

# KIITEE Biology Sample Paper – 3

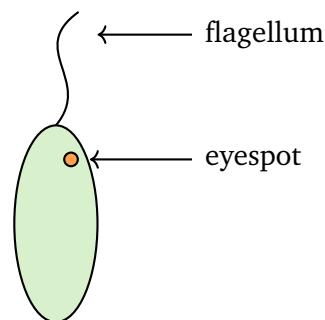
Duration: 50 Minutes

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.** The freshwater protist shown below is a euglenoid. Unlike a typical plant cell, such an organism:



*Euglena* (euglenoid)

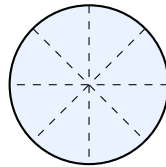
- (A) stores its food only as starch
- (B) is strictly autotrophic under all conditions
- (C) has a protein-rich pellicle instead of a rigid cellulose cell wall
- (D) possesses a hard outer shell of silica



**Q2.** Ascomycetes are called sac fungi because their sexual spores (ascospores) are produced inside sac-like asci. A common example of an ascomycete is:

- (A) *Penicillium*
- (B) *Agaricus* (the field mushroom)
- (C) *Rhizopus* (bread mould)
- (D) *Ustilago* (smut)

**Q3.** The body form below can be divided into two equal halves by *any* vertical plane passing through its central axis. This type of symmetry, seen in adult cnidarians such as *Hydra* and jellyfish, is:



any plane through the centre → equal halves

- (A) Bilateral symmetry
- (B) Radial symmetry
- (C) Asymmetry (no plane of symmetry)
- (D) Pseudo-segmental symmetry

**Q4.** Collenchyma provides mechanical support and flexibility to young, growing organs such as the petiole and stem of herbaceous plants. Its cells are:

- (A) dead, with uniformly lignified walls
- (B) dead, with a much-reduced lumen
- (C) living, but completely without any wall thickening
- (D) living, with extra cellulose and pectin deposited at the corners

**Q5.** Cardiac muscle, present only in the wall of the heart, is distinguished from the other muscle types by being:

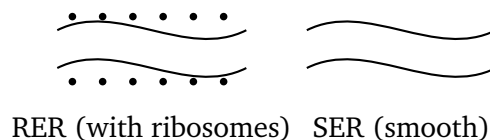


- (A) striated, unbranched and under voluntary control
- (B) smooth, spindle-shaped and under voluntary control
- (C) striated, branched and involuntary, with intercalated discs
- (D) smooth, branched and involuntary, without striations

**Q6.** In a China rose (*Hibiscus*) flower, each petal overlaps the next in a regular, twisted manner, one margin covering the margin of the adjacent petal. This mode of aestivation is called:

- (A) Valvate
- (B) Twisted (contorted)
- (C) Imbricate
- (D) Vexillary

**Q7.** The endomembrane network shown has a rough portion (RER, studded with ribosomes) and a smooth portion (SER). The smooth endoplasmic reticulum is chiefly the site of:



- (A) synthesis and folding of secretory proteins
- (B) production of ATP by oxidative phosphorylation
- (C) packaging of finished products into secretory vesicles
- (D) synthesis of lipids and steroid hormones

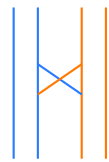
**Q8.** Which lipid, having a hydrophilic phosphate “head” and two hydrophobic fatty-acid “tails”, is the principal building block of the cell-membrane bilayer?

- (A) Phospholipid
- (B) Triglyceride (neutral fat)



- (C) Cholesterol ester
- (D) Plant wax

**Q9.** The exchange of corresponding segments between non-sister chromatids of a homologous pair, shown below, increases genetic variation. This crossing over takes place during:



chiasma

- (A) Metaphase of mitosis
- (B) Anaphase I of meiosis
- (C) Pachytene of prophase I of meiosis
- (D) Telophase II of meiosis

**Q10.** The ribosomes in a bacterial cell differ in size from those free in the cytoplasm of a human cell. Bacterial (prokaryotic) ribosomes are of the type:

- (A) 80S
- (B) 70S
- (C) 60S
- (D) 40S

**Q11.** On warm, humid nights, droplets of liquid water appear at the tips and margins of the leaves of small herbaceous plants. This guttation, driven by root pressure, occurs through special pores called:

- (A) Stomata
- (B) Lenticels
- (C) Trichomes

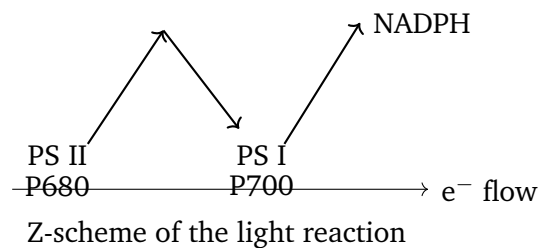


(D) Hydathodes

**Q12.** *Rhizobium* bacteria in the root nodules of legumes fix atmospheric nitrogen. The pink pigment of the nodule that protects the nitrogenase enzyme by mopping up free oxygen is:

- (A) Leghaemoglobin
- (B) Haemocyanin
- (C) Phytochrome
- (D) Cytochrome oxidase

**Q13.** In the Z-scheme of the light reaction shown, electrons flow from Photosystem II to Photosystem I. The reaction-centre pigment of Photosystem I, which absorbs light maximally at 700 nm, is:



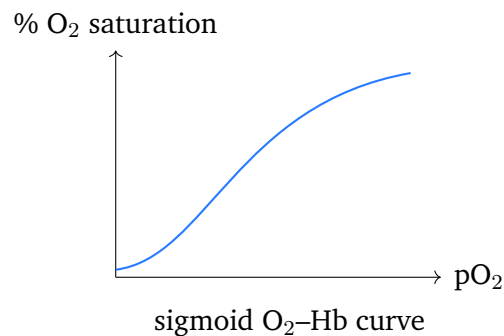
- (A) P680
- (B) Chlorophyll *b*
- (C) P700
- (D) Phycocyanin

