

# KIITEE Biology Sample Paper – 9

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.** Which one of the following features is characteristic of a dicotyledonous plant?

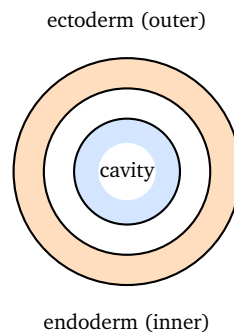
- (A) Fibrous root system
- (B) Parallel venation in the leaves
- (C) Trimerous flowers (floral parts in threes)
- (D) Reticulate (net-like) venation in the leaves

**Q2.** In a haplodiplontic life cycle, as seen in mosses and ferns, the two alternating generations are:

- (A) A haploid gametophyte and a diploid sporophyte
- (B) Two haploid (gametophytic) generations
- (C) Two diploid (sporophytic) generations
- (D) A diploid gametophyte and a haploid sporophyte



- Q3.** The cross-section below shows an animal whose body wall is built from only two cell layers (an outer ectoderm and an inner endoderm) with a gelatinous mesoglea in between. Such animals are described as:



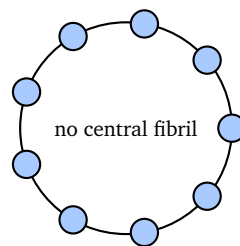
- (A) Acoelomate  
(B) Triploblastic  
(C) Diploblastic  
(D) Pseudocoelomate
- Q4.** The thin lining of the lung alveoli and the endothelium of blood capillaries, both specialised for rapid diffusion of gases and materials, are made of:
- (A) Ciliated columnar epithelium  
(B) Simple squamous epithelium  
(C) Cuboidal epithelium  
(D) Compound (stratified) epithelium
- Q5.** The dense regular connective tissue that attaches a skeletal muscle to a bone is the:
- (A) Tendon  
(B) Ligament  
(C) Areolar tissue  
(D) Hyaline cartilage



**Q6.** A drupe is a fleshy fruit in which the inner wall of the fruit (endocarp) becomes hard and stony to enclose the seed. Which of the following is a drupe?

- (A) Tomato
- (B) Apple
- (C) Mango
- (D) Orange

**Q7.** The cross-section of a centriole is shown below. Its microtubular fibrils are arranged in a characteristic pattern of:



centriole (cross-section)

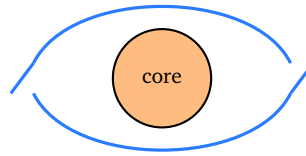
- (A) 9 + 2
- (B) 9 + 0
- (C) 9 + 1
- (D) 0 + 2

**Q8.** Lactose, the sugar present in milk, is a disaccharide formed by the union of:

- (A) Glucose + glucose
- (B) Glucose + fructose
- (C) Fructose + galactose
- (D) Glucose + galactose

**Q9.** In the chromatin model shown, the long, negatively charged DNA double helix is wound around a core of positively charged proteins to form a nucleosome. These core proteins are the:





DNA wound around protein core

- (A) Histones
- (B) Cellulose
- (C) Pectin
- (D) Lignin

**Q10.** Cytoplasmic bridges that pass through the cell walls of adjacent plant cells and connect their protoplasts, allowing transport of substances, are called:

- (A) Desmosomes
- (B) Gap junctions
- (C) Plasmodesmata
- (D) Tight junctions

**Q11.** Which plant growth regulator promotes cell division (cytokinesis) and delays the ageing (senescence) of leaves, keeping them green?

- (A) Abscisic acid
- (B) Cytokinin
- (C) Ethylene
- (D) Gibberellin

**Q12.** In a leguminous root nodule, the pink pigment leghaemoglobin is essential because it:

- (A) Transports nitrogen gas into the root
- (B) Fixes atmospheric nitrogen on its own



- (C) Carries out photosynthesis inside the nodule
- (D) Scavenges oxygen to protect the enzyme nitrogenase

**Q13.** Carotenoids such as carotene and xanthophyll act as accessory pigments in photosynthesis because they:

- (A) Absorb wavelengths of light not captured by chlorophyll and protect it from photo-oxidation
- (B) Carry out the dark (light-independent) reactions
- (C) Split water molecules to release oxygen
- (D) Fix carbon dioxide directly into glucose

**Q14.** The respiratory (Krebs) pathway is described as an amphibolic pathway because it:

- (A) Releases molecular oxygen as a by-product
- (B) Operates only in the cytoplasm of the cell
- (C) Serves both in the breakdown (catabolism) and in the synthesis (anabolism) of biomolecules
- (D) Requires direct input of light energy

**Q15.** After a carbohydrate-rich meal, excess glucose is converted into glycogen and stored chiefly in the:

- (A) Pancreas
- (B) Liver
- (C) Spleen
- (D) Kidney

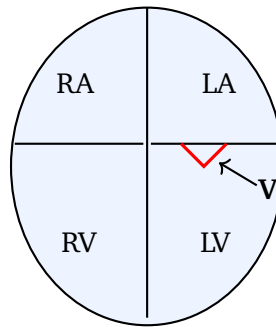
**Q16.** Each molecule of human haemoglobin is built of four polypeptide chains, each with one haem group. The maximum number of oxygen molecules that one haemoglobin molecule can carry is:

- (A) 1



- (B) 2
- (C) 3
- (D) 4

**Q17.** In the heart diagram below, the valve **V** guards the opening between the left atrium and the left ventricle and prevents backflow of blood. Valve **V** is the:

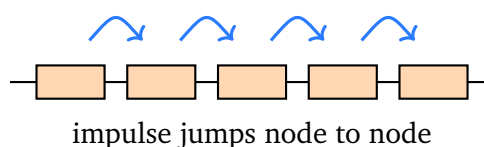


- (A) Bicuspid (mitral) valve
- (B) Tricuspid valve
- (C) Pulmonary semilunar valve
- (D) Aortic semilunar valve

**Q18.** The juxtaglomerular apparatus of the kidney releases the enzyme renin in response to:

- (A) A rise in blood glucose level
- (B) A rise in arterial blood pressure
- (C) A fall in glomerular blood pressure (and GFR)
- (D) A rise in plasma calcium level

**Q19.** In the myelinated axon shown, a nerve impulse does not travel continuously but jumps from one node of Ranvier to the next, as indicated by the arrows. This mode of impulse transmission is called:



- (A) Continuous conduction
- (B) Saltatory conduction
- (C) Synaptic transmission
- (D) Reflex conduction

**Q20.** The hormone that controls the development of male secondary sexual characters and is secreted by the Leydig (interstitial) cells of the testis is:

- (A) Testosterone
- (B) Estrogen
- (C) Progesterone
- (D) Prolactin

**Q21.** During strenuous exercise, when oxygen supply to the muscle is inadequate, the muscle fatigues mainly due to the build-up of:

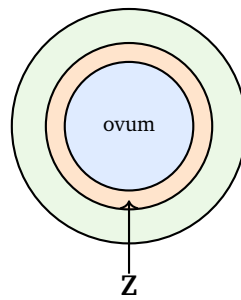
- (A) Glycogen
- (B) Ethanol formed from pyruvate
- (C) Lactic acid
- (D) Carbon dioxide

**Q22.** The events by which the pistil recognises compatible pollen, allowing it to germinate, while rejecting incompatible pollen, are collectively termed:

- (A) Pollination
- (B) Double fertilisation
- (C) Self-incompatibility
- (D) Pollen–pistil interaction

**Q23.** In the section of a mammalian ovum shown, the layer **Z** is a transparent, non-cellular glycoprotein coat lying immediately outside the plasma membrane of the egg. Layer **Z** is the:





- (A) Corona radiata
- (B) Zona pellucida
- (C) Vitelline (plasma) membrane
- (D) Chorionic layer

**Q24.** Human gestation of about nine months is divided into three trimesters. Each trimester lasts roughly:

- (A) 12 weeks (about three months)
- (B) 4 weeks (about one month)
- (C) 24 weeks (about six months)
- (D) 36 weeks (about nine months)

**Q25.** Tubectomy, a permanent method of birth control in human females, is carried out by cutting or tying off the:

- (A) Vas deferens
- (B) Ovaries
- (C) Cervix
- (D) Fallopian (uterine) tubes

**Q26.** In Mendel's monohybrid cross, two  $F_1$  pea plants heterozygous for round seed shape ( $Rr$ ) are self-pollinated, as shown in the Punnett square. The phenotypic ratio of round to wrinkled seeds in the  $F_2$  generation is:



	R	r
R	RR	Rr
r	Rr	rr

- (A) 1 : 1
- (B) 1 : 2 : 1
- (C) 3 : 1
- (D) 9 : 3 : 3 : 1

**Q27.** Human skin colour, which shows a continuous range of shades and is governed by three pairs of genes acting additively, is an example of:

- (A) Polygenic inheritance
- (B) Codominance
- (C) Incomplete dominance
- (D) Pleiotropy

**Q28.** In the somatic cells of a normal human female, one of the two X chromosomes is inactivated and remains condensed as a darkly stained structure called the:

- (A) Nucleolus
- (B) Barr body
- (C) Centromere
- (D) Chiasma

**Q29.** The central dogma of molecular biology, depicted in the flow diagram below, describes the direction in which genetic information normally flows:

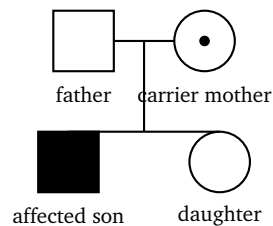


- (A) Protein → RNA → DNA



- (B) RNA  $\rightarrow$  DNA  $\rightarrow$  Protein
- (C) DNA  $\rightarrow$  Protein  $\rightarrow$  RNA
- (D) DNA  $\rightarrow$  RNA  $\rightarrow$  Protein

**Q30.** In the pedigree below, a phenotypically normal man ( $\square$ ) marries a phenotypically normal carrier woman ( $\odot$ ) and they have a colour-blind son ( $\blacksquare$ ) and a normal daughter ( $\circ$ ). This pattern indicates the trait is:



- (A) Autosomal dominant
  - (B) Y-linked
  - (C) X-linked recessive
  - (D) Autosomal recessive
- Q31.** In a population at Hardy–Weinberg equilibrium, a gene has two alleles A and a. If the frequency of allele A (p) is 0.7, the frequency of allele a (q) is:
- (A) 0.3
  - (B) 0.7
  - (C) 0.49
  - (D) 0.09
- Q32.** The viral diseases dengue and chikungunya are transmitted to humans by the bite of the mosquito:
- (A) *Anopheles*
  - (B) *Aedes*
  - (C) *Culex*



(D) *Glossina*

**Q33.** Citric acid is manufactured industrially through microbial fermentation using the fungus:

(A) *Saccharomyces cerevisiae*

(B) *Lactobacillus*

(C) *Clostridium butylicum*

(D) *Aspergillus niger*

**Q34.** Interferons are antiviral proteins secreted by virus-infected cells. Their main role is to:

(A) Digest the cell walls of invading bacteria

(B) Clot the blood at the site of a wound

(C) Protect surrounding non-infected cells from viral infection

(D) Carry oxygen from the lungs to the tissues

**Q35.** The correct sequence of major steps in recombinant DNA technology is:

(A) Isolation of DNA → cutting with restriction enzymes → ligation into a vector → transfer into a host

(B) Transfer into a host → cutting → isolation → ligation

(C) Ligation → isolation → cutting → transfer

(D) Cutting → transfer into host → isolation → ligation

**Q36.** The technique in which recombinant DNA is delivered directly into the nucleus of an animal cell with the help of a very fine glass needle is called:

(A) Electroporation

(B) Microinjection

(C) Gene gun (biolistics)



(D) Liposome-mediated transfer

**Q37.** The grant of patents on the wound-healing use of turmeric, the basmati rice variety and neem-based products, drawing on traditional Indian knowledge without authorisation, is an example of:

- (A) Bioremediation
- (B) Biofortification
- (C) Biomagnification
- (D) Biopiracy

**Q38.** The number of individuals of a population present per unit area (or volume) at a given time is the population attribute called:

- (A) Natality
- (B) Mortality
- (C) Carrying capacity
- (D) Population density

**Q39.** The total amount of living biomass (mass of living organisms per unit area) present in an ecosystem at a given moment is referred to as the:

- (A) Gross primary productivity
- (B) Net primary productivity
- (C) Standing crop
- (D) Secondary productivity

**Q40.** In the IUCN Red List, a species facing an extremely high risk of extinction in the immediate future is placed in the category:

- (A) Vulnerable
- (B) Critically Endangered
- (C) Near Threatened
- (D) Least Concern



## Detailed Solutions

Q1.

## Solution

**Concept — Monocots vs dicots:** Flowering plants are divided into monocotyledons and dicotyledons on the basis of cotyledon number, root, venation and floral symmetry.

**Step 1 — List the dicot features:** Dicots have two cotyledons, a tap root system, reticulate (net-like) leaf venation and tetramerous or pentamerous flowers.

**Step 2 — Match the option:** Reticulate venation in the leaves is the distinctive dicot feature among the choices.

**Why other options are wrong:**

- Option A (fibrous root) is a monocot character.
- Option B (parallel venation) is typical of monocots.
- Option C (trimerous flowers) is a monocot floral pattern.

**Final Answer:** Reticulate venation marks a dicot  $\Rightarrow$

[Go Back to Q1](#)

Q2.

## Solution

**Concept — Alternation of generations:** A haplodiplontic life cycle alternates between a multicellular haploid phase and a multicellular diploid phase.

**Step 1 — Identify the haploid phase:** The gamete-producing body is the gametophyte and is haploid ( $n$ ).

**Step 2 — Identify the diploid phase:** The spore-producing body is the sporophyte and is diploid ( $2n$ ); meiosis in it restores the haploid spores.

**Why other options are wrong:**

- Option B: both generations cannot be haploid in haplodiplontic cycles.
- Option C: both generations are not diploid.
- Option D reverses the ploidy of the two generations.

**Final Answer:** Haploid gametophyte alternates with diploid sporophyte  $\Rightarrow$

[Go Back to Q2](#)



Q3.

**Solution**

**Concept — Germ layers:** Animals are grouped by the number of embryonic cell layers forming the body wall.

**Step 1 — Read the diagram:** The figure shows only two cell layers, an outer ectoderm and an inner endoderm, separated by a non-cellular mesoglea.

**Step 2 — Classify:** A body built of just two germ layers is diploblastic (e.g. cnidarians such as *Hydra*).

**Why other options are wrong:**

- Option A (acoelomate) refers to absence of a coelom, not to two layers.
- Option B (triploblastic) has three germ layers including mesoderm.
- Option D (pseudocoelomate) refers to a false body cavity.

**Final Answer:** Two germ layers = diploblastic ⇒

**Answer: (C)** [Go Back to Q3](#)

Q4.

**Solution**

**Concept — Epithelial tissue:** The flatter the epithelial cell, the easier diffusion across it; thin squamous cells suit exchange surfaces.

**Step 1 — Identify the tissue:** Alveolar walls and the endothelium of capillaries are made of a single layer of flat, scale-like cells, i.e. simple squamous epithelium.

**Step 2 — Relate to function:** Its extreme thinness minimises the diffusion distance for gases and small molecules.

**Why other options are wrong:**

- Option A (ciliated columnar) lines the airways for mucus movement.
- Option C (cuboidal) lines ducts and tubules.
- Option D (stratified) is protective, not for diffusion.

