KIITEE Biology Sample Paper – 7

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. Gymnosperms such as *Pinus* and *Cycas* are distinguished from angiosperms chiefly by the fact that their:

(A) Seeds are enclosed within a ripened ovary (fruit)

(B) Ovules are naked, not enclosed within an ovary

(C) Plant body is a gametophyte-dominated thallus

(D) Reproduction is entirely by spores, without seeds

Q2. Mycoplasmas (PPLO) are regarded as the smallest known living cells. A distinctive feature that allows them to take many shapes and resist penicillin is that they:

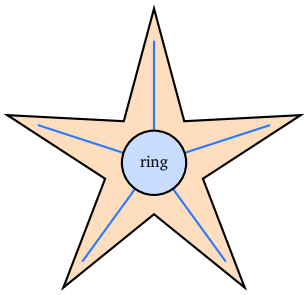
(A) Possess a thick peptidoglycan cell wall

(B) Are obligately photosynthetic

(C) Have a true membrane-bound nucleus

(D) Completely lack a cell wall

Q3. The starfish shown below moves and captures prey using fluid-filled tube feet operated by the system marked at its centre. This locomotory and feeding system, unique to phylum Echinodermata, is the:



radial & ring canals of a starfish

(A) Open circulatory system

(B) Tracheal system

(C) Water vascular system

(D) Lateral line system

Q4. The outermost protective layer of a leaf is covered by a waxy, water-resistant film of cutin. This film, which checks excessive water loss and infection, is the:

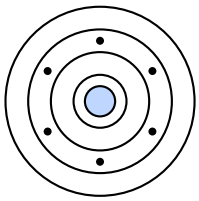
(A) Cuticle

(B) Casparian strip

(C) Endodermis

(D) Pericycle

Q5. The transverse section of compact bone below shows bone matrix laid down in concentric rings (lamellae) around a central canal carrying blood vessels and nerves. This structural unit of compact bone is the:



concentric lamellae round a central canal

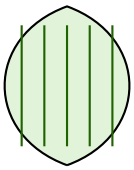
(A) Haversian system (osteon)

(B) Sarcomere

(C) Nephron

(D) Malpighian corpuscle

Q6. The leaf shown below has its veins running side by side, more or less parallel to one another along the length of the lamina. This pattern of venation is characteristic of:



veins running parallel

(A) Dicotyledonous leaves

(B) Monocotyledonous leaves

(C) Gymnosperm needles only

(D) Pteridophyte fronds only

Q7. Peroxisomes and glyoxysomes are single-membrane microbodies. The enzyme that they characteristically contain, which breaks down the toxic hydrogen peroxide produced in the cell, is:

(A) Pepsin

(B) RuBisCO

(C) DNA polymerase

(D) Catalase

Q8. Malonate inhibits the enzyme succinate dehydrogenase because malonate closely resembles succinate and binds to the same site. This is an example of:

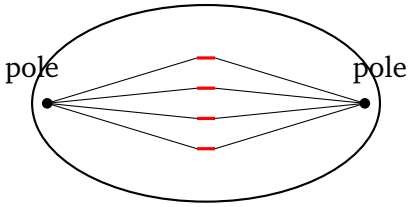
(A) Non-competitive (allosteric) inhibition

(B) Feedback activation

(C) Competitive inhibition

(D) Irreversible denaturation

Q9. In the dividing cell shown, the chromosomes have lined up exactly along the central equatorial plane, with spindle fibres attached to their centromeres from both poles. The cell is in:



chromosomes on the metaphase plate

(A) Prophase

(B) Metaphase

(C) Anaphase

(D) Telophase

Q10. Movement of a solute across the plasma membrane down its concentration gradient, without any expenditure of ATP, is called passive transport. Which of the following is a passive process?

(A) Facilitated diffusion through a carrier protein

(B) The sodium–potassium pump

(C) Endocytosis of large particles

(D) Active uptake of mineral ions by roots

Q11. Removal of the shoot tip (decapitation) of a plant often makes the lower lateral buds sprout and grow. This shows that the apex normally suppresses lateral buds through the hormone:

(A) Abscisic acid

(B) Ethylene

(C) Auxin

(D) Cytokinin

Q12. The chlorophyll molecule has a porphyrin head with a long phytol tail. The metal ion held at the centre of the porphyrin ring is:

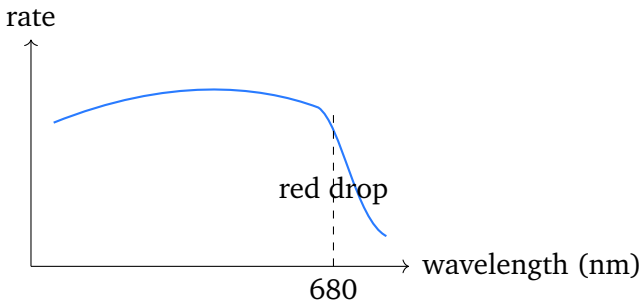
(A) Iron (Fe)

(B) Copper (Cu)

(C) Manganese (Mn)

(D) Magnesium (Mg)

