TALLENTEX Biology

Sample Paper – 10

Duration: 23 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Correct Answer), modelled on the Biology portion of **TALLENTEX** entrance.
- Each correct answer carries **+4 marks**. There is **a penalty of** -1 **mark** for incorrect answers. Unattempted questions carry no penalty.
- Only **one** option is correct. Choose carefully.
- Syllabus: **NCERT Class 9 and Class 10 Biology**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Multiple Choice Questions (Single Correct)

Q1. The endoplasmic reticulum (ER) is a network of membranes inside the cell. Which of the following correctly describes the function of the **rough endoplasmic reticulum (RER)**?

(A) It synthesises lipids and detoxifies drugs and poisons

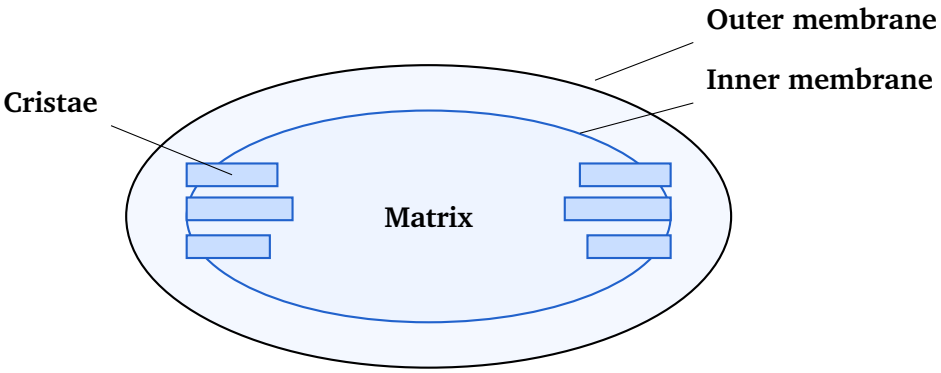
(B) It is studded with ribosomes and is responsible for synthesising and folding secretory proteins, which are then transported to the Golgi apparatus

(C) It stores calcium ions required for muscle contraction and is found mainly in liver cells

(D) It digests worn-out organelles and foreign particles using hydrolytic enzymes

Q2. Study the diagram of a mitochondrion below. The inner mitochondrial

membrane has shelf-like folds called **cristae**. What is the functional significance of these cristae?



(A) They store the genetic information (mitochondrial DNA) required for replication

(B) They separate the mitochondrial matrix from the cytoplasm, preventing enzyme leakage

(C) They greatly increase the surface area of the inner membrane, providing more space for the electron transport chain complexes and ATP synthase enzymes that produce ATP

(D) They act as channels allowing nutrients to enter the mitochondria from the cytoplasm

Q3. A mature plant cell contains a large central vacuole that may occupy up to 90% of the cell volume. The membrane that encloses this vacuole is specifically called the:

(A) Plasma membrane (cell membrane)

(B) Nuclear envelope

(C) Plasmalemma

(D) Tonoplast

Q4. Many nerve fibres in the peripheral nervous system are wrapped in a white, fatty covering called the **myelin sheath**. What is the primary function of this myelin sheath in nerve impulse transmission?

(A) It acts as an electrical insulator around the axon, allowing the impulse to jump between the nodes of Ranvier (saltatory conduction), greatly increasing the speed of signal transmission

(B) It supplies nutrients (glucose and oxygen) directly to the axon from the surrounding tissue

(C) It converts chemical signals from adjacent neurons into electrical impulses at the synapse

(D) It prevents the nerve from bending or breaking by providing mechanical support

Q5. Bryophytes (mosses and liverworts) are often called the "amphibians of the plant kingdom." Which combination of features correctly describes the Bryophyta?

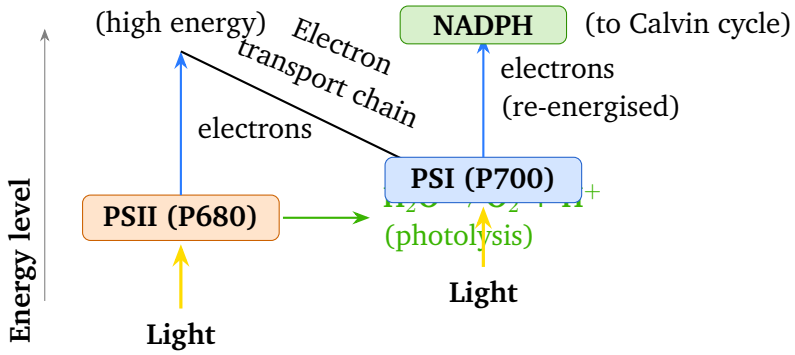
(A) They have well-developed vascular tissue (xylem and phloem) and reproduce by seeds