**Final Answer:** Alveoli and endothelium are simple squamous epithelium ⇒

**Answer: (B)** [Go Back to Q4](#)



Q5.

**Solution**

**Concept — Dense regular connective tissue:** Tendons and ligaments are dense regular connective tissues but join different structures.

**Step 1 — Define a tendon:** A tendon is a cord of collagen fibres that attaches a muscle to a bone.

**Step 2 — Contrast with a ligament:** A ligament joins one bone to another bone at a joint.

**Why other options are wrong:**

- Option B (ligament) connects bone to bone.
- Option C (areolar tissue) is a loose packing tissue.
- Option D (hyaline cartilage) cushions joint surfaces.

**Final Answer:** Muscle-to-bone attachment is by a tendon ⇒

**Answer: (A)** [Go Back to Q5](#)

Q6.

**Solution**

**Concept — Fruit types:** A drupe has a fleshy mesocarp and a hard, stony endocarp around a single seed.

**Step 1 — Apply the definition:** Among the options, mango has the typical drupe structure with a stony endocarp enclosing the seed.

**Step 2 — Note the type of each:** Tomato is a berry, apple is a pome, orange is a hesperidium.

**Why other options are wrong:**

- Option A (tomato) is a true berry.
- Option B (apple) is a false fruit (pome).
- Option D (orange) is a hesperidium.

**Final Answer:** Mango is a drupe ⇒

**Answer: (C)** [Go Back to Q6](#)



Q7.

**Solution**

**Concept — Centriole structure:** A centriole is a hollow cylinder of microtubules with a characteristic fibril arrangement.

**Step 1 — Read the diagram:** The cross-section shows nine peripheral fibril groups and no fibril at the centre.

**Step 2 — State the pattern:** This is the 9 + 0 arrangement (nine peripheral triplets, zero central tubules), typical of centrioles and basal bodies.

**Why other options are wrong:**

- Option A (9 + 2) is the pattern of cilia and flagella, not centrioles.
- Options C and D (9 + 1, 0 + 2) are not real microtubule patterns of centrioles.

**Final Answer:** A centriole shows the 9 + 0 pattern ⇒ **B**

**Answer: (B)** [Go Back to Q7](#)

Q8.

**Solution**

**Concept — Disaccharides:** A disaccharide forms when two monosaccharides join by a glycosidic bond.

**Step 1 — Recall lactose:** Lactose (milk sugar) is made of one glucose and one galactose unit.

**Step 2 — Compare with others:** Maltose is glucose + glucose, and sucrose is glucose + fructose.

**Why other options are wrong:**

- Option A (glucose + glucose) is maltose.
- Option B (glucose + fructose) is sucrose.
- Option C (fructose + galactose) is not a common natural sugar.

**Final Answer:** Lactose = glucose + galactose ⇒ **D**

**Answer: (D)** [Go Back to Q8](#)



Q9.

**Solution**

**Concept — Chromatin packaging:** DNA is packed in the nucleus by winding around basic proteins to form nucleosomes.

**Step 1 — Identify the core proteins:** The protein core is an octamer of histones (two each of H2A, H2B, H3 and H4).

**Step 2 — Explain the attraction:** Histones are rich in basic amino acids (lysine, arginine) carrying positive charge, which binds the negatively charged phosphate backbone of DNA.

**Why other options are wrong:**

- Option B (cellulose) and option C (pectin) are plant cell-wall carbohydrates.
- Option D (lignin) is a wall-strengthening polymer, not a DNA-binding protein.

**Final Answer:** DNA winds around histones  $\Rightarrow$

[Go Back to Q9](#)

Q10.

**Solution**

**Concept — Cell junctions:** Adjacent plant cells stay connected through cytoplasmic channels crossing their walls.

**Step 1 — Identify the structure:** These fine cytoplasmic bridges through the cell wall are plasmodesmata.

**Step 2 — Note the function:** They form the symplastic pathway, allowing direct transport of water, ions and signalling molecules between cells.

**Why other options are wrong:**

- Options A (desmosomes) and D (tight junctions) are animal cell junctions.
- Option B (gap junctions) are animal channels; plant equivalents are plasmodesmata.

**Final Answer:** The plant cytoplasmic bridges are plasmodesmata  $\Rightarrow$

[Go Back to Q10](#)



Q11.

**Solution**

**Concept — Plant growth regulators:** Each hormone has a signature set of effects; cytokinins are known for promoting division and delaying ageing.

**Step 1 — Match the effect:** Cytokinin stimulates cytokinesis (cell division) and delays leaf senescence (Richmond–Lang effect).

**Step 2 — Recall its sources:** It is abundant in regions of active division such as root tips and developing fruits.

**Why other options are wrong:**

- Option A (abscisic acid) promotes dormancy and senescence.
- Option C (ethylene) hastens ripening and senescence.
- Option D (gibberellin) promotes stem elongation and bolting.

**Final Answer:** Cell division plus delayed senescence is cytokinin ⇒ **B**

**Answer: (B)** [Go Back to Q11](#)

Q12.

**Solution**

**Concept — Biological nitrogen fixation:** The enzyme nitrogenase, which reduces  $N_2$  to ammonia, is irreversibly inactivated by free oxygen.

