TALLENTEX Biology

Sample Paper – 9

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. White blood cells (leucocytes) can engulf and destroy harmful bacteria by surrounding them with the cell membrane and drawing them into the cell. This process is known as:

(A) Endocytosis (phagocytosis)

(B) Exocytosis

(C) Pinocytosis

(D) Osmosis

Q2. Plant cells possess a rigid cell wall outside the plasma membrane. Which of the following correctly describes the composition and function of the primary cell wall in plants?

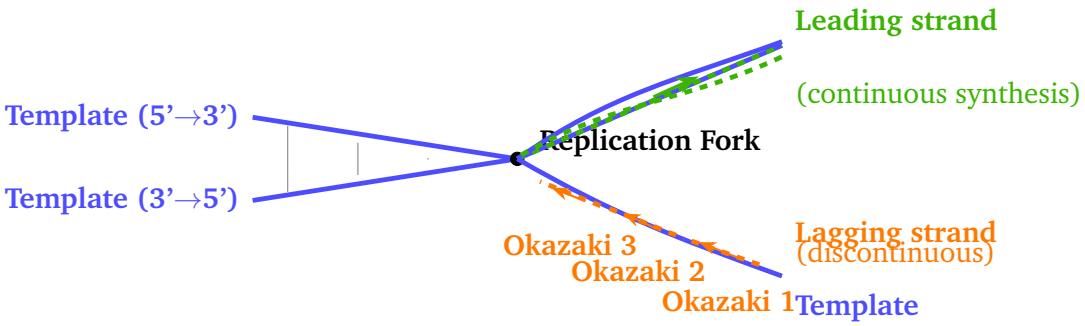
(A) The primary cell wall is made of lignin and provides waterproofing

(B) The primary cell wall is mainly composed of cellulose fibres and provides structural support while allowing water and ions to pass through

(C) The primary cell wall is made of chitin, the same material as the exoskeleton of insects

(D) The primary cell wall is composed of phospholipids, similar to the cell membrane

Q3. DNA replication in cells follows a semi-conservative mechanism. Study the diagram below showing a replication fork. Which statement correctly describes the semi-conservative model?



(A) Both new DNA strands are entirely newly synthesised; no parent strand is retained

(B) Each daughter DNA molecule has two new strands; both parent strands are destroyed

(C) Each daughter DNA molecule consists of one original (template) strand and one newly synthesised strand

(D) Both daughter DNA molecules share all four strands equally between them

Q4. Adipose tissue is a type of loose connective tissue found beneath the skin and around internal organs. Which of the following best describes the primary functions of adipose tissue?

(A) Conducting nerve impulses rapidly between organs

(B) Contracting to produce voluntary body movements

(C) Transporting oxygen and nutrients through the bloodstream

(D) Storing energy in the form of fat droplets and providing thermal insulation to the body

Q5. Class Reptilia includes organisms such as lizards, snakes, turtles, and crocodiles. Which combination of features is characteristic of reptiles?

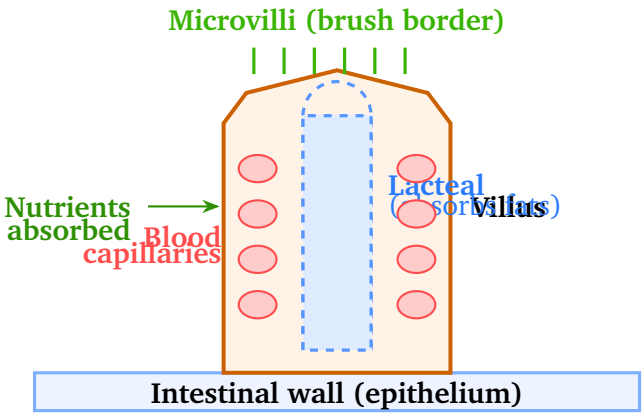
(A) Dry, scaly skin; ectothermic (cold-blooded); lay amniotic eggs; breathe through lungs

(B) Moist, smooth skin; endothermic (warm-blooded); lay eggs in water; breathe through gills

(C) Feathers covering the body; endothermic; internal fertilisation; four-chambered heart

(D) Hair or fur on the body; endothermic; give birth to live young; nurse young with milk

Q6. The small intestine is the primary site of nutrient absorption. Study the diagram below showing a villus cross-section. How do villi and microvilli increase the efficiency of absorption?



(A) They produce digestive enzymes that break down food more rapidly

(B) They enormously increase the surface area available for absorption, with blood capillaries for glucose and amino acids, and lacteals for fatty acids

(C) They secrete mucus that lubricates the food and speeds its passage through the intestine

(D) They generate peristaltic movements to push digested food towards the large intestine

Q7. When oxygen is absent, cells can still obtain energy through anaerobic respiration (fermentation). Which of the following correctly compares the end products of lactic acid fermentation (in human muscle cells) and alcoholic fermentation (in yeast)?