(B) They are fully aquatic, permanently submerged in water, and reproduce by spores

(C) They have roots, stems, and leaves but lack flowers or seeds

(D) They lack vascular tissue, require water for fertilisation (motile sperms), and show alternation of generations between a dominant gametophyte and a sporophyte

Q6. Study the simplified electron-flow diagram (Z-scheme) for the light reactions of photosynthesis below. During the light reactions, water is split and oxygen is released. At which stage does this water splitting (photolysis) occur, and what energy carrier is produced at the end of the Z-scheme?



(A) Water is split at PSI (P700) and glucose is the final energy carrier produced

(B) Water is split at the electron transport chain (between the two photosystems) and ATP is the only product

(C) Water splitting (photolysis) occurs at PSII (P680) when light energy is absorbed; the Z-scheme ends with the production of NADPH at PSI (P700), which carries energy to the Calvin cycle

(D) Water is split at both PSII and PSI simultaneously, producing NADPH and glucose directly

Q7. The Krebs cycle (citric acid cycle) is a key stage in cellular respiration. Which of the following correctly describes both the **location** of the Krebs cycle and its major **products**?

(A) It occurs in the mitochondrial matrix; each turn of the cycle produces 2 CO_2, 3 NADH, 1 $FADH_2$, and 1 ATP (or GTP)

(B) It occurs on the inner mitochondrial membrane; products are O_2, ATP, and water

(C) It occurs in the cytoplasm (cytosol); products are pyruvate and a net gain of 2 ATP

(D) It occurs in the thylakoid membrane; products are glucose and NADPH

Q8. In plants, organic food (mainly sucrose) synthesised during photosynthesis in leaves is transported throughout the plant body. Which of the following statements correctly describes this process of **translocation**?

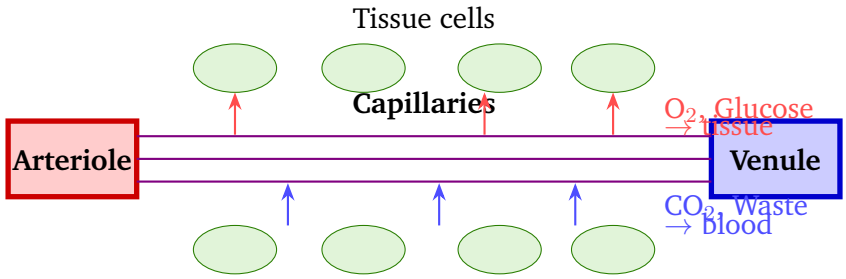
(A) Food is transported upward only through the xylem, along with water and minerals, by transpiration pull

(B) Sucrose is loaded into the phloem at the source (e.g., leaf) and transported to sink regions (e.g., roots, fruits, growing tips) by bulk flow driven by a pressure gradient — the pressure flow (mass flow) hypothesis

(C) Translocation occurs by simple diffusion of glucose along a concentration gradient from leaf to root, requiring no energy

(D) Food is transported exclusively downward from leaves to roots and cannot move upward in the phloem

Q9. Study the diagram of a capillary bed below. Materials are constantly exchanged between the blood in capillaries and the surrounding tissues. Which statement correctly describes what moves **out of** the capillary into the tissue, and what moves **into** the capillary from the tissue?



(A) CO_2 and glucose move out into the tissue; O_2 and urea move into the capillary

(B) Only water moves out of the capillary; all other substances remain in the blood

(C) Oxygen and glucose move out of the capillary into the tissue; carbon dioxide and metabolic waste products move from the tissue into the capillary blood

(D) All materials move bidirectionally through the arteriole wall; capillaries are only for blood storage

Q10. When the body has excess amino acids, they cannot be stored. The liver

breaks them down in a process called **deamination**. What correctly describes deamination and its product?