**Q14.** In the electron transport chain on the inner mitochondrial membrane, electrons are passed along carriers and are finally handed over to the terminal electron acceptor, which is:

- (A)  $\text{NAD}^+$
- (B) FAD
- (C) Pyruvate
- (D) Molecular oxygen ( $\text{O}_2$ )



- Q15.** Trypsin, a protein-digesting enzyme of pancreatic juice, is secreted in an inactive form (trypsinogen) and is activated by enterokinase. It works best in the:
- (A) strongly acidic medium of the stomach
  - (B) alkaline medium of the small intestine
  - (C) neutral medium of the buccal cavity
  - (D) acidic medium of the large intestine
- Q16.** The oxygen–haemoglobin dissociation curve below is sigmoid in shape. A shift of this curve to the right, which helps unload more oxygen in actively respiring tissues (the Bohr effect), is brought about by:



- (A) a rise in pCO<sub>2</sub> and a fall in pH
  - (B) a fall in tissue temperature
  - (C) a rise in blood pH (alkalosis)
  - (D) a fall in pCO<sub>2</sub>
- Q17.** During ventricular systole of the human cardiac cycle:
- (A) the ventricles relax and passively fill with blood from the atria
  - (B) the atria contract to push the last of the blood into the ventricles
  - (C) the ventricles contract, the semilunar valves open, and blood is forced into the aorta and pulmonary artery
  - (D) all four chambers relax together (the joint diastole)

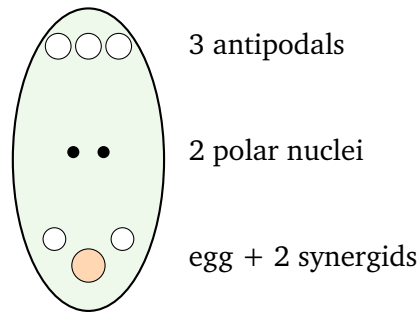


- Q18.** The loop of Henle and the vasa recta together work as a counter-current system in the kidney. Their chief role is to:
- (A) filter the blood plasma under high pressure
  - (B) set up and maintain an osmotic gradient in the medulla so that concentrated urine can be formed
  - (C) secrete the enzyme renin into the blood
  - (D) add glucose back into the filtrate
- Q19.** The cerebrum, the largest part of the human brain, is the principal centre for:
- (A) intelligence, memory, voluntary movement and the seat of consciousness
  - (B) control of the heartbeat and the rhythm of breathing
  - (C) maintenance of body balance and muscular coordination
  - (D) regulation of body temperature, hunger and thirst
- Q20.** Adrenaline (epinephrine), the “emergency” or fight-or-flight hormone released by the adrenal medulla, brings about:
- (A) a fall in heart rate and blood pressure
  - (B) increased secretion of digestive juices and gut movement
  - (C) a lowering of blood glucose by promoting glycogen storage
  - (D) an increase in heart rate, blood pressure and blood glucose
- Q21.** In a resting skeletal muscle the myosin-binding sites on the actin (thin) filament are masked by tropomyosin. Contraction is triggered when calcium ions released from the sarcoplasmic reticulum bind to:
- (A) the myosin heads directly
  - (B) troponin, shifting tropomyosin and exposing the binding sites
  - (C) the actin backbone, breaking it down



(D) the sarcolemma, opening it

**Q22.** The mature angiosperm embryo sac (female gametophyte) shown below develops from a single functional megaspore (monosporic development). A typical embryo sac is:



- (A) 8-celled and 8-nucleate
- (B) 6-celled and 7-nucleate
- (C) 7-celled and 8-nucleate
- (D) 3-celled and 3-nucleate

**Q23.** In human oogenesis, a primary oocyte completes the first meiotic division only around the time of ovulation. Each primary oocyte finally gives rise to:

- (A) one functional ovum and (usually three) polar bodies
- (B) four equal, functional ova
- (C) two ova and two polar bodies
- (D) one ovum only, with no polar bodies

**Q24.** The placenta connects the foetus to the uterine wall of the mother. In addition to the exchange of nutrients, gases and wastes, it also acts as an endocrine tissue by secreting:

- (A) digestive enzymes for the foetus
- (B) antibodies of the IgM class
- (C) red blood cells for the foetal circulation



(D) hormones such as hCG, progesterone and oestrogen

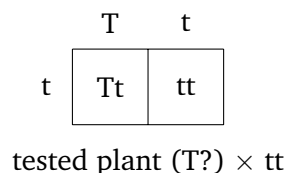
**Q25.** Gonorrhoea, a sexually transmitted infection that can lead to infertility if left untreated, is caused by the bacterium:

- (A) *Treponema pallidum*
- (B) *Neisseria gonorrhoeae*
- (C) *Trichomonas vaginalis*
- (D) *Chlamydomonas reinhardtii*

**Q26.** Mendel's law of independent assortment states that, during the formation of gametes:

- (A) one allele of a pair is always dominant over the other
- (B) the two alleles of a gene separate so that each gamete receives only one
- (C) the alleles of one gene segregate independently of the alleles of another gene
- (D) both alleles of a gene pass together into the same gamete

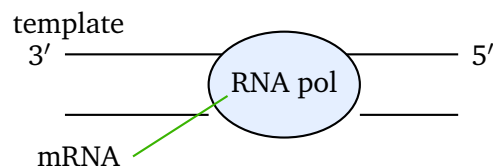
**Q27.** To find out whether a tall pea plant is homozygous (TT) or heterozygous (Tt), it is crossed with a dwarf (tt) plant, as shown. If the offspring appear in a 1 tall : 1 dwarf ratio, the tested tall plant must have been:



- (A) heterozygous (Tt)
- (B) homozygous dominant (TT)
- (C) homozygous recessive (tt)
- (D) triploid (TTt)