**Step 1 — Identify the protective role:** Leghaemoglobin is an oxygen-scavenger pigment in the nodule that keeps the oxygen level very low.

**Step 2 — Link to the enzyme:** By mopping up oxygen, leghaemoglobin shields nitrogenase, allowing nitrogen fixation to continue.

**Why other options are wrong:**

- Option A: it does not transport nitrogen gas.
- Option B: fixation is done by nitrogenase, not by leghaemoglobin.
- Option C: nodules do not photosynthesise.

**Final Answer:** Leghaemoglobin scavenges oxygen to protect nitrogenase ⇒ **D**

**Answer: (D)** [Go Back to Q12](#)



Q13.

**Solution**

**Concept — Accessory pigments:** Pigments other than chlorophyll *a* widen the range of light usable for photosynthesis.

**Step 1 — State the role:** Carotenoids absorb light at wavelengths (blue-green) that chlorophyll cannot, and pass the energy to chlorophyll.

**Step 2 — Add the protective role:** They also quench excess energy, protecting chlorophyll from photo-oxidative damage.

**Why other options are wrong:**

- Option B: dark reactions are enzyme-driven, not pigment-driven.
- Option C: water splitting is carried out by Photosystem II, not carotenoids.
- Option D: CO<sub>2</sub> fixation is done by RuBisCO in the Calvin cycle.

**Final Answer:** Carotenoids extend light capture and protect chlorophyll ⇒

[Go Back to Q13](#)

Q14.

**Solution**

**Concept — Amphibolic pathway:** A pathway is amphibolic if it serves both degradation and biosynthesis.

**Step 1 — Note the catabolic role:** The respiratory pathway breaks glucose and other fuels down to release energy.

**Step 2 — Note the anabolic role:** Its intermediates (e.g. acetyl-CoA,  $\alpha$ -ketoglutarate) are withdrawn to synthesise fatty acids, amino acids and other molecules.

**Why other options are wrong:**

- Option A: oxygen release is a feature of photosynthesis.
- Option B: respiration also uses mitochondria, not just cytoplasm.
- Option D: respiration does not need light.

**Final Answer:** It serves both catabolism and anabolism ⇒

[Go Back to Q14](#)



Q15.

**Solution**

**Concept — Glycogen storage:** Excess blood glucose is stored as the polysaccharide glycogen (glycogenesis), chiefly in the liver.

**Step 1 — Identify the main store:** The liver stores the largest reserve of glycogen and releases glucose to maintain blood sugar.

**Step 2 — Note the trigger:** Insulin promotes this conversion of glucose to liver glycogen after a meal.

**Why other options are wrong:**

- Option A (pancreas) secretes the hormones but does not store glycogen.
- Option C (spleen) stores blood cells, not glycogen.
- Option D (kidney) regulates excretion, not glycogen storage.

**Final Answer:** Glycogen is stored mainly in the liver  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q15](#)

Q16.

**Solution**

**Concept — Haemoglobin and oxygen:** Each haem group binds one  $O_2$  molecule; the number of haem groups sets the oxygen capacity.

**Step 1 — Count the subunits:** Haemoglobin has four polypeptide chains ( $2\alpha + 2\beta$ ), each carrying one haem group.

**Step 2 — Compute the capacity:** With four haem groups, one haemoglobin molecule can hold  $4 \times 1 = 4$  oxygen molecules.

**Why other options are wrong:**

- Options A, B and C (1, 2, 3) ignore one or more of the four haem groups.

**Final Answer:** One haemoglobin carries four  $O_2$  molecules  $\Rightarrow$  **D**

**Answer: (D)** [Go Back to Q16](#)



Q17.

**Solution**

**Concept — Heart valves:** Atrioventricular valves prevent backflow from ventricles into atria during ventricular contraction.

**Step 1 — Read the diagram:** Valve V lies between the left atrium and left ventricle.

**Step 2 — Name it:** The left atrioventricular valve has two flaps, so it is the bicuspid (mitral) valve.

**Why other options are wrong:**

- Option B (tricuspid) guards the right atrioventricular opening.
- Option C (pulmonary semilunar) is at the base of the pulmonary artery.
- Option D (aortic semilunar) is at the base of the aorta.

**Final Answer:** The left AV valve is the bicuspid (mitral) valve  $\Rightarrow$  **A**

**Answer: (A)** [Go Back to Q17](#)

Q18.

**Solution**

**Concept — Juxtaglomerular apparatus (JGA):** The JGA monitors blood pressure and sodium and controls renin release.

**Step 1 — Identify the stimulus:** A fall in glomerular blood pressure (and hence GFR) is sensed by the JGA.

**Step 2 — State the response:** The JGA secretes renin, triggering the renin–angiotensin–aldosterone pathway that raises blood pressure and GFR.

**Why other options are wrong:**

- Option A: blood glucose does not control renin.
- Option B: a rise in blood pressure suppresses, not stimulates, renin.
- Option D: plasma calcium is regulated by PTH and calcitonin.

**Final Answer:** Renin is released when glomerular blood pressure falls  $\Rightarrow$  **C**

**Answer: (C)** [Go Back to Q18](#)



Q19.