(A) Amino acids are converted to glycogen in the liver by adding water molecules, producing glucose

(B) Deamination occurs in the kidneys; the amino group is combined with phosphate to form creatinine

(C) Amino acids are oxidised completely to CO_2 and H_2O, producing no nitrogenous waste

(D) The amino group ($-NH_2$) is removed from amino acids in the liver, converted to ammonia (NH_3), and then combined with CO_2 via the ornithine (urea) cycle to form non-toxic urea, which is excreted by the kidneys

Q11. The human brain is divided into several regions, each with specific functions. The **thalamus** is a structure found in the forebrain (diencephalon). What is the primary function of the thalamus?

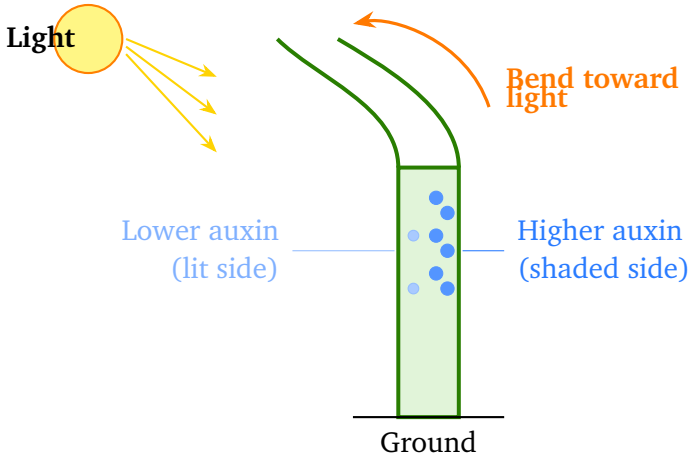
(A) It acts as the main relay and processing centre for all sensory information (except smell) travelling from the body and sense organs to the cerebral cortex

(B) It regulates body temperature, hunger, thirst, and sleep-wake cycles

(C) It coordinates voluntary muscle movements and maintains balance and posture

(D) It controls heart rate, breathing rate, and blood pressure as a vital centre

Q12. Study the diagram below showing a shoot bending toward a light source. This response is called **phototropism**. What causes the shoot to bend toward the light?



(A) Light directly destroys cells on the lit side, causing them to shrink and the shoot to bend

(B) Auxin migrates away from the light source (toward the shaded side); the higher auxin concentration on the shaded side causes faster cell elongation there, bending the shoot toward the light

(C) More auxin accumulates on the lit side, causing faster elongation on the lit side and pushing the shoot away from the light

(D) The shoot grows toward light because light provides energy (ATP) directly to cells on the lit side, speeding up their growth

Q13. In some animal species, an egg can develop into a new individual without being fertilised by a sperm. This phenomenon is called:

(A) Budding — a type of asexual reproduction where a new individual grows from an outgrowth of the parent

(B) Regeneration — the ability to regrow lost body parts from a fragment

(C) Parthenogenesis — development of a new individual from an unfertilised egg (e.g., drones in honeybees develop from unfertilised eggs of the queen)

(D) Binary fission — splitting of one organism into two equal halves

Q14. Human height and skin colour are examples of traits that do not show simple Mendelian ratios (e.g., 3:1). Instead, they show a **continuous**

variation (a range of phenotypes) in the population. Which genetic explanation best accounts for this?

(A) These traits are controlled by a single dominant gene that shows incomplete penetrance

(B) These traits are sex-linked (X-linked) and therefore show different ratios in males and females

(C) These traits are controlled by a single gene with many alleles, each producing a distinct phenotype

(D) These traits are **polygenic** — controlled by multiple genes at different loci, each contributing additively to the phenotype. The combined effect of many genes and environmental influences produces a continuous range of variation (e.g., a normal distribution curve for height)

Q15. Biodiversity hotspots are regions of exceptionally high biodiversity that are also under serious threat of habitat loss. India is home to two of the world's recognised biodiversity hotspots. Which of the following correctly identifies them?

(A) The Western Ghats (and Sri Lanka) and the Eastern Himalayas (Indo-Burma region)

(B) The Thar Desert (Rajasthan) and the Sundarbans (West Bengal)

(C) The Deccan Plateau and the Indo-Gangetic Plains

(D) The Andaman Islands and the Lakshadweep Islands

Detailed Solutions

Q1.

