm are produced in the seminiferous tubules $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Ovarian cycle: After ovulation the empty Graafian follicle becomes the corpus luteum ("yellow body"), a temporary endocrine gland.

Step 1 — Identify the secretion: The corpus luteum secretes large amounts of progesterone (with some oestrogen).

Step 2 — Note its role: Progesterone maintains the thickened uterine lining (endometrium) for a possible pregnancy.

Why other options are wrong:

- Option A (corpus albicans) is the degenerated, non-secreting remnant.
- Option C (corpus callosum) is a band of nerve fibres in the brain.
- Option D (primary follicle) is an immature follicle before ovulation.

Final Answer: The progesterone-secreting body is the corpus luteum $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Intra-uterine devices: The Copper-T is a copper-releasing IUD placed in the uterus to prevent conception.

Step 1 — Identify the mechanism: The released copper ions are toxic to sperm, suppressing their motility and fertilising capacity.

Step 2 — Add the effect on the uterus: It also makes the endometrium unsuitable for implantation, but its chief action is the spermicidal effect of copper.

Why other options are wrong:

- Option B describes tubectomy (a surgical sterilisation), not an IUD.
- Option C describes hormonal pills, not a Copper-T.
- Option D is biologically false; an IUD does not act on the testis.

Final Answer: Copper-T works by copper ions suppressing sperm $\Rightarrow$ A

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Test cross: Crossing a heterozygote with a homozygous recessive reveals the gametes of the heterozygote directly in the offspring ratio.

Step 1 — List the gametes: RrYy produces four gamete types in equal numbers: RY, Ry, rY, ry. The tester rryy gives only ry.

Step 2 — Read the cross: Each gamete of RrYy combines with ry, giving RrYy, Rryy, rrYy, rryy in equal 1:1:1:1 proportions, which are four different phenotypes.

Why other options are wrong:

- Option A (9:3:3:1) is the F_2 of a dihybrid self-cross, not a test cross.
- Option B (3:1) is a monohybrid F_2 ratio.
- Option C (1:2:1) is a monohybrid genotypic ratio.

Final Answer: A dihybrid test cross gives 1:1:1:1 $\Rightarrow$ D

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Pleiotropy: When one gene affects many, seemingly unrelated traits at once, the effect is called pleiotropy.

Step 1 — Define it: A single pleiotropic gene controls several phenotypic characters (e.g. the gene for phenylketonuria affects pigmentation, IQ and more).

Step 2 — Distinguish it: It is the reverse of polygenic inheritance, where many genes act on one trait.

Why other options are wrong:

- Option A (epistasis) is one gene masking another gene.
- Option B (codominance) is two alleles both expressed (e.g. AB blood group).
- Option D (incomplete dominance) gives a blended intermediate phenotype.

Final Answer: One gene affecting many traits is pleiotropy $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — X-linked inheritance: A male has only one X chromosome, which he passes to his daughters; his sons receive his Y.

Step 1 — Trace the X: Every daughter inherits the father's only X, so she receives any X-linked gene he carries.

Step 2 — Note the carrier state: For a recessive X-linked gene, the daughters become carriers (one defective X), not necessarily affected.

Why other options are wrong:

- Option A: sons get the father's Y, never his X-linked gene.
- Option C: it is certainly transmitted to all daughters.
- Option D: the gene is not passed to sons at all.

Final Answer: A father's X-linked gene goes to all his daughters $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept — lac operon: The *lac* operon is an inducible system; in the absence of lactose a repressor binds the operator and blocks transcription.

Step 1 — Action of the inducer: When lactose (its isomer allolactose) is present, it binds to the repressor and changes its shape so it can no longer bind the operator.

Step 2 — Result: With the operator free, RNA polymerase transcribes the structural genes z, y and a, producing the enzymes to use lactose.

Why other options are wrong:

- Option B: lactose does not bind the operator.
- Option C: the structural genes are transcribed, not destroyed.
- Option D: lactose lowers, not raises, the repressor's affinity for DNA.

Final Answer: Lactose inactivates the repressor, switching on the operon $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Aneuploidy: Turner syndrome results from monosomy of the sex chromosomes (45, XO) in a female.

Step 1 — Count the chromosomes: 44 autosomes + a single X gives 45 chromosomes, one fewer than normal.

Step 2 — Note the features: Such individuals are sterile females with rudimentary ovaries, short stature and lack of secondary sexual characters.

Why other options are wrong:

- Option A (Down syndrome) is trisomy of chromosome 21 (47 chromosomes).
- Option B (Klinefelter) is 47, XXY (a male).
- Option C (haemophilia) is a gene disorder, not a chromosome-number change.

Final Answer: A 45,XO sterile female has Turner syndrome $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept — Homology vs analogy: Analogous organs have the same function but different structure and origin, and arise by convergent evolution.

Step 1 — Compare the wings: A butterfly wing (a fold of body wall) and a bird wing (modified forelimb with bones) do the same job, flight, but are built very differently.

Step 2 — Classify: Same function, different structure $\Rightarrow$ analogous organs.

Why other options are wrong:

- Option A (homologous) means same structure/origin but possibly different function (divergent evolution).
- Option B (vestigial) are reduced, functionless remnants.
- Option D (atavistic) refers to the reappearance of ancestral traits.

Final Answer: Butterfly and bird wings are analogous organs $\Rightarrow$ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Helminth diseases: Ascariasis is caused by the intestinal roundworm *Ascaris lumbricoides*.

Step 1 — Identify the pathogen: *Ascaris* is a parasitic nematode that lives in the human intestine.