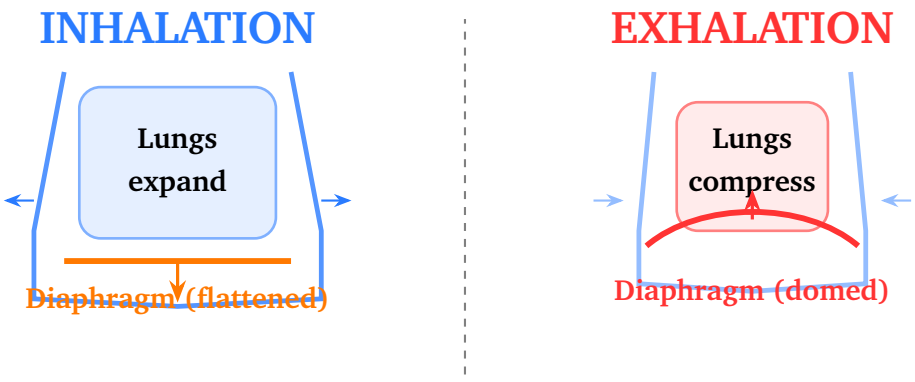
(A) Both produce lactic acid and CO_2 as end products

(B) Both produce ethanol and CO_2 as end products

(C) Lactic acid fermentation produces lactic acid (no CO_2); alcoholic fermentation produces ethanol and CO_2

(D) Lactic acid fermentation produces ethanol; alcoholic fermentation produces lactic acid and water

Q8. The diaphragm and intercostal muscles bring about breathing movements. Study the diagram below showing the positions of the diaphragm during inhalation and exhalation. Which statement correctly describes the role of the diaphragm?



(A) During inhalation, the diaphragm becomes dome-shaped and moves upward, pushing air into the lungs

(B) During exhalation, the diaphragm flattens and moves downward, creating a vacuum that draws air out

(C) The diaphragm plays no role in breathing; only the intercostal muscles control lung volume

(D) During inhalation, the diaphragm contracts, flattens, and moves downward, increasing the volume of the thoracic cavity and drawing air into the lungs

Q9. After digestion and absorption in the small intestine, nutrient-rich blood is carried to the liver before entering the general circulation. Which blood vessel carries this absorbed blood from the intestines directly to the liver?

(A) Hepatic portal vein

(B) Hepatic artery

(C) Hepatic vein

(D) Superior mesenteric artery

Q10. The loop of Henle is a U-shaped section of the renal tubule found in the kidney. What is its primary functional significance?

(A) It filters blood under high pressure to produce the glomerular filtrate

(B) It creates an osmotic gradient in the kidney medulla that enables concentrated urine to be produced by reabsorbing water

(C) It secretes urea directly from the bloodstream into the tubule

(D) It carries urine from the kidney to the urinary bladder

Q11. The human brain has several distinct regions, each with specific functions. Which region of the brain is primarily responsible for maintaining body balance, posture, and coordinating fine motor movements?

(A) Cerebrum (cerebral cortex)

(B) Medulla oblongata

(C) Cerebellum

(D) Hypothalamus

Q12. Abscisic acid (ABA) is a plant hormone sometimes called the "stress hormone." Which of the following are recognised functions of ABA in plants?

(A) Promoting seed germination and stimulating shoot elongation

(B) Stimulating cell division in meristematic tissue and promoting fruit set

(C) Promoting flowering in short-day plants and inhibiting root growth

(D) Promoting seed dormancy and causing stomata to close under drought (water stress) conditions

Q13. The human menstrual cycle is approximately 28 days long. On approximately which day of the cycle does ovulation (release of a mature egg from the ovary) typically occur?

(A) Around day 14 (mid-cycle), triggered by a surge in LH (luteinising hormone)

(B) On day 1, when menstruation begins

(C) On day 28, at the end of the cycle just before the next menstruation

(D) On day 7, immediately after menstruation ends

Q14. In the ABO blood group system, a person with blood group AB has the genotype $I^A I^B$. In this individual, both the A antigen and the B antigen are expressed simultaneously on red blood cells. This pattern of inheritance, where both alleles are fully expressed in the heterozygote, is called:

(A) Incomplete dominance

(B) Codominance

(C) Complete dominance

(D) Sex-linked inheritance

Q15. Carbon is continuously cycled through the biosphere, atmosphere, and geosphere. Which of the following correctly describes how carbon is **fixed** from the atmosphere and how it is **released** back?

(A) Carbon is fixed by cellular respiration in animals and released by photosynthesis in plants

(B) Carbon is fixed by burning of fossil fuels and released by transpiration in plants

(C) Carbon is fixed (converted from CO_2 to organic compounds) by photosynthesis; it is released back as CO_2 by respiration, decomposition, and combustion

(D) Carbon is fixed by decomposers breaking down dead matter and released by nitrogen fixation in the soil

Detailed Solutions

Q1.

Solution

Concept: Endocytosis — phagocytosis in white blood cells

Endocytosis is the process by which cells engulf external material by infolding the plasma membrane to form an internal vesicle. When the material being engulfed is a solid particle (such as a bacterium or dead cell debris), the process is called **phagocytosis** ("cell eating"). White blood cells (neutrophils and macrophages) use phagocytosis as a key defence mechanism: the cell membrane extends pseudopods that surround the bacterium, fuse, and draw it into the cell inside a phagosome. Lysosomes then fuse with the phagosome, releasing digestive enzymes that destroy the pathogen.