Solution

Concept: Rough endoplasmic reticulum (RER) — structure and function

The endoplasmic reticulum (ER) forms a connected network of membranes continuous with the nuclear envelope. The **rough ER** is distinguished by the presence of **ribosomes** on its outer (cytoplasmic) surface, giving it a "rough" appearance under the electron microscope. Its functions are:

- **Protein synthesis**: ribosomes on the RER surface translate mRNA into polypeptide chains that are threaded into the RER lumen.
- **Protein folding and modification**: inside the RER, proteins are folded into their correct 3D shapes with the help of chaperone proteins, and may be glycosylated (sugar chains added).
- **Transport**: correctly folded proteins are packaged into vesicles and transported to the Golgi apparatus for further processing and secretion.

RER is especially abundant in cells that secrete large amounts of protein — e.g., pancreatic acinar cells (digestive enzymes) and antibody-secreting plasma cells.

Why other options are wrong:

- **(A)** Lipid synthesis and drug detoxification are functions of the *smooth* ER (SER), which lacks ribosomes.
- **(C)** Calcium ion storage is a function of the SER in muscle cells (sarcoplasmic reticulum), not the RER.
- **(D)** Digestion of worn-out organelles and foreign particles is performed by *lysosomes*, not the RER.

Answer: (B) Go Back to Q 1

Q2.

Solution

Concept: Mitochondrial cristae and their role in ATP synthesis

Mitochondria are the sites of aerobic respiration and are often called the "powerhouses of the cell." The inner mitochondrial membrane is not smooth — it is

folded into numerous shelf-like projections called **cristae** (singular: crista). The key significance of cristae is:

- **Increased surface area**: the folds dramatically increase the surface area of the inner membrane (up to 5 times that of a smooth sphere of the same size).
- This extra surface accommodates large numbers of **electron transport chain (ETC) protein complexes** (Complexes I–IV) and **ATP synthase** (Complex V) enzyme molecules.
- During oxidative phosphorylation, electrons from NADH and $FADH_2$ pass along the ETC, pumping protons (H^+) across the inner membrane. The resulting proton gradient drives ATP synthase to produce **ATP** from ADP + P_i.

More cristae = more ETC complexes = more ATP produced per unit time.

Why other options are wrong:

- **(A)** Mitochondrial DNA (mt-DNA) is located in the *matrix*, not on the cristae. The cristae are membrane folds, not genetic storage sites.
- **(B)** The outer mitochondrial membrane separates the mitochondrion from the cytoplasm; the inner membrane (with cristae) separates the matrix from the intermembrane space, but the main purpose of cristae is to increase surface area for ATP synthesis, not enzyme containment.
- **(D)** Nutrients enter the mitochondria through protein channels in the outer membrane (porins) and specific transporters in the inner membrane, not through cristae as nutrient channels.

Answer: (C) Go Back to Q 2

Q3.

Solution

Concept: Tonoplast — the vacuolar membrane of plant cells

In mature plant cells, the central vacuole is a large, fluid-filled compartment (cell sap) that can occupy 80–90% of the cell volume. The membrane enclosing this vacuole is specifically called the **tonoplast**. It is a selectively permeable membrane that:

- Controls the movement of ions and molecules between the cytoplasm and the vacuolar sap.

- Maintains turgor pressure, which is essential for plant rigidity and cell growth.
- Contains specific transport proteins (e.g., aquaporins for water, and pumps for ions).

The tonoplast is distinct from the plasma membrane (which surrounds the entire cell) and from the nuclear envelope.

Why other options are wrong:

- **(A)** The plasma membrane (cell membrane) surrounds the entire cell and separates the cytoplasm from the cell wall — it does not surround the vacuole.
- **(B)** The nuclear envelope is a double membrane surrounding the nucleus, completely unrelated to the vacuole.
- **(C)** "Plasmalemma" is simply another name for the plasma membrane (cell membrane), not the vacuolar membrane.

Answer: (D) Go Back to Q 3

Q4.

Solution

Concept: Myelin sheath and saltatory conduction

Nerve fibres (axons) that transmit signals over long distances are often wrapped in a **myelin sheath** formed by Schwann cells (in the peripheral nervous system) or oligodendrocytes (in the CNS). The sheath is made of layers of lipid-rich membrane that act as an electrical insulator. Key points:

- The myelin sheath does not cover the axon continuously — there are periodic gaps called **nodes of Ranvier** where the axon membrane is exposed.
- In myelinated fibres, the nerve impulse does not travel continuously along the entire axon membrane. Instead, it "jumps" from one node of Ranvier to the next — this is called **saltatory conduction** (from Latin *saltare* = to jump).
- Saltatory conduction is **much faster** (up to 100–150 m/s) than conduction in unmyelinated fibres (0.5–2 m/s) and is also more energy-efficient (fewer ion pumps needed to restore the resting potential).