Q13. The graph shows the rate of photosynthesis falling sharply when light of wavelength longer than about 680 nm is used, even though such light is still absorbed. This decline (the "red drop") was the key observation behind:



(A) The chemiosmotic hypothesis

(B) The discovery of two photosystems (Emerson enhancement)

(C) The Calvin cycle

(D) Glycolysis

Q14. Glycolysis, the breakdown of glucose to pyruvate by the Embden–Meyerhof–Parnas pathway, takes place in the:

(A) Inner mitochondrial membrane

(B) Mitochondrial matrix

(C) Cytoplasm (cytosol)

(D) Thylakoid lumen

Q15. The dental formula of an adult human, written for one half of the upper and lower jaw, is $\frac{2123}{2123}$. The digits in this formula stand, in order, for the number of:

(A) Incisors, canines, premolars and molars

(B) Canines, incisors, molars and premolars

(C) Molars, premolars, canines and incisors

(D) Premolars, molars, incisors and canines

Q16. During normal inspiration in humans, air is drawn into the lungs because:

(A) The diaphragm relaxes and domes upward, raising thoracic pressure

(B) The internal intercostal muscles pull the ribs down and in

(C) Lung volume decreases and intrapulmonary pressure rises

(D) The diaphragm contracts and flattens, increasing thoracic volume and lowering pressure

Q17. Lymph differs from blood in that lymph:

(A) Lacks red blood cells and most plasma proteins, but contains white blood cells

(B) Is rich in red blood cells and oxygen

(C) Contains more plasma proteins than blood plasma

(D) Has no cells of any kind

Q18. In humans, ammonia produced from the breakdown of amino acids is converted into the less toxic urea by the ornithine (urea) cycle. This cycle operates mainly in the:

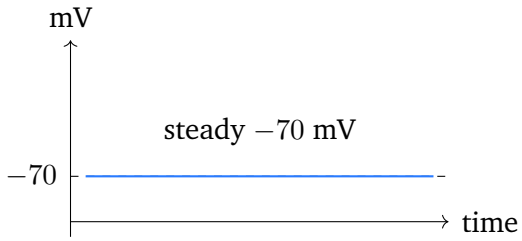
(A) Kidneys

(B) Liver

(C) Pancreas

(D) Spleen

Q19. The trace below shows the electrical potential across the membrane of a resting neuron that is not conducting any impulse. This steady value of about -70 mV, maintained largely by the Na^+/K^+ pump and the membrane's higher permeability to K^+, is the:



(A) Action potential

(B) Depolarisation

(C) Resting membrane potential

(D) Threshold potential

Q20. The hormone calcitonin helps to keep blood calcium within normal limits. When blood calcium rises too high, calcitonin acts to:

(A) Increase calcium absorption from the gut

(B) Stimulate bone breakdown to release calcium

(C) Raise the blood calcium level further

(D) Lower the blood calcium level

Q21. Of the twelve pairs of ribs in humans, the last two pairs are not connected to the sternum either directly or indirectly. These pairs are called:

(A) True ribs

(B) Floating ribs

(C) Vertebrosternal ribs

(D) Cervical ribs

Q22. Bananas develop fleshy edible fruits without fertilisation, and so the fruits are seedless. The development of fruit without fertilisation is called:

(A) Parthenocarpy

(B) Parthenogenesis

(C) Apomixis

(D) Polyembryony

Q23. After being produced in the seminiferous tubules of the testis, sperms are stored and matured before being carried towards the urethra. The correct path of sperm transport is:

(A) Vas deferens $\rightarrow$ epididymis $\rightarrow$ urethra

(B) Urethra $\rightarrow$ vas deferens $\rightarrow$ epididymis

(C) Epididymis $\rightarrow$ vas deferens $\rightarrow$ urethra

(D) Vas deferens $\rightarrow$ urethra $\rightarrow$ epididymis

Q24. The yellowish first milk secreted by the mother in the days just after childbirth is rich in antibodies (especially IgA) that protect the newborn. This first milk is called:

(A) Lactose

(B) Lymph

(C) Plasma

(D) Colostrum

Q25. Condoms and diaphragms work as contraceptives because they:

(A) Form a physical barrier that prevents sperm from meeting the ovum

(B) Suppress ovulation through hormones

(C) Make the uterus unfit for implantation by surgery

(D) Permanently block the vas deferens

Q26. In genetics, the observable physical or biochemical characteristic of an organism (such as flower colour) is its phenotype, whereas the genetic constitution responsible for it is its:

(A) Karyotype

(B) Phenotype

(C) Genotype

(D) Ecotype

Q27. The ABO blood group system in humans is controlled by three alleles (I^A, I^B, i) of a single gene. The existence of more than two alleles of the same gene in a population is called:

(A) Pleiotropy

(B) Multiple allelism

(C) Polygenic inheritance

(D) Linkage

Q28. In grasshoppers, females have two X chromosomes (XX) while males have only one X and no Y (XO). In this XX–XO type of sex determination, the sex of the offspring is decided by:

(A) Whether the egg carries an X or a Y chromosome

(B) The presence of a Y chromosome in the male

(C) Environmental temperature during development

(D) Whether the fertilising sperm carries an X chromosome or none

Q29. Hershey and Chase used bacteriophages whose DNA was labelled with ^{32}P and whose protein coat was labelled with ^{35}S. Their experiment conclusively proved that:

(A) DNA, not protein, is the genetic material

(B) Protein is the genetic material

(C) RNA is the genetic material in all organisms

(D) Both DNA and protein carry genetic information equally

Q30. Thalassemia is an inherited blood disorder in which there is anaemia because of:

(A) Substitution of valine for glutamate in the beta-globin chain

(B) Reduced or absent synthesis of one of the globin chains of haemoglobin

(C) An extra copy of chromosome 21

(D) Inability of blood to clot

Q31. Darwin observed many species of finches on the Galapagos islands, all descended from a single seed-eating ancestor but with beaks adapted to different diets. This evolution of many forms from one ancestral stock in a new habitat is called:

(A) Convergent evolution

(B) Industrial melanism

(C) Genetic drift

(D) Adaptive radiation

Q32. Ringworm, one of the most common contagious skin diseases marked by dry, scaly, ring-like lesions, is caused by:

(A) A protozoan

(B) A virus

(C) Fungi (dermatophytes such as *Microsporum*, *Trichophyton*)

(D) A bacterium

Q33. Many plants form mycorrhiza, a symbiosis between their roots and a fungus. The plant benefits chiefly because the fungal partner improves the uptake of:

(A) Phosphorus from the soil

(B) Atmospheric nitrogen directly

(C) Carbon dioxide for photosynthesis

(D) Sunlight for the roots

Q34. The human immunodeficiency virus (HIV), which causes AIDS, gradually weakens the body's immunity because it mainly infects and destroys the:

(A) Red blood cells

(B) Platelets

(C) Neurons of the brain

(D) Helper T-lymphocytes

Q35. A cloning vector must contain a specific DNA sequence at which replication begins, so that the recombinant DNA can multiply inside the host cell. This sequence is the:

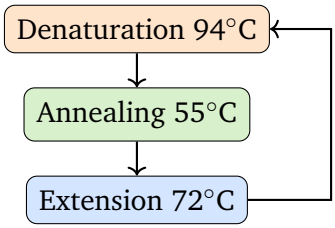
(A) Selectable marker

(B) Recognition site for a restriction enzyme

(C) Origin of replication (ori)

(D) Multiple cloning site

Q36. The polymerase chain reaction amplifies a DNA segment by repeating the three steps shown in the cycle below. The step in which the double-stranded DNA is heated to about 94°C to separate the two strands is:



(A) Annealing

(B) Denaturation

(C) Extension

(D) Ligation

Q37. The recognition sequence of the restriction enzyme *Eco*RI is shown below. The enzyme cuts both strands between G and A, leaving single-stranded overhangs. The sequence reads the same 5′ →3′ on both strands, so it is a:

5′– G A A T T C –3′
3′– C T T A A G –5′
staggered cuts give sticky ends

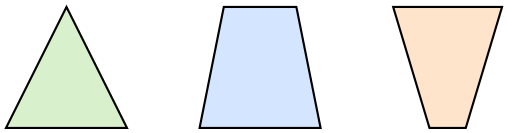
(A) Palindromic sequence

(B) Telomere

(C) Promoter

(D) Centromere

Q38. Three age pyramids of human populations are shown below. The pyramid that represents a rapidly *expanding* (growing) population, with a very broad base of pre-reproductive individuals, is:



(A) Pyramid II

(B) Pyramid I

(C) Pyramid III

(D) All three represent the same growth

Q39. In an ecosystem, the rate at which producers capture and store energy as biomass is the gross primary productivity (GPP). The net primary productivity (NPP) available to herbivores is obtained by:

(A) Adding the energy lost in respiration to GPP

(B) Multiplying GPP by the number of trophic levels

(C) Taking GPP as exactly equal to NPP

(D) Subtracting the energy lost in respiration from GPP

Q40. Excess nutrients such as nitrates and phosphates draining into a lake cause a rapid overgrowth of algae (algal bloom), followed by oxygen depletion and death of fish. This nutrient enrichment of water bodies is called:

(A) Biomagnification

(B) Biological oxygen demand

(C) Eutrophication

(D) Sedimentation

Detailed Solutions

Q1.

Solution

Concept — Gymnosperms: Gymnosperms are seed plants in which the ovules are borne exposed on the surface of megasporophylls, so the seeds are not covered.

Step 1 — Read the key word: "Gymno" means naked and "sperma" means seed. The ovules are not enclosed inside an ovary.

Step 2 — Compare with angiosperms: In angiosperms the ovules lie within a closed ovary that ripens into a fruit; in gymnosperms there is no ovary and hence no true fruit.

Why other options are wrong:

- Option A describes the angiosperm condition.
- Option C: gymnosperms are sporophyte-dominated vascular plants, not thalloid gametophytes.
- Option D: gymnosperms reproduce by seeds, not only by spores.

Final Answer: Gymnosperms bear naked ovules, not enclosed in an ovary $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Mycoplasma: Mycoplasmas (PPLO, pleuro-pneumonia-like organisms) are the smallest free-living cells known and are prokaryotic.