- Q28.** While working on *Drosophila*, T.H. Morgan observed that certain genes are inherited together far more often than expected by chance. Such linked genes:
- (A) always lie on different chromosomes
  - (B) always show exactly 50% recombination
  - (C) assort completely independently of one another
  - (D) lie close together on the same chromosome and tend to be inherited together
- Q29.** During transcription, shown below, RNA polymerase moves along the template DNA strand (reading it 3' → 5') and assembles a complementary mRNA molecule. The new RNA strand is synthesised:



- (A) in the 3' → 5' direction
  - (B) in the 5' → 3' direction
  - (C) in both directions at the same time
  - (D) using ribonucleotides joined by peptide bonds
- Q30.** Sickle-cell anaemia results from a single point mutation in the gene for the  $\beta$ -globin chain of haemoglobin. The molecular change is that:
- (A) valine at the sixth position is replaced by glutamic acid
  - (B) the entire  $\beta$ -globin gene is deleted
  - (C) glutamic acid at the sixth position is replaced by valine
  - (D) an extra copy of chromosome 21 is present
- Q31.** The Hardy–Weinberg principle states that the allele and genotype frequencies of a population stay constant from one generation to the next, provided that:



- (A) there is no mutation, gene migration, genetic drift or natural selection, and mating is random
- (B) natural selection acts strongly on the population
- (C) the population size is very small
- (D) mutations keep arising at a high rate

**Q32.** Pneumonia, which inflames the alveoli of the lungs and fills them with fluid so that breathing becomes difficult, is caused in humans chiefly by the bacterium:

- (A) *Salmonella typhi*
- (B) *Plasmodium vivax*
- (C) Rhinovirus
- (D) *Streptococcus pneumoniae*

**Q33.** In the secondary (biological) treatment of sewage, the primary effluent is vigorously aerated so that aerobic microbes grow into masses called flocs. This activated-sludge step mainly:

- (A) raises the biochemical oxygen demand (BOD) of the effluent
- (B) lowers the biochemical oxygen demand (BOD) of the effluent
- (C) adds chlorine to disinfect the water
- (D) removes only the heavy grit and sand

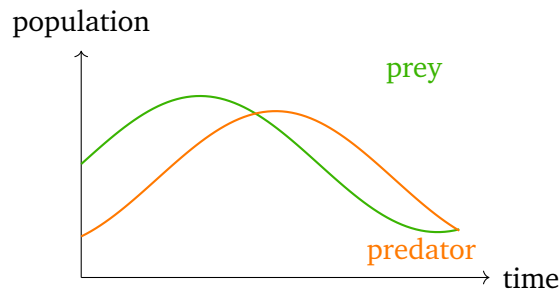
**Q34.** A vaccine protects against a disease by introducing antigens (a weakened or inactivated form of the pathogen) into the body, so that the body:

- (A) is supplied with ready-made antibodies from outside
- (B) develops the disease in a severe form
- (C) produces its own antibodies and memory cells, giving active immunity
- (D) destroys its own white blood cells



- Q35.** In agarose gel electrophoresis the fragments of cut DNA are separated by size. Because DNA carries a negative charge, the fragments move towards the anode (positive electrode), and:
- (A) smaller fragments move faster and travel farther than larger ones
  - (B) larger fragments move faster than smaller ones
  - (C) all the fragments move at exactly the same speed
  - (D) the DNA moves towards the cathode (negative electrode)
- Q36.** The Ti (tumour-inducing) plasmid, now disarmed and widely used to deliver desired genes into plant cells, is found naturally in the soil bacterium:
- (A) *Escherichia coli*
  - (B) *Bacillus thuringiensis*
  - (C) *Thermus aquaticus*
  - (D) *Agrobacterium tumefaciens*
- Q37.** The first clinical gene therapy, carried out in 1990 on a young girl, treated a severe combined immunodeficiency (SCID) caused by the deficiency of the enzyme:
- (A) tyrosinase
  - (B) adenosine deaminase (ADA)
  - (C) DNA ligase
  - (D) carbonic anhydrase
- Q38.** The graph shows the population cycles of a prey species and its predator over time. The characteristic relationship between the two curves is that the:





- (A) two populations always peak at exactly the same moment
- (B) prey population peaks only after the predator population peaks
- (C) predator population peaks a little after the prey population, with a time lag
- (D) neither population changes in size over time

**Q39.** Unlike the carbon and nitrogen cycles, the phosphorus cycle is described as a sedimentary cycle because:

- (A) its largest reservoir is rock and it has no significant gaseous (atmospheric) phase
- (B) phosphorus is most abundant in the atmosphere
- (C) phosphorus is fixed directly from the air by bacteria
- (D) it has a large atmospheric pool like carbon dioxide

**Q40.** Protecting and conserving species within their own natural habitat, for example in national parks, wildlife sanctuaries and biosphere reserves, is known as:

- (A) ex-situ conservation
- (B) cryopreservation of gametes
- (C) conservation by tissue culture
- (D) in-situ conservation



## Detailed Solutions

Q1.

## Solution

**Concept — Euglenoids (Kingdom Protista):** Euglenoids are mostly freshwater, flagellate protists that share features of both plants and animals.

**Step 1 — Note the covering:** Instead of a rigid cellulose cell wall, a euglenoid has a flexible, protein-rich layer just below the plasma membrane called the pellicle.

**Step 2 — Note the nutrition:** In sunlight euglenoids photosynthesise, but in the dark they behave as heterotrophs (they are mixotrophic), so they are not strictly autotrophic.

**Why other options are wrong:**

- Option A: their reserve food is paramylon, not starch.
- Option B: they are mixotrophic, not strictly autotrophic.
- Option D: a silica shell is a feature of diatoms (chrysophytes), not euglenoids.