Why other options are wrong:

- **(B)** Nutrient supply to the axon comes from the cell body (through axoplasmic transport) and from surrounding glial cells; the myelin sheath itself is an insulator, not a nutrient conduit.
- **(C)** Conversion of chemical signals to electrical impulses occurs at receptor sites or at the cell body (synaptic integration); the myelin sheath is on the axon shaft and does not perform signal conversion.
- **(D)** Mechanical support of nerves comes from connective tissue sheaths (endoneurium, perineurium, epineurium), not the myelin sheath whose role is electrical insulation.

Answer: (A) Go Back to Q 4

Q5.

Solution

Concept: Bryophyta — key distinguishing features

Bryophytes (Division Bryophyta: mosses, liverworts, and hornworts) are the simplest land plants. They are called the "amphibians of the plant kingdom" because they live on land but require water for reproduction (motile, flagellate sperms must swim to fertilise eggs). Key features:

- **No vascular tissue**: unlike ferns and seed plants, bryophytes lack true xylem and phloem. Water and nutrients move by diffusion and osmosis, limiting their size.
- **No true roots**: they have rhizoids (hair-like structures) for anchorage, not true roots, stems, or leaves.
- **Water-dependent reproduction**: flagellate sperms (antherozoids) must swim through a film of water to reach the egg (archegonium).
- **Alternation of generations**: the dominant, photosynthetic stage is the **gametophyte** (haploid); the sporophyte (diploid) is dependent on the gametophyte and produces haploid spores by meiosis.

Option (D) correctly captures the three defining features: no vascular tissue, water-dependent fertilisation, and alternation of generations with a dominant gametophyte.

Why other options are wrong:

- **(A)** Vascular tissue and seed reproduction describe *seed plants* (gymnosperms and angiosperms), not bryophytes.
- **(B)** Bryophytes are *not* permanently submerged; they live in moist terrestrial environments.
- **(C)** True roots, stems, and leaves are features of vascular plants (pteridophytes and seed plants); bryophytes have only rhizoids and leaf-like/stem-like structures without vascular tissue.

Answer: (D) Go Back to Q 5

Q6.

Solution

Concept: Light reactions of photosynthesis — Z-scheme, water splitting, NADPH production

The light reactions of photosynthesis take place in the **thylakoid membranes** of the chloroplast and involve two photosystems connected in a Z-shaped electron flow:

1. **Photosystem II (P680)** absorbs light at 680 nm. This energy excites electrons in the reaction centre to a higher energy level. To replace these lost electrons, **water is split (photolysis)**: $2\,H_2O \rightarrow 4\,H^+ + 4\,e^- + O_2$. The oxygen released is the source of atmospheric O_2.
2. The excited electrons from PSII pass through the **electron transport chain** (plastoquinone, cytochrome b_6f complex, plastocyanin), losing energy that is used to pump protons and generate ATP.
3. **Photosystem I (P700)** absorbs light at 700 nm and re-energises the electrons. These high-energy electrons are then used to reduce **$NADP^+$ to NADPH** (via ferredoxin and $NADP^+$ reductase).
4. NADPH (and ATP) produced in the light reactions provide the energy and reducing power for the **Calvin cycle** (dark reactions) to fix CO_2 into glucose.

Option (C) correctly states: water splitting at PSII (P680); Z-scheme ends with NADPH production at PSI (P700).

Why other options are wrong:

- **(A)** Water splitting occurs at PSII, not PSI; and glucose is the product of the *Calvin cycle*, not the Z-scheme directly.

- **(B)** Water is not split between the two photosystems — it is split specifically at PSII. ATP alone is not the only product; NADPH is equally important.
- **(D)** Water is split only at PSII, not at both photosystems simultaneously; glucose is not a direct product of the light reactions.

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept: Krebs cycle — location and products

The **Krebs cycle** (citric acid cycle) is the second stage of aerobic respiration, occurring after glycolysis and pyruvate oxidation. Key facts:

- **Location**: the **mitochondrial matrix** (the aqueous interior enclosed by the inner mitochondrial membrane).
- **Input**: acetyl-CoA (2-carbon unit derived from pyruvate) combines with oxaloacetate (4-carbon) to form citrate (6-carbon).
- **Products per turn of the cycle**:
  - $2 \times CO_2$ (released as waste gas)
  - $3 \times$ NADH (electron carriers for the ETC)
  - $1 \times FADH_2$ (another electron carrier)
  - $1 \times$ ATP (or GTP, by substrate-level phosphorylation)
- The cycle turns twice per glucose molecule (since glucose yields 2 pyruvates).