Step 1 — Identify the special feature: Unlike almost all other bacteria, mycoplasmas have no cell wall at all.

Step 2 — Link to the observations: Without a rigid wall they are pleomorphic (many shapes) and are unaffected by penicillin, which acts on cell-wall synthesis.

Why other options are wrong:

- Option A: they specifically lack peptidoglycan walls.
- Option B: they are not obligately photosynthetic.
- Option C: being prokaryotes, they have no membrane-bound nucleus.

Final Answer: Mycoplasmas completely lack a cell wall $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Echinoderms: Phylum Echinodermata (e.g. starfish) possesses a unique water vascular system derived from the coelom.

Step 1 — Read the diagram: The central ring canal gives off radial canals into the arms; these connect to tube feet.

Step 2 — Link to function: Water pressure within this system extends and retracts the tube feet, enabling locomotion, food capture and respiration.

Why other options are wrong:

- Option A (open circulatory system) is for blood, not the tube-feet mechanism.
- Option B (tracheal system) is the air-tube system of insects.
- Option D (lateral line system) is a sense organ of fishes.

Final Answer: The tube feet are worked by the water vascular system $\Rightarrow$ C

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Protective surface tissue: The aerial parts of a plant are covered by an epidermis, the outer wall of which is coated with cutin.

Step 1 — Name the waxy film: This layer of cutin on the outer epidermal wall is the cuticle.

Step 2 — Link to function: Being waxy and water-repellent, the cuticle checks evaporation of water and entry of pathogens.

Why other options are wrong:

- Option B (Casparian strip) is a suberin band in the root endodermis, not a surface film.
- Option C (endodermis) is an inner cortical layer.
- Option D (pericycle) lies inside the endodermis and gives rise to lateral roots.

Final Answer: The waxy cutin film on the leaf surface is the cuticle $\Rightarrow$ A

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Compact bone: Compact bone is built of repeating cylindrical units, each made of concentric lamellae around a central vascular canal.

Step 1 — Read the diagram: The rings are the lamellae and the central canal carries blood vessels and nerves; the dots are lacunae housing osteocytes.

Step 2 — Name the unit: This whole cylinder is the Haversian system, also called an osteon, with the central canal being the Haversian canal.

Why other options are wrong:

- Option B (sarcomere) is the contractile unit of muscle.
- Option C (nephron) is the functional unit of the kidney.
- Option D (Malpighian corpuscle) is the filtering part of a nephron.

Final Answer: The lamellae round a central canal form the Haversian system $\Rightarrow$ A

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Leaf venation: The arrangement of veins in the leaf lamina is a useful clue to whether a plant is a monocot or a dicot.

Step 1 — Read the diagram: The veins run side by side, parallel to one another, without forming a network.

Step 2 — Match to the class: Parallel venation is the typical pattern of monocotyledonous leaves (e.g. grass, maize), whereas dicots show reticulate (net-like) venation.

Why other options are wrong:

- Option A (dicots) shows reticulate venation.
- Options C and D wrongly restrict parallel venation to gymnosperms or ferns.

Final Answer: Parallel venation is characteristic of monocot leaves $\Rightarrow$ B

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Microbodies: Peroxisomes and glyoxysomes are single-membrane microbodies that handle reactions producing or destroying hydrogen peroxide.

Step 1 — Identify the enzyme: These microbodies are rich in catalase, the enzyme that splits toxic H_2O_2 into water and oxygen.

Step 2 — Note their roles: Peroxisomes take part in photorespiration and fatty-acid oxidation; glyoxysomes (in fat-storing seeds) carry the glyoxylate cycle.

Why other options are wrong:

- Option A (pepsin) is a gastric protease.
- Option B (RuBisCO) fixes CO_2 in chloroplast stroma.
- Option C (DNA polymerase) synthesises DNA.

Final Answer: Microbodies characteristically contain catalase $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Enzyme inhibition: An inhibitor that structurally resembles the substrate and competes with it for the active site is a competitive inhibitor.

Step 1 — Compare malonate and succinate: Malonate closely resembles the normal substrate succinate, so it binds the active site of succinate dehydrogenase.

Step 2 — Note the consequence: While malonate occupies the site, succinate cannot bind; raising the substrate concentration can overcome the inhibition, confirming it is competitive.

Why other options are wrong:

- Option A (non-competitive) binds a site other than the active site.
- Option B (feedback activation) is not an inhibition at all.
- Option D (denaturation) is permanent loss of structure, not reversible competition.

Final Answer: Malonate is a classic competitive inhibitor $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Mitotic metaphase: During metaphase the chromosomes become aligned at the equatorial plane and spindle fibres attach to their centromeres.

Step 1 — Read the diagram: All chromosomes lie in one row exactly midway between the two poles (the metaphase plate), with fibres from both poles attached.

Step 2 — Match to the stage: This precise equatorial alignment is the hallmark of metaphase.

Why other options are wrong:

- Option A (prophase): chromosomes condense but are not yet aligned.
- Option C (anaphase): sister chromatids have already moved towards the poles.
- Option D (telophase): chromosomes reach the poles and nuclei reform.

Final Answer: Equatorial alignment of chromosomes marks metaphase $\Rightarrow$ B

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Membrane transport: Passive transport moves substances down their concentration gradient and needs no metabolic energy (ATP).