**Final Answer:** A euglenoid has a protein pellicle instead of a cellulose wall ⇒ **C**

**Answer: (C)** [Go Back to Q1](#)

Q2.

## Solution

**Concept — Ascomycetes (sac fungi):** In this class the sexual spores, called ascospores, are formed inside sac-like cells named asci.

**Step 1 — Recall examples:** Yeast (*Saccharomyces*), *Penicillium*, *Aspergillus*, *Neurospora* and morels are ascomycetes.

**Step 2 — Match the option:** *Penicillium* is an ascomycete, so it is the correct example here.

**Why other options are wrong:**

- Option B (*Agaricus*, mushroom) is a basidiomycete.
- Option C (*Rhizopus*) is a zygomycete.
- Option D (*Ustilago*, smut) is a basidiomycete.

**Final Answer:** *Penicillium* is the ascomycete ⇒ **A**



Answer: (A) [Go Back to Q2](#)

Q3.

### Solution

**Concept — Body symmetry:** Animals are grouped by how their body can be divided into similar halves.

**Step 1 — Read the diagram:** The body can be cut into two equal halves by any plane passing through the central axis, like the spokes of a wheel.

**Step 2 — Name the symmetry:** This is radial symmetry, shown by coelenterates (cnidarians) such as *Hydra* and jellyfish.

**Why other options are wrong:**

- Option A (bilateral) allows only one plane to give equal halves (left and right).
- Option C (asymmetry) means no plane divides the body equally, as in *Amoeba*.
- Option D is not a recognised symmetry type.

**Final Answer:** Many planes through the centre give equal halves  $\Rightarrow$  radial symmetry  $\Rightarrow$

Answer: (B) [Go Back to Q3](#)

Q4.

### Solution

**Concept — Collenchyma:** It is a simple living mechanical tissue that supports young, growing plant parts while still allowing them to bend.

**Step 1 — Note the cells are living:** Collenchyma cells retain their protoplasm, so they are living at maturity.

**Step 2 — Note the thickening:** Their walls have extra deposits of cellulose and pectin localised at the corners, giving support with flexibility.

**Why other options are wrong:**

- Options A and B describe dead, lignified cells, which is sclerenchyma.
- Option C wrongly says there is no thickening; the corner thickening is the defining feature.



**Final Answer:** Living cells with extra cellulose at the corners  $\Rightarrow$

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

Q5.

### Solution

**Concept — Cardiac muscle:** This muscle is found only in the heart and combines features of skeletal and smooth muscle.

**Step 1 — List its features:** It is striated (cross-banded) and branched, but it is involuntary (not under conscious control).

**Step 2 — Identify the special junction:** Neighbouring cardiac fibres are joined by intercalated discs, which allow rapid, coordinated contraction of the heart.

**Why other options are wrong:**

- Option A wrongly calls it voluntary and unbranched.
- Options B and D wrongly call it smooth (non-striated).

**Final Answer:** Striated, branched, involuntary with intercalated discs  $\Rightarrow$

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

Q6.

### Solution

**Concept — Aestivation:** It describes the arrangement of sepals or petals in a floral bud before it opens.

**Step 1 — Read the description:** Each petal overlaps the next in a regular, twisted way, one margin lying over the margin of the neighbouring petal.

**Step 2 — Name the type:** This regular overlapping pattern is twisted (contorted) aestivation, seen in China rose, cotton and *Lady's finger*.

**Why other options are wrong:**

- Option A (valvate): margins merely touch without overlapping.
- Option C (imbricate): overlapping is irregular, not in one twisted direction.
- Option D (vexillary): the special papilionaceous pattern of pea, not this.

**Final Answer:** Regular one-way overlap  $\Rightarrow$  twisted aestivation  $\Rightarrow$

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



Q7.

**Solution**

**Concept — Endoplasmic reticulum:** The ER is a network of tubules; the rough ER bears ribosomes while the smooth ER does not.

**Step 1 — Note what RER does:** Because it carries ribosomes, the rough ER is involved in the synthesis and transport of proteins.

**Step 2 — Note what SER does:** The smooth ER, lacking ribosomes, is the main site of synthesis of lipids and steroid hormones (and helps detoxify drugs).

**Why other options are wrong:**

- Option A (protein synthesis) is a function of the rough ER.
- Option B (ATP production) occurs in mitochondria.
- Option C (packaging into vesicles) is the work of the Golgi apparatus.

**Final Answer:** The smooth ER makes lipids and steroids ⇒

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

Q8.

**Solution**

**Concept — Membrane lipids:** A molecule that has both a water-loving and a water-hating end is called amphipathic, and such molecules form bilayers.

**Step 1 — Identify the structure:** A phospholipid has a hydrophilic phosphate head and two hydrophobic fatty-acid tails.

**Step 2 — Relate to the membrane:** In water the tails turn inward and the heads face outward, forming the lipid bilayer that is the framework of every cell membrane.

**Why other options are wrong:**

- Option B (triglyceride) has three fatty-acid tails and no phosphate; it is a storage fat.
- Option C (cholesterol ester) is a storage form of cholesterol, not the main bilayer unit.
- Option D (wax) is a protective coating, not a membrane builder.

**Final Answer:** The amphipathic membrane lipid is the phospholipid ⇒

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



Q9.

**Solution**

**Concept — Crossing over:** It is the mutual exchange of segments between non-sister chromatids of a homologous pair, producing new gene combinations.

**Step 1 — Read the diagram:** The blue and orange chromatids exchange parts at a point called the chiasma.

**Step 2 — Time it correctly:** Crossing over occurs during the pachytene sub-stage of prophase I of meiosis, when homologous chromosomes are closely paired (synapsed).

**Why other options are wrong:**

- Option A (mitosis) does not involve pairing of homologues, so no crossing over.
- Option B (anaphase I) is when homologues separate, after crossing over is done.
- Option D (telophase II) is the final stage of the second division.