The NADH and $FADH_2$ produced donate their electrons to the electron transport chain on the inner membrane, driving ATP synthesis via oxidative phosphorylation (the main ATP-generating step).

Why other options are wrong:

- **(B)** The inner mitochondrial membrane is the site of the *electron transport chain* (ETC) and ATP synthase; O_2 is consumed at the end of the ETC, not in the Krebs cycle itself.
- **(C)** The cytoplasm (cytosol) is the location of *glycolysis*, which produces pyruvate and 2 net ATP — not the Krebs cycle.

- **(D)** The thylakoid membrane is the site of the *light reactions of photosynthesis* (in chloroplasts); glucose and NADPH are photosynthesis products, not Krebs cycle products.

Answer: (A) Go Back to Q 7

Q8.

Solution

Concept: Translocation in phloem — pressure flow (mass flow) hypothesis

Translocation is the transport of organic solutes (mainly sucrose, and sometimes amino acids) in the phloem. The accepted mechanism is the **pressure flow (mass flow) hypothesis** proposed by Münch (1930):

1. At the **source** (e.g., photosynthesising leaf), sucrose is actively loaded into phloem sieve tube elements. This lowers the water potential inside the sieve tube, causing water to enter by osmosis from the adjacent xylem. **High hydrostatic pressure** builds up at the source.
2. At the **sink** (e.g., root, fruit, meristem), sucrose is unloaded (used for respiration or converted to starch). Water leaves the sieve tube, reducing pressure there. **Low hydrostatic pressure** exists at the sink.
3. The resulting **pressure gradient** drives bulk flow of phloem sap from source to sink.

Unlike xylem transport (which is unidirectional, upward), phloem can transport in any direction — from source to sink, which may be above or below the leaf.

Why other options are wrong:

- **(A)** Xylem transports *water and minerals* (not organic food) upward from roots to leaves, driven by transpiration pull. Food is transported in the *phloem*.
- **(C)** Translocation is not simple diffusion — it is an active (energy-requiring) process at the loading and unloading steps, and the bulk flow requires a pressure gradient, not just a concentration gradient.
- **(D)** Phloem transport is *bidirectional* (source to sink in any direction); it is incorrect to say it moves exclusively downward.

Answer: (B) Go Back to Q 8

Q9.

Solution

Concept: Capillary exchange — materials crossing between blood and tissue

Capillaries are the site of exchange between blood and the body's tissues. Their walls are only one cell thick (single layer of endothelial cells), allowing rapid diffusion of substances. The exchange follows concentration gradients:

- **Out of capillary into tissue**:
  - **Oxygen (O_2)**: blood arriving via arterioles is oxygenated; tissues have lower O_2 concentration (they consume O_2 in respiration). O_2 diffuses outward.
  - **Glucose and nutrients**: blood delivers these from the intestine/liver; tissues have lower concentrations as they use them.
- **Into capillary from tissue**:
  - **Carbon dioxide (CO_2)**: produced by cellular respiration in tissues; blood has lower CO_2, so CO_2 diffuses inward.
  - **Metabolic waste products** (e.g., urea, lactic acid): tissues produce these; blood carries them away to kidneys and liver.

This continuous exchange keeps tissues supplied with nutrients and cleared of waste.

Why other options are wrong:

- **(A)** CO_2 moves *into* the blood (not out); glucose moves *out* to tissue (not into blood). O_2 moves out to tissue (not into blood at this stage); urea moves into blood from tissue (not out).
- **(B)** Water does move (by osmosis/hydrostatic pressure), but many other substances also cross — oxygen, glucose, CO_2, and wastes all exchange at the capillary bed.
- **(D)** Materials do not exchange through the arteriole wall in this context; the arteriole wall is thick and muscular. Exchange occurs through the thin-walled capillaries.

Answer: (C) Go Back to Q 9

Q10.