Step 1 — Identify the passive process: Facilitated diffusion uses a carrier or channel protein but still moves solute down the gradient without ATP, so it is passive.

Step 2 — Eliminate active processes: Pumping ions against a gradient and engulfing particles both require energy.

Why other options are wrong:

- Option B (Na–K pump) is active transport, using ATP.
- Option C (endocytosis) is energy-requiring bulk transport.
- Option D (active mineral uptake) consumes ATP against the gradient.

Final Answer: Facilitated diffusion is the passive process $\Rightarrow$ A

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Apical dominance: The growing shoot apex suppresses the growth of lateral (axillary) buds, a phenomenon called apical dominance.

Step 1 — Identify the hormone: Auxin produced at the shoot tip moves down and inhibits the lateral buds.

Step 2 — Explain the experiment: When the tip is cut off, the source of auxin is removed, so the lateral buds are released and sprout. Auxin is also used to promote rooting of cuttings.

Why other options are wrong:

- Option A (abscisic acid) promotes dormancy and stomatal closure.
- Option B (ethylene) ripens fruits and promotes abscission.
- Option D (cytokinin) in fact promotes lateral bud growth, opposing apical dominance.

Final Answer: Apical dominance is maintained by auxin $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Chlorophyll structure: Chlorophyll is a porphyrin (tetrapyrrole) ring with a central metal ion and a phytol tail.

Step 1 — Identify the central metal: The metal held at the centre of the chlorophyll porphyrin ring is magnesium (Mg).

Step 2 — Contrast with haem: In haemoglobin the analogous porphyrin holds iron, but in chlorophyll it is magnesium.

Why other options are wrong:

- Option A (Fe) is the central metal of haem, not chlorophyll.
- Options B (Cu) and C (Mn) are micronutrients but not the central metal of chlorophyll.

Final Answer: The central metal of chlorophyll is magnesium $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Red drop and enhancement: Emerson found that photosynthetic efficiency drops sharply at wavelengths beyond about 680 nm (the red drop).

Step 1 — Read the graph: The rate stays high through the visible red, then falls steeply past 680 nm.

Step 2 — Interpret the result: Supplying shorter-wavelength light along with the far-red light restored the rate (the Emerson enhancement effect). This showed that two pigment systems (Photosystem I and Photosystem II) work together.

Why other options are wrong:

- Option A (chemiosmosis) explains ATP synthesis, not the red drop.
- Option C (Calvin cycle) is the dark reaction.
- Option D (glycolysis) is a respiratory pathway.

Final Answer: The red drop led to the discovery of two photosystems $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Glycolysis: Glycolysis is the first stage of respiration, common to aerobic and anaerobic pathways.

Step 1 — Locate the pathway: All ten enzymes of the Embden–Meyerhof–Parnas pathway are present in the cytoplasm (cytosol).

Step 2 — Contrast with later stages: The Krebs cycle occurs in the mitochondrial matrix and the electron transport chain on the inner mitochondrial membrane, but glycolysis is purely cytoplasmic.

Why other options are wrong:

- Options A and B are sites of later aerobic respiration.
- Option D (thylakoid lumen) belongs to photosynthesis.

Final Answer: Glycolysis takes place in the cytoplasm $\Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Dental formula: The dental formula lists the number of each kind of tooth in one half of the upper jaw over one half of the lower jaw, in a fixed order.

Step 1 — Recall the order: The standard order is Incisors, Canines, Premolars, Molars (I, C, PM, M).

Step 2 — Read the digits: $\frac{2123}{2123}$ therefore means 2 incisors, 1 canine, 2 premolars and 3 molars in each half jaw, giving 32 teeth in all.

Why other options are wrong:

- Options B, C and D scramble the fixed I-C-PM-M order.

Final Answer: The order is incisors, canines, premolars, molars $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Mechanism of inspiration: Breathing in is an active process driven by the diaphragm and external intercostal muscles.

Step 1 — Trace the muscle action: The diaphragm contracts and flattens, and the external intercostals raise the ribs and sternum, increasing the volume of the thoracic cavity.

Step 2 — Apply the pressure law: A larger thoracic volume lowers the intrapulmonary pressure below atmospheric pressure, so air rushes into the lungs.

Why other options are wrong:

- Options A and B describe expiration (diaphragm relaxing, ribs pulled down).
- Option C: lung volume increases, not decreases, during inspiration.

Final Answer: The diaphragm contracts and flattens, increasing thoracic volume $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Lymph: Lymph is the tissue fluid that drains into lymphatic vessels; it is similar to plasma but modified.

Step 1 — State its composition: Lymph is a colourless fluid that lacks red blood cells and most of the larger plasma proteins, but it contains white blood cells (mainly lymphocytes).

Step 2 — Note its functions: It returns tissue fluid and proteins to blood, absorbs fats from the intestine, and takes part in immunity.

Why other options are wrong:

- Option B: lymph is poor in RBCs and oxygen.
- Option C: lymph has fewer plasma proteins than blood plasma.
- Option D: lymph does contain cells (WBCs).