**Final Answer:** Crossing over occurs at pachytene of prophase I ⇒ **C**

**Answer: (C)** [Go Back to Q9](#)

Q10.

**Solution**

**Concept — Ribosomes:** Ribosomes are graded by their sedimentation coefficient, measured in Svedberg (S) units.

**Step 1 — Recall the prokaryotic value:** Prokaryotic (bacterial) ribosomes are 70S, made of a 50S and a 30S subunit.

**Step 2 — Contrast with eukaryotes:** The ribosomes in the cytoplasm of eukaryotes (like human cells) are larger, the 80S type (60S + 40S).

**Why other options are wrong:**

- Option A (80S) is the eukaryotic cytoplasmic ribosome.
- Options C and D (60S, 40S) are subunits of the 80S ribosome, not whole prokaryotic ribosomes.

**Final Answer:** Bacterial ribosomes are of the 70S type ⇒ **B**

**Answer: (B)** [Go Back to Q10](#)



Q11.

**Solution**

**Concept — Guttation:** It is the loss of liquid water (droplets) from the margins of leaves, driven by positive root pressure when transpiration is low.

**Step 1 — Identify the conditions:** On warm, humid nights, absorption continues but transpiration nearly stops, so root pressure pushes water out.

**Step 2 — Identify the pores:** The water escapes through special pores at vein endings on leaf margins called hydathodes.

**Why other options are wrong:**

- Option A (stomata) release water as vapour (transpiration), not liquid droplets.
- Option B (lenticels) allow gas exchange in woody stems.
- Option C (trichomes) are epidermal hairs, not pores for water loss.

**Final Answer:** Guttation occurs through hydathodes  $\Rightarrow$

[Go Back to Q11](#)

Q12.

**Solution**

**Concept — Symbiotic nitrogen fixation:** *Rhizobium* in legume root nodules converts atmospheric  $N_2$  into ammonia using the enzyme nitrogenase.

**Step 1 — Note the problem:** Nitrogenase is destroyed by oxygen, so free  $O_2$  must be kept very low inside the nodule.

**Step 2 — Identify the protector:** The nodule makes a pink, oxygen-binding pigment called leghaemoglobin, which mops up free oxygen and shields nitrogenase.

**Why other options are wrong:**

- Option B (haemocyanin) is a respiratory pigment in some invertebrates.
- Option C (phytochrome) is a light-sensing pigment.
- Option D (cytochrome oxidase) is a respiratory enzyme, not an  $O_2$  scavenger of the nodule.

**Final Answer:** The oxygen-scavenging nodule pigment is leghaemoglobin  $\Rightarrow$

[Go Back to Q12](#)



Q13.

**Solution**

**Concept — Z-scheme:** In the light reaction electrons flow from Photosystem II to Photosystem I along an electron transport chain, drawn as a zig-zag (Z).

**Step 1 — Identify the two reaction centres:** The reaction centre of PS II absorbs maximally at 680 nm (P680), and that of PS I at 700 nm (P700).

**Step 2 — Match the clue:** The pigment absorbing at 700 nm in PS I is P700.

**Why other options are wrong:**

- Option A (P680) belongs to PS II.
- Option B (chlorophyll *b*) is an accessory, not a reaction-centre, pigment.
- Option D (phycocyanin) is an accessory pigment of cyanobacteria/red algae.

**Final Answer:** The 700 nm reaction-centre pigment of PS I is P700 ⇒

**Answer: (C)** [Go Back to Q13](#)

Q14.

**Solution**

**Concept — Oxidative phosphorylation:** Electrons from NADH and FADH<sub>2</sub> pass down the electron transport chain, releasing energy used to make ATP.

**Step 1 — Trace the electrons:** The carriers (complexes I–IV) hand electrons from one to the next, losing energy at each step.

**Step 2 — Identify the terminal acceptor:** At the end, the electrons are accepted by molecular oxygen, which combines with protons to form water.

**Why other options are wrong:**

- Options A and B (NAD<sup>+</sup>, FAD) are electron donors/carriers, not the final acceptor.
- Option C (pyruvate) is a substrate of respiration, not the terminal acceptor.

**Final Answer:** The terminal electron acceptor is molecular oxygen ⇒

**Answer: (D)** [Go Back to Q14](#)



Q15.

**Solution**

**Concept — Trypsin:** It is a protein-splitting enzyme of pancreatic juice, secreted as inactive trypsinogen.

**Step 1 — Note its activation:** Trypsinogen is converted to active trypsin by the intestinal enzyme enterokinase (enteropeptidase).

**Step 2 — Note its optimum medium:** Pancreatic juice and bile make the small intestine alkaline, and trypsin works best in this alkaline medium.

**Why other options are wrong:**

- Option A: the acidic stomach suits pepsin, not trypsin.
- Option C: the mouth has near-neutral salivary amylase action, not protein digestion by trypsin.
- Option D: the large intestine is not where trypsin acts.

**Final Answer:** Trypsin acts in the alkaline small intestine  $\Rightarrow$  **B**

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

Q16.

**Solution**

**Concept — Oxygen dissociation curve:** The S-shaped curve shows how the percentage saturation of haemoglobin changes with the partial pressure of oxygen.

**Step 1 — Understand a right shift:** A shift to the right means haemoglobin gives up oxygen more readily, which is useful in active tissues.

**Step 2 — Identify the cause (Bohr effect):** A rise in  $p\text{CO}_2$  and a fall in pH (more acidic) lower haemoglobin's affinity for oxygen, shifting the curve to the right.

**Why other options are wrong:**

- Option B (fall in temperature) shifts the curve left.
- Option C (rise in pH/alkalosis) shifts the curve left.
- Option D (fall in  $p\text{CO}_2$ ) shifts the curve left.

**Final Answer:** High  $p\text{CO}_2$  with low pH shifts the curve right  $\Rightarrow$  **A**

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



Q17.