Solution

Concept: Deamination and urea formation in the liver (ornithine cycle)

The body cannot store excess amino acids. When more amino acids are present than needed for protein synthesis, the liver breaks them down in a two-step process:

1. **Deamination**: the amino group ($-NH_2$) is removed from the amino acid. This produces a keto acid (which enters the Krebs cycle or is converted to glucose/fat) and ammonia (NH_3), which is highly toxic.
2. **Urea cycle (ornithine cycle)**: ammonia is immediately combined with CO_2 in a series of reactions within the liver mitochondria and cytoplasm, using the carrier molecule **ornithine**. The product is **urea** $[(NH_2)_2CO]$, which is non-toxic, water-soluble, and released into the blood.
3. Urea is transported to the **kidneys**, filtered, and excreted in urine.

This is why blood urea nitrogen (BUN) is a clinical marker of liver and kidney function.

Why other options are wrong:

- **(A)** Conversion of amino acids to glycogen involves transamination and gluconeogenesis; adding water molecules to form glucose is not "deamination." Deamination specifically refers to removal of the amino group.
- **(B)** Deamination occurs in the *liver*, not the kidneys. Creatinine is a waste product from *creatine phosphate* breakdown in muscle, formed by a different pathway.
- **(C)** Complete oxidation of amino acids to CO_2 and H_2O does occur (after deamination and entry of the carbon skeleton into Krebs cycle), but the question asks about deamination specifically — which does produce nitrogenous waste (urea).

Answer: (D) Go Back to Q 10

Q11.

Solution

Concept: Thalamus — the sensory relay centre of the brain

The **thalamus** is a large, egg-shaped structure in the **diencephalon** (part of the forebrain), forming the bulk of the inner brain above the brainstem. Its key function is to act as the brain's central **relay station**:

- Virtually all sensory information from the body (touch, pain, temperature, vision, hearing, taste) — *except smell (olfaction)* — passes through the thalamus before reaching the cerebral cortex.
- The thalamus sorts, filters, and relays this information to the appropriate areas of the cerebral cortex for conscious perception and processing.
- It also relays signals from the cortex to the cerebellum and brainstem.

Compare the other brain regions:

Brain region	**Primary function**
Hypothalamus	Temperature, hunger, thirst, sleep-wake, hormones
Cerebellum	Coordination, balance, fine motor control
Medulla oblongata	Heart rate, breathing, blood pressure (vital centres)
Thalamus	Sensory relay (all senses except smell)

Why other options are wrong:

- **(B)** Regulation of body temperature, hunger, thirst, and sleep-wake cycles is the function of the *hypothalamus* (below the thalamus in the diencephalon).
- **(C)** Coordination of voluntary muscle movements and maintenance of balance/posture is the function of the *cerebellum*.
- **(D)** Control of heart rate, breathing rate, and blood pressure is the function of the *medulla oblongata* (brainstem).

Answer: (A) Go Back to Q 11

Q12.

Solution

Concept: Phototropism and auxin redistribution

Phototropism is the directional growth response of plants toward (positive phototropism) or away from (negative phototropism) a light source. The mechanism involves the plant hormone **auxin (IAA — indole-3-acetic acid)**:

1. Auxin is produced in the **shoot apex** (tip).
2. When light strikes the shoot from one side, **phototropin** (a blue-light receptor) detects the light direction and triggers lateral redistribution of auxin.
3. Auxin migrates laterally **away from the light**, accumulating on the **shaded side**.
4. Higher auxin concentration on the shaded side stimulates faster **cell elongation** on that side.
5. The shaded side grows *longer* than the lit side, causing the shoot to **curve toward the light**.

This was first demonstrated by Charles Darwin and his son Francis Darwin (1880), and the role of auxin was elucidated by Frits Went (1926) through his Avena coleoptile experiments.

Why other options are wrong:

- **(A)** Light does not destroy cells on the lit side; phototropism is entirely due to differential growth caused by auxin redistribution.
- **(C)** This is the opposite of what actually happens. Auxin accumulates on the *shaded* side (not the lit side), and the shaded side grows faster, bending the shoot *toward* the light (not away from it).
- **(D)** Auxin does not require light to supply ATP; cell elongation is driven by auxin-stimulated proton pumping and cell wall loosening, not by direct light-energy delivery.

Answer: (B) Go Back to Q 12

Q13.