**Solution**

**Concept — Conduction in myelinated axons:** Myelin insulates the axon except at the nodes of Ranvier, where ion exchange occurs.

**Step 1 — Read the diagram:** The arrows show the impulse leaping from one node to the next over the insulated internodes.

**Step 2 — Name the process:** This node-to-node jumping is saltatory conduction, which is much faster than continuous conduction.

**Why other options are wrong:**

- Option A (continuous conduction) occurs in unmyelinated fibres.
- Option C (synaptic transmission) is signalling across a synapse, not along an axon.
- Option D (reflex conduction) is not a recognised conduction type.

**Final Answer:** Node-to-node jumping is saltatory conduction  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q19](#)

Q20.

**Solution**

**Concept — Male sex hormone:** The Leydig (interstitial) cells of the testis secrete androgens under LH control.

**Step 1 — Identify the hormone:** The principal androgen is testosterone.

**Step 2 — Note its action:** It drives spermatogenesis and the male secondary sexual characters (beard, deep voice, muscle growth).

**Why other options are wrong:**

- Options B (estrogen) and C (progesterone) are chiefly female hormones.
- Option D (prolactin) stimulates milk production.

**Final Answer:** The Leydig-cell androgen is testosterone  $\Rightarrow$  **A**

**Answer: (A)** [Go Back to Q20](#)



Q21.

**Solution**

**Concept — Muscle fatigue:** When oxygen runs short, muscle cells switch to anaerobic respiration of glucose.

**Step 1 — Identify the product:** Pyruvate is reduced to lactic acid during anaerobic glycolysis in the muscle.

**Step 2 — Link to fatigue:** Accumulating lactic acid lowers the pH and impairs contraction, causing fatigue and cramps.

**Why other options are wrong:**

- Option A (glycogen) is the fuel store, not the fatigue agent.
- Option B (ethanol) is formed by yeast, not human muscle.
- Option D (CO<sub>2</sub>) is freely removed and is not the chief cause.

**Final Answer:** Muscle fatigue is due to lactic acid build-up ⇒

**Answer: (C)** [Go Back to Q21](#)

Q22.

**Solution**

**Concept — Pollen–pistil interaction:** After pollination the pistil chemically dialogues with the pollen to accept or reject it.

**Step 1 — Define the process:** Recognition of compatible pollen, promotion of its germination and guidance of the pollen tube constitute pollen–pistil interaction.

**Step 2 — Note the outcome:** Incompatible pollen is rejected, preventing fertilisation by unsuitable pollen.

**Why other options are wrong:**

- Option A (pollination) is only the transfer of pollen to the stigma.
- Option B (double fertilisation) is the fusion event after the tube reaches the ovule.
- Option C (self-incompatibility) is one specific rejection mechanism, not the whole interaction.

**Final Answer:** Recognition and acceptance of pollen is pollen–pistil interaction ⇒

**Answer: (D)** [Go Back to Q22](#)



Q23.

**Solution**

**Concept — Coats of the ovum:** A mammalian egg is surrounded, from inside out, by the plasma membrane, the zona pellucida and the corona radiata.

**Step 1 — Read the diagram:** Layer Z lies just outside the egg plasma membrane and inside the outer cellular layer.

**Step 2 — Identify it:** This transparent, non-cellular glycoprotein coat is the zona pellucida, important in sperm binding and the block to polyspermy.

**Why other options are wrong:**

- Option A (corona radiata) is the outermost layer of follicular cells.
- Option C (vitelline/plasma membrane) lies inside the zona pellucida.
- Option D (chorionic layer) is an extra-embryonic membrane, not an egg coat.

**Final Answer:** The glycoprotein coat outside the membrane is the zona pellucida ⇒

[Go Back to Q23](#)

Q24.

**Solution**

**Concept — Trimesters:** Human gestation of about 9 months (around 38–40 weeks) is split into three equal trimesters.

**Step 1 — Divide the period:** Nine months divided by three gives about three months per trimester.

**Step 2 — Convert to weeks:** Three months is roughly 12–13 weeks, so each trimester is about 12 weeks.

**Why other options are wrong:**

- Option B (4 weeks) is only about a month.
- Option C (24 weeks) covers two trimesters.
- Option D (36 weeks) is nearly the whole pregnancy.

**Final Answer:** Each trimester lasts about 12 weeks (three months) ⇒

[Go Back to Q24](#)



Q25.

**Solution**

**Concept — Sterilisation:** Surgical contraception blocks the gamete-transport ducts; in females the operation is tubectomy.

**Step 1 — Identify the duct:** Tubectomy cuts or ties off the fallopian (uterine) tubes.

**Step 2 — Explain the effect:** This stops the ovum from meeting the sperm, preventing fertilisation.

**Why other options are wrong:**

- Option A (vas deferens) is cut in vasectomy (male).
- Option B (ovaries) are not removed in tubectomy.
- Option C (cervix) is not the structure operated upon.

**Final Answer:** Tubectomy ties the fallopian tubes  $\Rightarrow$

**Answer: (D)** [Go Back to Q25](#)

Q26.

**Solution**

**Concept — Monohybrid  $F_2$  ratio:** A cross between two heterozygotes ( $Rr \times Rr$ ) gives a fixed ratio of phenotypes.