**Solution**

**Concept — Cardiac cycle:** Systole means contraction and diastole means relaxation of the heart chambers.

**Step 1 — Define ventricular systole:** The ventricles contract, raising the pressure inside them.

**Step 2 — Trace the blood flow:** The rising pressure closes the atrio-ventricular valves and opens the semilunar valves, so blood is pushed into the aorta and pulmonary artery.

**Why other options are wrong:**

- Option A describes ventricular diastole (relaxation and filling).
- Option B describes atrial systole.
- Option D describes the joint diastole, when all chambers relax.

**Final Answer:** In ventricular systole blood is forced into the great arteries ⇒

[Go Back to Q17](#)

Q18.

**Solution**

**Concept — Counter-current system:** The loop of Henle (filtrate) and the vasa recta (blood) run parallel but carry fluids in opposite directions.

**Step 1 — Note the effect:** This arrangement concentrates salts (NaCl and urea) deep in the medulla, making it increasingly hyperosmotic from cortex to inner medulla.

**Step 2 — Link to function:** The maintained osmotic gradient lets the collecting duct reabsorb water and produce concentrated (hypertonic) urine.

**Why other options are wrong:**

- Option A (filtration) occurs at the glomerulus, not the loop.
- Option C (renin secretion) is the job of the juxtaglomerular apparatus.
- Option D: glucose is reabsorbed mainly in the proximal tubule.

**Final Answer:** The loop maintains a medullary gradient to concentrate urine ⇒

[Go Back to Q18](#)



Q19.

**Solution**

**Concept — Cerebrum:** It is the largest and most developed part of the human brain, forming most of the forebrain.

**Step 1 — List its roles:** The cerebrum controls voluntary muscular movements and is the seat of intelligence, memory, reasoning, will and consciousness.

**Step 2 — Note sensory–motor areas:** Its cortex has separate sensory, motor and association areas for these higher functions.

**Why other options are wrong:**

- Option B (heartbeat and breathing) is controlled by the medulla oblongata.
- Option C (balance and coordination) is the work of the cerebellum.
- Option D (temperature, hunger, thirst) is regulated by the hypothalamus.

**Final Answer:** The cerebrum governs intelligence, memory, voluntary action and consciousness ⇒

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

Q20.

**Solution**

**Concept — Adrenaline:** Secreted by the adrenal medulla in stress or emergency, it prepares the body for “fight or flight”.

**Step 1 — Note the cardiovascular effects:** It speeds up the heartbeat and raises blood pressure.

**Step 2 — Note the metabolic effects:** It promotes the breakdown of glycogen (glycogenolysis), raising blood glucose to supply quick energy.

**Why other options are wrong:**

- Option A is the opposite of its true action.
- Option B is wrong, because adrenaline slows digestion during stress.
- Option C is wrong, because adrenaline raises (not lowers) blood glucose.

**Final Answer:** Adrenaline raises heart rate, blood pressure and blood glucose ⇒

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



Q21.

**Solution**

**Concept — Molecular basis of contraction:** On the thin filament, the binding sites for myosin are normally blocked by the tropomyosin–troponin complex.

**Step 1 — Identify the calcium target:** The calcium ions released on stimulation bind to troponin.

**Step 2 — Note the result:** This binding shifts tropomyosin aside, uncovering the binding sites so that myosin heads can attach to actin and the muscle contracts.

**Why other options are wrong:**

- Option A: calcium does not act on the myosin heads to begin contraction.
- Option C: calcium does not break down actin.
- Option D: calcium does not open the sarcolemma.

**Final Answer:** Calcium binds troponin to start contraction ⇒ **B**

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

Q22.

**Solution**

**Concept — Embryo sac:** The female gametophyte of an angiosperm develops, in most plants, from one functional megaspore (monosporic development).

**Step 1 — Count the nuclei:** Three rounds of free-nuclear division give eight nuclei.

**Step 2 — Count the cells:** These organise into seven cells: three antipodals, two synergids, one egg, and one central cell holding the two polar nuclei. So it is 7-celled and 8-nucleate.

**Why other options are wrong:**

- Option A wrongly gives 8 cells; the two polar nuclei share one central cell.
- Options B and D give wrong cell and nucleus numbers.

**Final Answer:** A typical embryo sac is 7-celled and 8-nucleate ⇒ **C**

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



Q23.

**Solution**

**Concept — Oogenesis:** The formation of the female gamete is unequal, so that most of the cytoplasm is saved for one large ovum.

**Step 1 — Trace the divisions:** One primary oocyte undergoes meiosis I to give a large secondary oocyte and a small first polar body; meiosis II gives one ovum and a second polar body.

**Step 2 — Count the products:** The outcome is one functional ovum and (usually) three polar bodies, which degenerate.

**Why other options are wrong:**

- Option B: the four products are not equal, and only one is a functional ovum.
- Option C: there is one ovum, not two.
- Option D: polar bodies are indeed formed.

**Final Answer:** One primary oocyte yields one ovum and three polar bodies ⇒

[Go Back to Q23](#)

Q24.

**Solution**

**Concept — Placenta:** It is the structural and functional link between the developing foetus and the mother's body.

**Step 1 — Note the exchange role:** It allows oxygen and nutrients to pass from mother to foetus and carbon dioxide and wastes to pass the other way.

**Step 2 — Note the endocrine role:** The placenta also secretes hormones, including hCG, human placental lactogen, progesterone and oestrogens, which maintain pregnancy.

**Why other options are wrong:**

- Option A: the placenta does not secrete digestive enzymes.
- Option B: it is not primarily an antibody factory of the IgM type.
- Option C: it does not manufacture the foetus's red blood cells.

**Final Answer:** The placenta secretes hormones such as hCG, progesterone and oestrogen ⇒

[Go Back to Q24](#)



Q25.