Solution

Concept: Parthenogenesis — development from an unfertilised egg

Parthenogenesis is a form of asexual reproduction in which an unfertilised egg develops into a new individual. It occurs naturally in several animal groups:

- **Honeybees (*Apis mellifera*)**: the queen bee lays both fertilised eggs (which develop into diploid workers and queens) and **unfertilised eggs** (which develop by parthenogenesis into haploid **drones** — the male bees). This is classic haplodiploidy.
- Also seen in some wasps, ants, aphids, water fleas (Daphnia), certain lizards, and some species of fish and birds.

Parthenogenesis is distinct from other types of asexual reproduction because it uses an egg cell (a sexual cell) that develops without fertilisation.

Why other options are wrong:

- **(A)** Budding is a type of asexual reproduction where a new organism grows as an outgrowth (bud) from the parent body (e.g., *Hydra*, yeast). No egg cell is involved.
- **(B)** Regeneration is the regrowth of a complete organism from a body fragment (e.g., *Planaria*, starfish). It is not the same as development from an unfertilised egg.
- **(D)** Binary fission is the splitting of a parent organism into two approximately equal daughter organisms (e.g., *Amoeba*, bacteria, *Leishmania*). It involves no egg cell.

Answer: (C) Go Back to Q 13

Q14.

Solution

Concept: Polygenic inheritance and continuous variation

Many human traits — including **height**, **skin colour**, eye colour, and intelligence — do not fit simple Mendelian ratios. Instead, they show a **continuous range** of variation (a bell-curve or normal distribution) in a population. This is explained by **polygenic inheritance**:

- The trait is controlled by **multiple genes** at different chromosomal loci (e.g., skin colour is influenced by at least 3–6 genes, each with multiple alleles).
- Each gene contributes an **additive** (quantitative) effect to the phenotype.
- The more genes involved, the more phenotypic classes are possible, producing a near-continuous gradation.
- **Environmental factors** (e.g., nutrition for height, UV exposure for skin colour) also influence the phenotype, further blending the classes into a smooth distribution.

This explains why parents of medium height can have very tall or very short children (segregation and recombination of many genes), and why the trait cannot be simply dominant or recessive.

Why other options are wrong:

- **(A)** Incomplete penetrance means a dominant allele is not always expressed; this explains *individuals missing the expected phenotype*, not a continuous gradation of heights.
- **(B)** Sex-linkage explains different trait frequencies in males and females (e.g., colour blindness, haemophilia); it does not explain the continuous distribution of height in both sexes.
- **(C)** A single gene with many alleles (multiple allelism, e.g., ABO blood groups) produces a limited number of distinct phenotypes, not a truly continuous distribution.

Answer: (D) Go Back to Q 14

Q15.

Solution

Concept: Biodiversity hotspots in India

A **biodiversity hotspot** is a biogeographic region that satisfies two criteria:

1. It contains at least **1,500 endemic vascular plant species** (species found nowhere else on Earth).
2. It has lost at least **70%** of its original natural vegetation (under serious threat).

There are 36 recognised biodiversity hotspots globally (as of recent assessments).

India hosts two:

- **Western Ghats and Sri Lanka hotspot**: a chain of mountains along India's western coast (Maharashtra, Goa, Karnataka, Kerala), famous for high endemism in amphibians, plants, and birds. Sri Lanka is included as part of the same biogeographic region.
- **Indo-Burma hotspot** (Eastern Himalayas / Eastern Himalaya hotspot): covers northeast India (including parts of Assam, Meghalaya, Arunachal Pradesh) and extends into Myanmar, China, Thailand, and Indochina. Exceptionally rich in freshwater biodiversity and endemic species.

Why other options are wrong:

- **(B)** The Thar Desert (arid, low biodiversity) and Sundarbans (important mangrove ecosystem and biosphere reserve, but not classified as a global biodiversity hotspot) are significant ecological regions but do not meet the hotspot criteria.
- **(C)** The Deccan Plateau and Indo-Gangetic Plains are large geographical regions with ecological importance, but they are not designated as global biodiversity hotspots — they have lower endemism and less severe threat status relative to the hotspot criteria.
- **(D)** The Andaman and Nicobar Islands are ecologically rich and part of the *Sundaland hotspot* (which extends to Southeast Asia) — but they are not typically listed as a separate Indian hotspot. The Lakshadweep Islands are coral atolls with lower overall biodiversity. Neither is considered a standalone hotspot separate from the two main Indian ones.

Answer: (A) Go Back to Q 15

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	D	4	A	5	D
6	C	7	A	8	B	9	C	10	D
11	A	12	B	13	C	14	D	15	A