**Step 1 — Read the Punnett square:** The four boxes give RR, Rr, Rr and rr.

**Step 2 — Group by phenotype:** RR, Rr and Rr are round (dominant) and rr is wrinkled, so round : wrinkled = 3 : 1.

**Why other options are wrong:**

- Option A (1 : 1) is a test-cross ratio.
- Option B (1 : 2 : 1) is the genotypic, not phenotypic, ratio.
- Option D (9 : 3 : 3 : 1) is the dihybrid  $F_2$  ratio.

**Final Answer:** The monohybrid  $F_2$  phenotypic ratio is 3 : 1  $\Rightarrow$

**Answer: (C)** [Go Back to Q26](#)



Q27.

**Solution**

**Concept — Polygenic (quantitative) inheritance:** A trait controlled by several genes whose effects add up shows a continuous range of phenotypes.

**Step 1 — Apply to skin colour:** Human skin colour is governed by three (or more) gene pairs acting additively.

**Step 2 — Note the outcome:** The more dominant alleles present, the darker the skin, giving a gradation of shades, i.e. polygenic inheritance.

**Why other options are wrong:**

- Option B (codominance) is two alleles both expressed (e.g. AB blood).
- Option C (incomplete dominance) gives a blended single-gene phenotype.
- Option D (pleiotropy) is one gene affecting many traits.

**Final Answer:** Skin colour is a polygenic trait  $\Rightarrow$

[Go Back to Q27](#)

Q28.

**Solution**

**Concept — Dosage compensation:** To equalise X-linked gene dosage between the sexes, one X in female cells is inactivated.

**Step 1 — Identify the structure:** The inactivated, condensed X chromosome appears as a darkly staining mass called the Barr body.

**Step 2 — Note the count:** The number of Barr bodies equals (number of X chromosomes – 1), so a normal female has one.

**Why other options are wrong:**

- Option A (nucleolus) is the site of ribosome assembly.
- Option C (centromere) holds sister chromatids together.
- Option D (chiasma) is a crossing-over point in meiosis.

**Final Answer:** The inactivated X appears as the Barr body  $\Rightarrow$

[Go Back to Q28](#)



Q29.

**Solution**

**Concept — Central dogma:** Francis Crick's central dogma sets the normal direction of genetic information flow.

**Step 1 — Read the diagram:** The arrows run DNA → RNA (transcription) and RNA → Protein (translation).

**Step 2 — State the flow:** Hence information flows DNA → RNA → Protein.

**Why other options are wrong:**

- Options A and C reverse or scramble the steps.
- Option B (RNA → DNA → Protein) is reverse transcription, a special case, not the central dogma's main flow.

**Final Answer:** Information flows DNA → RNA → Protein ⇒

**Answer: (D)** [Go Back to Q29](#)

Q30.

**Solution**

**Concept — X-linked recessive inheritance:** A recessive allele on the X chromosome is masked in carrier females but expressed in males with a single X.

**Step 1 — Read the pedigree:** A normal father and a normal carrier mother produce an affected son and a normal daughter.

**Step 2 — Deduce the pattern:** The son receives his single X (carrying the defective allele) from the carrier mother and shows the trait; the trait skips the father. This fits an X-linked recessive trait such as colour blindness.

**Why other options are wrong:**

- Option A (autosomal dominant) would show the trait in every generation, including a parent.
- Option B (Y-linked) would pass only from father to all sons.
- Option D (autosomal recessive) would not show the marked sex bias toward affected males.

**Final Answer:** The pattern is X-linked recessive ⇒

**Answer: (C)** [Go Back to Q30](#)



Q31.

**Solution**

**Concept — Hardy–Weinberg principle:** For two alleles, the allele frequencies sum to one:  $p + q = 1$ .

**Step 1 — Write the equation:**  $p + q = 1$ .

**Step 2 — Substitute and solve:** With  $p = 0.7$ ,  $q = 1 - 0.7 = 0.3$ .

**Why other options are wrong:**

- Option B (0.7) repeats the frequency of A, not a.
- Option C (0.49) is  $p^2$ , the AA genotype frequency.
- Option D (0.09) is  $q^2$ , the aa genotype frequency.

**Final Answer:**  $q = 1 - 0.7 = 0.3 \Rightarrow$

**Answer: (A)** [Go Back to Q31](#)

Q32.

**Solution**

**Concept — Mosquito-borne viral diseases:** Different mosquito genera transmit different diseases.

**Step 1 — Identify the vector:** Dengue and chikungunya viruses are spread by *Aedes aegypti*.

**Step 2 — Recall its habit:** *Aedes* is a day-biting mosquito that breeds in clean stagnant water.

**Why other options are wrong:**

- Option A (*Anopheles*) transmits malaria.
- Option C (*Culex*) transmits filariasis.
- Option D (*Glossina*, tsetse fly) transmits sleeping sickness.

**Final Answer:** Dengue and chikungunya are spread by *Aedes*  $\Rightarrow$

**Answer: (B)** [Go Back to Q32](#)



Q33.

**Solution**

**Concept — Microbial products:** Several organic acids are produced commercially by specific microbes.

**Step 1 — Match acid to microbe:** Citric acid is obtained from the fungus *Aspergillus niger*.

**Step 2 — Note other examples:** Acetic acid comes from *Acetobacter*, lactic acid from *Lactobacillus*, butyric acid from *Clostridium butylicum*.