**Solution**

**Concept — Sexually transmitted diseases:** Different STDs are caused by different micro-organisms.

**Step 1 — Identify the pathogen:** Gonorrhoea is a bacterial STD caused by *Neisseria gonorrhoeae*.

**Step 2 — Note the effect:** If untreated it can damage the reproductive tract and cause infertility.

**Why other options are wrong:**

- Option A (*Treponema pallidum*) causes syphilis, a different STD.
- Option C (*Trichomonas*) causes trichomoniasis.
- Option D (*Chlamydomonas*) is a green alga, not a human pathogen.

**Final Answer:** Gonorrhoea is caused by *Neisseria gonorrhoeae* ⇒ **B**

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

Q26.

**Solution**

**Concept — Law of independent assortment:** This is Mendel's third principle, drawn from the dihybrid cross.

**Step 1 — State the law:** When two pairs of contrasting traits are studied together, the alleles of one gene separate (assort) independently of the alleles of the other gene during gamete formation.

**Step 2 — Note the outcome:** This independence produces the 9:3:3:1 F<sub>2</sub> phenotypic ratio of the dihybrid cross.

**Why other options are wrong:**

- Option A states the law of dominance.
- Option B states the law of segregation.
- Option D is biologically false, since the two alleles of a gene must go to different gametes.

**Final Answer:** Alleles of different genes assort independently ⇒ **C**

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



Q27.

**Solution**

**Concept — Test cross:** An organism showing the dominant phenotype is crossed with a homozygous recessive to reveal its unknown genotype.

**Step 1 — Read the cross:** The dwarf parent (tt) gives only t gametes. If the tested tall plant were TT, all offspring would be tall (Tt).

**Step 2 — Interpret the 1:1 ratio:** A 1 tall : 1 dwarf ratio appears only if the tall plant produced both T and t gametes, that is, if it was heterozygous (Tt).

**Why other options are wrong:**

- Option B (TT) would give all tall offspring, not 1:1.
- Option C (tt) would itself be dwarf, not tall.
- Option D (triploid) is not relevant to this Mendelian cross.

**Final Answer:** A 1:1 test-cross ratio means the tall plant was Tt ⇒

**Answer: (A)** [Go Back to Q27](#)

Q28.

**Solution**

**Concept — Linkage:** Genes located on the same chromosome tend to be inherited together because they cannot assort independently.

**Step 1 — Recall Morgan's finding:** In *Drosophila*, Morgan found that some genes stayed together in inheritance more than expected by chance.

**Step 2 — Explain it:** Such linked genes lie close together on the same chromosome; the closer they are, the lower the chance of recombination between them.

**Why other options are wrong:**

- Options A and C describe genes on different chromosomes, which assort independently.
- Option B (always 50% recombination) describes unlinked genes, not linked ones.

**Final Answer:** Linked genes lie on the same chromosome and are inherited together ⇒

**Answer: (D)** [Go Back to Q28](#)



Q29.

**Solution**

**Concept — Transcription:** RNA polymerase copies one strand of DNA (the template) into a complementary messenger RNA.

**Step 1 — Read the template direction:** The enzyme reads the template strand in the 3' → 5' direction.

**Step 2 — Note the synthesis direction:** It adds ribonucleotides to the growing RNA only at the 3' end, so the RNA is built in the 5' → 3' direction.

**Why other options are wrong:**

- Option A reverses the direction of RNA synthesis.
- Option C is wrong, because synthesis proceeds one way only.
- Option D is wrong, because nucleotides are joined by phosphodiester (not peptide) bonds.

**Final Answer:** RNA is synthesised in the 5' → 3' direction ⇒ **B**

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

Q30.

**Solution**

**Concept — Sickle-cell anaemia:** It is an autosomal recessive disorder caused by a single base change (point mutation) in the  $\beta$ -globin gene.

**Step 1 — Note the codon change:** The codon GAG changes to GTG at the sixth position of the  $\beta$ -globin chain.

**Step 2 — Note the amino-acid change:** This substitutes the amino acid glutamic acid by valine, making the haemoglobin (HbS) sickle the red cells under low oxygen.

**Why other options are wrong:**

- Option A reverses the substitution.
- Option B describes a deletion, not a point mutation.
- Option D describes Down syndrome (trisomy 21).

**Final Answer:** Glutamic acid at position 6 is replaced by valine ⇒ **C**

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



Q31.

**Solution**

**Concept — Hardy–Weinberg equilibrium:** In an ideal, non-evolving population, allele and genotype frequencies remain constant ( $p^2 + 2pq + q^2 = 1$ ).

**Step 1 — List the conditions:** Equilibrium holds only when there is no mutation, no gene migration (flow), no genetic drift and no natural selection, and mating is random.

**Step 2 — Note the meaning:** If any of these is violated, allele frequencies change, which is evolution.

**Why other options are wrong:**

- Option B (strong selection) disturbs equilibrium.
- Option C (very small population) leads to genetic drift.
- Option D (frequent mutation) changes allele frequencies.

**Final Answer:** Frequencies stay constant only without the evolutionary forces and with random mating  $\Rightarrow$  **A**

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

Q32.

**Solution**

**Concept — Pneumonia:** It is an infection of the alveoli of the lungs, which fill with fluid and impair gas exchange.

**Step 1 — Identify the pathogen:** The common bacterial cause is *Streptococcus pneumoniae*.

**Step 2 — Note the symptoms:** Fever, chills, cough and difficulty in breathing follow because the alveoli are filled with fluid.

**Why other options are wrong:**

- Option A (*Salmonella typhi*) causes typhoid.
- Option B (*Plasmodium*) causes malaria.
- Option C (rhinovirus) causes the common cold.

**Final Answer:** Pneumonia is caused mainly by *Streptococcus pneumoniae*  $\Rightarrow$  **D**

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



Q33.

**Solution**

**Concept — Activated-sludge process:** It is the secondary (biological) stage of sewage treatment, carried out by aerobic microbes.