Final Answer: Lymph lacks RBCs and most plasma proteins but has WBCs $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Urea cycle: Humans are ureotelic; toxic ammonia is detoxified into urea through the ornithine (urea) cycle.

Step 1 — Locate the cycle: The urea cycle runs in the cells of the liver.

Step 2 — Follow the fate of urea: The urea formed is carried by blood to the kidneys, which excrete it in urine.

Why other options are wrong:

- Option A (kidneys) excrete urea but do not synthesise it.
- Option C (pancreas) secretes digestive enzymes and hormones.
- Option D (spleen) is concerned with blood storage and immunity.

Final Answer: The ornithine (urea) cycle operates in the liver $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Resting potential: A neuron that is not conducting an impulse maintains a steady voltage difference across its membrane.

Step 1 — Read the trace: The voltage stays constant at about -70 mV, inside negative relative to outside.

Step 2 — Explain its origin: The Na^+/K^+ pump keeps Na^+ high outside and K^+ high inside, and the membrane is more permeable to K^+; the resulting ionic distribution gives the resting membrane potential.

Why other options are wrong:

- Option A (action potential) is the transient reversal during an impulse.
- Option B (depolarisation) is the rising phase, not a steady resting state.
- Option D (threshold) is the trigger level for firing, not the resting value.

Final Answer: The steady -70 mV is the resting membrane potential $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Calcium homeostasis: Blood calcium is regulated by parathyroid hormone (raises it) and calcitonin (lowers it).

Step 1 — State calcitonin's action: Secreted by the thyroid, calcitonin reduces blood calcium when it rises too high.

Step 2 — Describe the mechanism: It inhibits the release of calcium from bone (suppresses osteoclasts) and promotes its deposition, thereby lowering blood calcium.

Why other options are wrong:

- Options A and B would raise blood calcium, which is the action of parathormone, not calcitonin.
- Option C is the opposite of calcitonin's role.

Final Answer: Calcitonin lowers the blood calcium level $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Rib cage: Humans have 12 pairs of ribs, classified by their attachment to the sternum.

Step 1 — Recall the groups: Pairs 1–7 are true ribs (joined to the sternum directly), pairs 8–10 are false ribs (joined indirectly), and pairs 11–12 have no sternal attachment at all.

Step 2 — Name the last two pairs: Because their front ends remain free, the 11th and 12th pairs are called floating ribs.

Why other options are wrong:

- Option A (true ribs) are the first seven pairs.
- Option C (vertebrosternal) is another name for true ribs.
- Option D (cervical ribs) is an abnormal extra rib, not a normal feature.

Final Answer: The last two unattached pairs are floating ribs $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Seedless fruits: A fruit that develops from the ovary without fertilisation, and therefore without seeds, is produced by parthenocarpy.

Step 1 — Apply to the example: In banana the fruit forms and matures without fertilisation, so it bears no viable seeds.

Step 2 — Note the use: Parthenocarpy (often induced by growth hormones) is exploited to raise seedless grapes, oranges and watermelons.

Why other options are wrong:

- Option B (parthenogenesis) is development of an egg into an organism without fertilisation, in animals.
- Option C (apomixis) is asexual seed formation, which still makes seeds.
- Option D (polyembryony) is the formation of more than one embryo in a seed.

Final Answer: Fruit without fertilisation is parthenocarpy $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Male reproductive duct system: Sperms made in the testis travel through a definite series of ducts before ejaculation.

Step 1 — Recall the route: From the seminiferous tubules sperms pass into the rete testis and vasa efferentia, then to the epididymis where they mature and are stored.

Step 2 — Complete the path: From the epididymis they move through the vas deferens, which joins the duct from the seminal vesicle and finally opens into the urethra: epididymis $\rightarrow$ vas deferens $\rightarrow$ urethra.

Why other options are wrong:

- Options A, B and D place the ducts in the wrong sequence.

Final Answer: The order is epididymis $\rightarrow$ vas deferens $\rightarrow$ urethra $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Colostrum: The first secretion of the mammary gland after childbirth differs from later milk.

Step 1 — Identify it: This yellowish first milk is colostrum.

Step 2 — State its value: Colostrum is rich in antibodies, especially immunoglobulin A (IgA), which give the newborn passive immunity against infections.

Why other options are wrong:

- Option A (lactose) is the milk sugar, not a secretion.
- Option B (lymph) is a body fluid, not milk.
- Option C (plasma) is the fluid part of blood.

Final Answer: The antibody-rich first milk is colostrum $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Barrier contraceptives: Barrier methods physically stop the sperm and ovum from meeting.

Step 1 — Identify the mechanism: Condoms, diaphragms and cervical caps cover the penis or the cervix and block the entry of sperm into the female tract.

Step 2 — Note the consequence: As no sperm reach the ovum, fertilisation cannot occur.

Why other options are wrong:

- Option B describes hormonal pills, not barriers.
- Option C describes surgical/IUD methods.
- Option D describes vasectomy, a sterilisation method.

Final Answer: Barrier methods prevent sperm from meeting the ovum $\Rightarrow$ A

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Phenotype and genotype: The phenotype is what we observe; the genotype is the underlying genetic make-up.