Step 2 — Note the spread and symptoms: Its eggs spread through contaminated food/water; infection causes internal bleeding, blockage of the intestine and muscular pain.

Why other options are wrong:

- Option A (*Wuchereria*) causes filariasis (elephantiasis).
- Option C (*Taenia*) is the tapeworm.
- Option D (*Entamoeba*) causes amoebiasis (amoebic dysentery).

Final Answer: Ascariasis is caused by *Ascaris lumbricoides* $\Rightarrow$ B

Answer: (B) Go Back to Q32

Q33.

Solution

Concept — Microbes in food: Baker's yeast, *Saccharomyces cerevisiae*, is used to leaven bread.

Step 1 — Identify the action: The yeast ferments sugars in the dough, releasing CO_2.

Step 2 — Note the effect: The trapped CO_2 bubbles make the dough rise and give bread its porous, spongy texture.

Why other options are wrong:

- Option B (*Lactobacillus*) is used for curd, not bread leavening.
- Option C (*Aspergillus niger*) is used to make citric acid.
- Option D (*Clostridium*) is used for some organic-acid/solvent production.

Final Answer: Bread is leavened by *Saccharomyces cerevisiae* $\Rightarrow$ A

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Allergy: An allergy is a hypersensitive (exaggerated) immune response to harmless environmental allergens.

Step 1 — Trace the reaction: On exposure, IgE antibodies on mast cells cause those cells to release chemical mediators.

Step 2 — Name the chemicals: The main mediators released are histamine and serotonin, which cause sneezing, watery eyes and inflammation.

Why other options are wrong:

- Option A (interferons) are antiviral proteins, not allergy mediators.
- Option B (IgG) is an antibody class, not the released chemical.
- Option C (lysozyme) is an antibacterial enzyme in secretions.

Final Answer: Mast cells release histamine and serotonin $\Rightarrow$ D

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Bioreactors: A bioreactor is a vessel for growing cells/microbes on a large scale to obtain a product.

Step 1 — Identify the common type: The simple stirred-tank bioreactor is usually cylindrical, with a stirrer that mixes the contents and helps aeration.

Step 2 — Note the controls: It also has an oxygen-delivery system, foam control, and temperature/pH control to keep conditions optimal.

Why other options are wrong:

- Option A (laminar air-flow chamber) only provides a sterile working space.
- Option B (autoclave) is used to sterilise equipment.
- Option D (thermal cycler) is the PCR machine, not a culture vessel.

Final Answer: The common culture vessel is the stirred-tank bioreactor $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Selectable marker: A vector needs a gene that lets us pick out the cells that have taken it up; this is the selectable marker.

Step 1 — Identify the function: Antibiotic-resistance genes are common markers: only transformed cells survive on a medium containing that antibiotic.

Step 2 — Confirm the role: It thus distinguishes transformants from non-transformants.

Why other options are wrong:

- Option A (structural gene) codes for the protein of interest.
- Option C (promoter) is where transcription begins.
- Option D (origin of replication) controls copy number, not selection.

Final Answer: The gene used to select transformed cells is the selectable marker $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept — Golden rice: Golden rice is a transgenic rice engineered to make pro-vitamin A in its grains.

Step 1 — Identify the enrichment: Its endosperm accumulates beta-carotene, which gives the grain a golden colour.

Step 2 — Note the purpose: Beta-carotene is converted to vitamin A in the body, so the rice helps fight vitamin A deficiency and the blindness it causes.

Why other options are wrong:

- Option B (vitamin C) is not the target nutrient of golden rice.
- Option C (iron) was the aim of other biofortified crops, not golden rice's golden colour.
- Option D (fatty acids) is unrelated to golden rice.

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

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Commensalism: Commensalism is an interaction in which one species benefits while the other is neither helped nor harmed $(+/0)$.

Step 1 — Analyse the example: The clownfish gains shelter and protection among the anemone's stinging tentacles; the anemone is essentially unaffected.

Step 2 — Classify: One-sided benefit with no effect on the partner $\Rightarrow$ commensalism.

Why other options are wrong:

- Option A (mutualism) needs both partners to gain $(+/+)$.
- Option B (parasitism) harms one partner $(+/-)$.
- Option C (predation) is one organism eating another $(+/-)$.

Final Answer: Clownfish and sea anemone show commensalism $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept — Pyramid of biomass: A biomass pyramid compares the standing crop (mass of living material) at each trophic level at one instant; in a pond it is inverted.

Step 1 — Compare standing crops: The phytoplankton (producers) are tiny and present in small total mass at any moment, even though they reproduce very fast.

Step 2 — Explain the inversion: The larger, longer-lived zooplankton and fish have a greater biomass at that instant, so the pyramid is broad at the top and narrow at the base.

Why other options are wrong:

- Option A: size is not the reason; it is the small instantaneous biomass of producers.
- Option B: energy always decreases, never increases, up the chain.
- Option D: decomposers are present in ponds; that is not the reason.

Final Answer: The small producer biomass supports a larger consumer biomass, inverting the pyramid $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Endemism: Endemic species are those restricted to a single, defined geographical area and found nowhere else.

Step 1 — Apply the definition: If a plant or animal occurs only in one region (e.g. certain species in the Western Ghats), it is endemic to that region.

Step 2 — Note the significance: Endemic species are especially vulnerable, so they receive priority in conservation and the Red Data Book.

Why other options are wrong:

- Option A (extinct) means no longer existing anywhere.
- Option C (introduced/exotic) are brought from elsewhere into a new area.
- Option D (keystone) species have a disproportionate effect on their ecosystem regardless of range.

Final Answer: Species confined to one area are endemic species $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q40

Answer Key

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