**Step 1 — Note the action:** On vigorous aeration the microbes grow into flocs and consume most of the organic matter in the effluent.

**Step 2 — Note the result:** As organic matter is used up, the biochemical oxygen demand (BOD) of the effluent falls sharply, indicating cleaner water.

**Why other options are wrong:**

- Option A reverses the effect; BOD goes down, not up.
- Option C (chlorination) is a separate disinfection step.
- Option D (grit removal) is part of primary, physical treatment.

**Final Answer:** The activated-sludge step lowers the BOD of the effluent ⇒

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

Q34.

**Solution**

**Concept — Vaccination:** A vaccine introduces antigens of a pathogen so that the immune system responds in advance.

**Step 1 — Note the response:** The body makes antibodies against the antigen and forms memory B- and T-cells.

**Step 2 — Note the protection:** On later exposure to the real pathogen, the memory cells mount a rapid, strong secondary response; this is active immunity.

**Why other options are wrong:**

- Option A (ready-made antibodies) describes passive immunity, not vaccination.
- Option B is wrong, since the vaccine does not cause severe disease.
- Option D is the opposite of what a vaccine does.

**Final Answer:** A vaccine makes the body produce antibodies and memory cells (active immunity) ⇒

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



Q35.

**Solution**

**Concept — Gel electrophoresis:** It separates DNA fragments through a sieve-like agarose gel using an electric field.

**Step 1 — Note the charge and direction:** DNA is negatively charged (due to phosphate groups), so it moves towards the positive electrode (anode).

**Step 2 — Note the size effect:** The gel slows large fragments more, so smaller fragments move faster and travel farther from the wells.

**Why other options are wrong:**

- Option B reverses the size relationship.
- Option C is wrong, because fragments separate by size, so speeds differ.
- Option D is wrong; negatively charged DNA moves to the anode, not the cathode.

**Final Answer:** Smaller DNA fragments migrate faster and farther ⇒

[Go Back to Q35](#)

Q36.

**Solution**

**Concept — Ti plasmid:** It is a natural gene-transfer system used in plant genetic engineering.

**Step 1 — Identify the source:** The Ti (tumour-inducing) plasmid occurs naturally in the soil bacterium *Agrobacterium tumefaciens*.

**Step 2 — Note its use:** In the laboratory the tumour-causing genes are removed (it is “disarmed”), and the plasmid is used to carry desired genes into plant cells.

**Why other options are wrong:**

- Option A (*E. coli*) is a common cloning host, not the source of the Ti plasmid.
- Option B (*Bacillus thuringiensis*) provides the Bt (cry) toxin gene.
- Option C (*Thermus aquaticus*) provides Taq polymerase for PCR.

**Final Answer:** The Ti plasmid comes from *Agrobacterium tumefaciens* ⇒

[Go Back to Q36](#)



Q37.

**Solution**

**Concept — Gene therapy:** It is the correction of a genetic defect by introducing a normal gene into a patient's cells.

**Step 1 — Recall the first case:** The first gene therapy (1990) was performed on a girl with severe combined immunodeficiency (SCID).

**Step 2 — Identify the missing enzyme:** Her SCID was due to the deficiency of the enzyme adenosine deaminase (ADA); a functional ADA gene was introduced into her lymphocytes.

**Why other options are wrong:**

- Option A (tyrosinase) deficiency causes albinism, not SCID.
- Option C (DNA ligase) is a DNA-joining enzyme, not the cause of this SCID.
- Option D (carbonic anhydrase) is unrelated to this disorder.

**Final Answer:** The first gene therapy treated ADA deficiency  $\Rightarrow$  **B**

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

Q38.

**Solution**

**Concept — Predator–prey cycles:** The numbers of a predator and its prey rise and fall in a linked, repeating pattern.

**Step 1 — Read the graph:** The prey curve (green) rises and falls, and the predator curve (orange) repeats the same shape but a little later.

**Step 2 — Explain the lag:** When prey are plentiful, predators get more food and increase; so the predator peak comes a short time after the prey peak. As predators rise, prey fall, and the predators then decline too.

**Why other options are wrong:**

- Option A is wrong; the peaks are out of step, not together.
- Option B reverses the order; the prey peak comes first.
- Option D is wrong; both populations clearly oscillate.

**Final Answer:** The predator peak follows the prey peak after a time lag  $\Rightarrow$  **C**

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



Q39.

**Solution**

**Concept — Phosphorus cycle:** Nutrient cycles are gaseous (reservoir in air) or sedimentary (reservoir in rock); phosphorus follows the sedimentary type.

**Step 1 — Locate the reservoir:** The chief store of phosphorus is in rocks and sediments as phosphate.

**Step 2 — Note the missing phase:** Phosphorus has no important gaseous form, so unlike carbon and nitrogen it has essentially no atmospheric phase.

**Why other options are wrong:**

- Option B is wrong; phosphorus is scarce in the atmosphere.
- Option C describes nitrogen fixation, not the phosphorus cycle.
- Option D wrongly gives phosphorus a large atmospheric pool like CO<sub>2</sub>.

**Final Answer:** Rock is the reservoir and there is no gaseous phase ⇒

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

Q40.

**Solution**

**Concept — Biodiversity conservation:** It is of two broad kinds, in-situ (on-site) and ex-situ (off-site).

**Step 1 — Define in-situ:** Conserving species in their own natural surroundings is in-situ conservation.

**Step 2 — Give examples:** National parks, wildlife sanctuaries, biosphere reserves and sacred groves are in-situ methods.

**Why other options are wrong:**

- Option A (ex-situ) conserves species away from their habitat, e.g. zoos and seed banks.
- Option B (cryopreservation) and Option C (tissue culture) are themselves ex-situ techniques.

**Final Answer:** Conserving species in their natural habitat is in-situ conservation ⇒

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



## Answer Key

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