Step 1 — Define genotype: The set of alleles an organism carries for a trait (e.g. TT, Tt or tt) is its genotype.

Step 2 — Relate the two: The genotype, acting with the environment, produces the visible phenotype; two organisms (TT and Tt) may share a phenotype but differ in genotype.

Why other options are wrong:

- Option A (karyotype) is the complete set of chromosomes by number and shape.
- Option B (phenotype) is the observable trait, already named in the question.
- Option D (ecotype) is a locally adapted population.

Final Answer: The genetic constitution behind a trait is the genotype $\Rightarrow$ C

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — Multiple alleles: When a single gene has more than two alternative forms in a population, the condition is multiple allelism.

Step 1 — Apply to ABO: The ABO blood group gene exists as three alleles, I^A, I^B and i, although any one diploid person carries only two of them.

Step 2 — State the rule: Multiple alleles are studied at the population level; an individual still has just two alleles per gene.

Why other options are wrong:

- Option A (pleiotropy) is one gene affecting several traits.
- Option C (polygenic inheritance) is many genes controlling one trait.
- Option D (linkage) is genes lying together on the same chromosome.

Final Answer: Three alleles of one gene illustrate multiple allelism $\Rightarrow$ B

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — XX–XO sex determination: In grasshoppers females are XX and males are XO (one X, no Y).

Step 1 — Analyse the gametes: All eggs carry one X. Of the sperms, half carry an X and half carry no sex chromosome.

Step 2 — Decide the sex: A sperm bearing an X gives XX (female); a sperm with no X gives XO (male). So the male is heterogametic and the sperm decides the sex.

Why other options are wrong:

- Option A wrongly mentions a Y chromosome, which is absent in this system.
- Option B again invokes a non-existent Y.
- Option C (temperature) applies to some reptiles, not grasshoppers.

Final Answer: Sex depends on whether the sperm carries an X or none $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Hershey–Chase experiment: Using bacteriophages, Hershey and Chase tested whether DNA or protein enters the host and acts as the genetic material.

Step 1 — Recall the labels: DNA contains phosphorus but no sulphur, so it was labelled with ^{32}P; protein contains sulphur but no phosphorus, so it was labelled with ^{35}S.

Step 2 — Read the result: Only the ^{32}P (DNA) entered the bacterial cells and appeared in the progeny phages, while the ^{35}S (protein) stayed outside. Hence DNA is the genetic material.

Why other options are wrong:

- Option B contradicts the result, since protein stayed outside.
- Option C: RNA was not the molecule tested here.
- Option D: the experiment showed DNA alone carries the information.

Final Answer: The experiment proved DNA is the genetic material $\Rightarrow$ A

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Thalassemia: Thalassemia is an autosomal recessive disorder of haemoglobin synthesis.

Step 1 — Identify the defect: The mutation reduces or abolishes the synthesis of one of the globin (alpha or beta) chains of haemoglobin.

Step 2 — Note the effect: Fewer normal globin chains mean less functional haemoglobin, leading to anaemia. (It is thus a quantitative defect, unlike sickle-cell anaemia, which is qualitative.)

Why other options are wrong:

- Option A describes sickle-cell anaemia, a structural defect.
- Option C describes Down syndrome (trisomy 21).
- Option D describes haemophilia (a clotting defect).

Final Answer: Thalassemia is reduced synthesis of a globin chain $\Rightarrow$ B

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Adaptive radiation: The evolution of several different species from a single ancestral type, each adapted to a different niche, is adaptive radiation.

Step 1 — Apply to the finches: Darwin's finches arose from one ancestral seed-eating species and diversified into forms with beaks suited to seeds, insects or cactus.

Step 2 — Note the driver: Different food sources and niches on the islands selected for different beak shapes, producing the radiation.

Why other options are wrong:

- Option A (convergent evolution) is unrelated forms becoming similar, the opposite situation.
- Option B (industrial melanism) is a single-trait colour change in moths.
- Option C (genetic drift) is random allele change, not this directed diversification.

Final Answer: Diversification of finches from one ancestor is adaptive radiation $\Rightarrow$ D

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Ringworm: Despite its name, ringworm is not caused by a worm.

Step 1 — Identify the pathogen: It is caused by a group of fungi called dermatophytes, belonging to genera such as *Microsporum*, *Trichophyton* and *Epidermophyton*.

Step 2 — Note the symptoms and spread: They grow on skin, nails and scalp, giving dry, scaly, ring-like lesions, and spread by contact or shared articles.

Why other options are wrong:

- Option A (protozoan), B (virus) and D (bacterium) are not the cause of ringworm.

Final Answer: Ringworm is caused by dermatophytic fungi $\Rightarrow$ C

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Mycorrhiza: A mycorrhiza is a mutualistic association between a fungus and the roots of higher plants.

Step 1 — State the benefit to the plant: The fungal hyphae greatly increase the absorptive surface and help the plant take up phosphorus and other minerals from the soil.

Step 2 — State the benefit to the fungus: In return the fungus receives sugars from the plant; such fungi are used as biofertilizers.

Why other options are wrong:

- Option B (nitrogen fixation) is done by *Rhizobium*, not mycorrhiza.
- Option C (CO_2) is taken up by leaves, not roots.
- Option D is meaningless, as roots do not use sunlight.