**Why other options are wrong:**

- Option A (*Saccharomyces*) produces ethanol.
- Option B (*Lactobacillus*) produces lactic acid.
- Option C (*Clostridium butylicum*) produces butyric acid.

**Final Answer:** Citric acid is made by *Aspergillus niger* ⇒

**Answer: (D)** [Go Back to Q33](#)

Q34.

**Solution**

**Concept — Interferons:** Interferons are part of the body's innate antiviral defence.

**Step 1 — State the source:** Virus-infected cells secrete interferons.

**Step 2 — State the action:** Interferons signal neighbouring healthy cells to resist viral entry and replication, limiting the spread of infection.

**Why other options are wrong:**

- Option A (digesting bacterial walls) is the action of lysozyme.
- Option B (clotting) is the role of fibrinogen and platelets.
- Option D (oxygen carriage) is done by haemoglobin.

**Final Answer:** Interferons protect non-infected cells from viruses ⇒

**Answer: (C)** [Go Back to Q34](#)



Q35.

**Solution**

**Concept — Steps in rDNA technology:** Making a recombinant follows a fixed logical order.

**Step 1 — Order the early steps:** First isolate the DNA, then cut it with restriction enzymes to get the gene of interest.

**Step 2 — Order the later steps:** Ligate the gene into a vector with DNA ligase, then transfer the recombinant vector into a host cell for cloning.

**Why other options are wrong:**

- Options B, C and D place transfer, ligation or cutting before isolation, which is not possible.

**Final Answer:** Isolation → cutting → ligation → transfer ⇒ **A**

**Answer: (A)** [Go Back to Q35](#)

Q36.

**Solution**

**Concept — Gene delivery methods:** Foreign DNA can be introduced into cells by several physical or chemical routes.

**Step 1 — Identify the technique:** Injecting DNA straight into the nucleus through a fine glass needle is microinjection.

**Step 2 — Note its use:** It is commonly used to make transgenic animals.

**Why other options are wrong:**

- Option A (electroporation) uses electric pulses to make pores in the membrane.
- Option C (gene gun) shoots DNA-coated metal particles into cells.
- Option D (liposome fusion) packages DNA in lipid vesicles.

**Final Answer:** Direct needle injection into the nucleus is microinjection ⇒ **B**

**Answer: (B)** [Go Back to Q36](#)



Q37.

**Solution**

**Concept — Biopiracy:** Biopiracy is the use of bio-resources or traditional knowledge of a community or country by others without authorisation and fair compensation.

**Step 1 — Apply to the examples:** Patents claimed abroad on turmeric, basmati rice and neem drew directly on long-standing Indian traditional knowledge.

**Step 2 — Classify:** Such unauthorised patenting is a classic case of biopiracy.

**Why other options are wrong:**

- Option A (bioremediation) is cleaning pollutants using organisms.
- Option B (biofortification) is breeding crops for higher nutrient content.
- Option C (biomagnification) is the build-up of toxins along a food chain.

**Final Answer:** Unauthorised patenting of traditional bio-resources is biopiracy ⇒

**D**

**Answer: (D)** [Go Back to Q37](#)

Q38.

**Solution**

**Concept — Population attributes:** A population is described by attributes such as density, natality, mortality and age structure.

**Step 1 — Define the attribute:** Population density is the number of individuals per unit area or volume at a given time.

**Step 2 — Distinguish from rates:** Natality and mortality are rates of change, whereas density is a count at one instant.

**Why other options are wrong:**

- Option A (natality) is the birth rate.
- Option B (mortality) is the death rate.
- Option C (carrying capacity) is the maximum sustainable population, not a current count.

**Final Answer:** Number per unit area is the population density ⇒ **D**

**Answer: (D)** [Go Back to Q38](#)



Q39.

**Solution**

**Concept — Standing crop:** The biomass present in an ecosystem at any moment is its standing crop.

**Step 1 — Define it:** Standing crop is the mass of living material (per unit area) present at a given time, usually expressed as dry weight or energy content.

**Step 2 — Separate from productivity:** Productivity refers to the rate of biomass production over time, not the amount present at one instant.

**Why other options are wrong:**

- Options A and B (GPP, NPP) are rates of production by producers.
- Option D (secondary productivity) is the rate of biomass formation by consumers.

**Final Answer:** Living biomass present at a time is the standing crop  $\Rightarrow$

**Answer: (C)** [Go Back to Q39](#)

Q40.

**Solution**

**Concept — IUCN Red List categories:** The IUCN ranks species by extinction risk, from Least Concern up to Extinct.

**Step 1 — Order the threat levels:** In increasing risk: Vulnerable < Endangered < Critically Endangered.

**Step 2 — Identify the highest:** A species facing an extremely high risk of extinction in the immediate future is Critically Endangered.

**Why other options are wrong:**

- Option A (Vulnerable) is a lower threat level.
- Option C (Near Threatened) is not yet threatened.
- Option D (Least Concern) is the lowest risk category.

**Final Answer:** The highest at-risk surviving category is Critically Endangered  $\Rightarrow$

**Answer: (B)** [Go Back to Q40](#)



## Answer Key

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