Final Answer: Mycorrhiza mainly improves phosphorus uptake $\Rightarrow$ A

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — HIV and AIDS: HIV is a retrovirus that progressively cripples the immune system.

Step 1 — Identify the target cell: HIV mainly infects the helper T-lymphocytes ($CD4^+$ T-cells), which coordinate immune responses.

Step 2 — Note the consequence: As helper T-cells are destroyed, their number falls, immunity collapses, and the patient becomes prone to opportunistic infections (AIDS).

Why other options are wrong:

- Options A (RBCs) and B (platelets) are not the primary targets of HIV.
- Option C (neurons): although the nervous system can be affected, the key cells destroyed are helper T-cells.

Final Answer: HIV chiefly destroys helper T-lymphocytes $\Rightarrow$ D

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Cloning vector features: A good cloning vector must replicate inside the host, so it needs a specific starting sequence for replication.

Step 1 — Name the sequence: The origin of replication (ori) is the sequence at which DNA replication is initiated.

Step 2 — State its importance: Any DNA linked to the ori can be made to replicate; the ori also governs the number of copies of the recombinant DNA (copy number).

Why other options are wrong:

- Option A (selectable marker) helps identify transformed cells, not start replication.
- Option B (restriction site) is where the vector is cut to insert DNA.
- Option D (multiple cloning site) is a cluster of restriction sites, not the replication start.

Final Answer: Replication starts at the origin of replication (ori) $\Rightarrow$ C

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — PCR cycle: Each PCR cycle has three temperature-controlled steps that are repeated many times to amplify DNA.

Step 1 — Read the cycle: The three steps are denaturation, annealing and extension, run in that order and then repeated.

Step 2 — Identify the strand-separation step: Heating to about 94°C breaks the hydrogen bonds and separates the two DNA strands; this is denaturation.

Why other options are wrong:

- Option A (annealing, $\sim$55°C) is where primers bind the single strands.
- Option C (extension, $\sim$72°C) is where Taq polymerase builds the new strand.

- Option D (ligation) is not a step of PCR at all.

Final Answer: Strand separation at 94°C is denaturation $\Rightarrow$ B

Answer: (B) Go Back to Q36

Q37.

Solution

Concept — Palindromic recognition sites: Restriction enzymes recognise short DNA sequences that read the same in the 5′ $\rightarrow$3′ direction on both strands.

Step 1 — Check the *Eco*RI site: Reading 5′ $\rightarrow$3′, the top strand is GAATTC and the bottom strand is also GAATTC, so it is a palindrome.

Step 2 — Link to sticky ends: *Eco*RI cuts each strand between G and A at staggered positions, leaving short single-stranded overhangs (sticky ends) that help join DNA fragments.

Why other options are wrong:

- Option B (telomere) is the protective end of a chromosome.
- Option C (promoter) is where transcription begins.
- Option D (centromere) is the spindle-attachment region of a chromosome.

Final Answer: GAATTC reading alike on both strands is a palindromic sequence $\Rightarrow$ A

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Age pyramids: The shape of an age pyramid shows the proportion of pre-reproductive, reproductive and post-reproductive individuals and predicts how the population will change.

Step 1 — Read the shapes: Pyramid I is a broad-based triangle, pyramid II is bell-shaped, and pyramid III is narrow at the base and wider above.

Step 2 — Match to growth status: A broad base means many young individuals who will soon reproduce, so pyramid I represents an expanding population. (II is stable; III, with a narrow base, is declining.)

Why other options are wrong:

- Option A (II) is stable, with a roughly straight profile.
- Option C (III) is declining, with fewer young individuals.
- Option D is wrong because the three shapes show different growth trends.

Final Answer: The broad-based pyramid I is the expanding population $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Primary productivity: Gross primary productivity (GPP) is the total energy fixed by producers; some of it is used up by the producers themselves in respiration.

Step 1 — Write the relation: Net primary productivity, NPP $=$ GPP $-$ R, where R is the energy lost in respiration.

Step 2 — Interpret: NPP is the biomass actually left over and available to the next trophic level (herbivores).

Why other options are wrong:

- Option A adds respiration instead of subtracting it.
- Option B has no biological basis.
- Option C is wrong because GPP is always greater than NPP by the respiratory loss.

Final Answer: NPP $=$ GPP $-$ respiration $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Eutrophication: Eutrophication is the natural or accelerated nutrient enrichment of a water body.

Step 1 — Trace the process: Run-off rich in nitrates and phosphates feeds a rapid overgrowth of algae, called an algal bloom, on the water surface.

Step 2 — Note the consequence: When the algae die, their decomposition by bacteria uses up the dissolved oxygen, so fish and other aquatic life suffocate and die.

Why other options are wrong:

- Option A (biomagnification) is the build-up of toxins along a food chain.
- Option B (BOD) is a measure of organic pollution, not the enrichment itself.
- Option D (sedimentation) is settling of suspended particles.

Final Answer: Nutrient enrichment causing algal blooms is eutrophication $\Rightarrow$ C

Answer: (C) Go Back to Q40

Answer Key

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