Why other options are wrong:

- **(B)** Exocytosis is the *reverse* process — vesicles inside the cell fuse with the plasma membrane to release contents *outside* the cell (e.g., secretion of hormones or neurotransmitters).
- **(C)** Pinocytosis ("cell drinking") is a form of endocytosis but involves the uptake of *liquids* and dissolved molecules in small vesicles, not solid bacteria.
- **(D)** Osmosis is the movement of *water* molecules across a semi-permeable membrane from a region of higher water potential to lower water potential — it is a passive process, not the engulfment of bacteria.

Answer: (A) Go Back to Q 1

Q2.

Solution

Concept: Cell wall composition and function in plants

The **primary cell wall** of plant cells is mainly composed of **cellulose** — long, unbranched polysaccharide chains of glucose units linked by β-1,4-glycosidic bonds. These cellulose chains are arranged into microfibrils embedded in a matrix of hemicellulose, pectin, and glycoproteins. The primary cell wall is **permeable** to water and small ions and provides structural support while allowing the cell to expand during growth. A **secondary cell wall** may form inside the primary wall and is often impregnated with **lignin**, making it rigid and waterproof (e.g., in xylem vessels and sclerenchyma).

Why other options are wrong:

- **(A)** Lignin is found in the *secondary* cell wall (e.g., in wood and sclerenchyma); the primary cell wall is composed of cellulose, not lignin.
- **(C)** Chitin is found in the cell walls of *fungi* and in the exoskeleton of arthropods; plant cell walls use cellulose, not chitin.
- **(D)** Phospholipids form the *plasma membrane* (cell membrane); the cell wall is entirely different in composition and lies outside the membrane.

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept: Semi-conservative DNA replication

The semi-conservative model of DNA replication, proposed by Watson and Crick and confirmed by the Meselson–Stahl experiment (1958), states that during replication each of the two parent strands serves as a template. The result is **two daughter DNA molecules**, each consisting of:

- **One original (parental) strand** (the template)
- **One newly synthesised strand**

This means the original genetic information is "conserved" in each daughter molecule ("semi" = half). As shown in the diagram: the leading strand is synthesised continuously toward the fork, while the lagging strand is synthesised discontinuously as Okazaki fragments away from the fork — both using their respective template strands.

Why other options are wrong:

- **(A)** This describes the "conservative" model (rejected by Meselson–Stahl), where the parent molecule is entirely preserved and a completely new double helix is made.
- **(B)** This is not a recognised model; it incorrectly states that parent strands are destroyed.
- **(D)** This describes the "dispersive" model (also rejected), where fragments of old and new DNA are randomly distributed across both daughter molecules.

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept: Adipose tissue — energy storage and insulation

Adipose tissue is a specialised loose connective tissue made up of adipocytes (fat cells). Each adipocyte contains a large central lipid droplet that pushes the nucleus to the periphery. Its primary functions are:

- **Energy storage**: fats stored in adipocytes are a highly concentrated energy reserve (9 kcal/g), mobilised during fasting or strenuous exercise.
- **Thermal insulation**: the subcutaneous adipose layer (hypodermis) reduces heat loss from the body, helping to maintain core body temperature.
- Additional functions include: cushioning and protecting internal organs, and endocrine functions (secreting leptin and adiponectin).

Why other options are wrong:

- **(A)** Conducting nerve impulses is the function of *nervous tissue* (neurons and glial cells).
- **(B)** Voluntary body movements are produced by *skeletal (striated) muscle tissue*.
- **(C)** Transporting oxygen and nutrients is the function of *blood* (a fluid connective tissue), specifically red blood cells and plasma.

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept: Class Reptilia — characteristic features

Reptiles belong to phylum Chordata, class Reptilia. Their distinguishing characteristics are:

- **Dry, scaly skin**: made of keratin (scales), which reduces water loss — an adaptation to terrestrial life.
- **Ectothermic (cold-blooded)**: body temperature depends on the external environment; they regulate temperature through behavioural means (basking in the sun).

- **Amniotic egg**: the egg has a leathery shell and extra-embryonic membranes (amnion, chorion, allantois) that protect the embryo from desiccation; can be laid on land.
- **Lung respiration**: all adult reptiles breathe through lungs (not gills).
- Most have a three-chambered heart (except crocodilians, which have four chambers).

Why other options are wrong:

- **(B)** Moist smooth skin and gills describe *Amphibia* (e.g., frogs); amphibians are also ectothermic but lay eggs in water.
- **(C)** Feathers and four-chambered heart describe *Aves* (birds), which are also endothermic.
- **(D)** Hair/fur, endothermy, and nursing with milk describe *Mammalia* (mammals).

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept: Villi and microvilli in small intestine absorption

The inner lining of the small intestine is highly specialised to maximise absorption:

- **Villi**: finger-like projections of the mucosa, each about 0.5–1.6 mm tall, that dramatically increase the surface area of the intestinal lining.
- **Microvilli**: even smaller projections on the surface of each epithelial cell (enterocyte), forming the "brush border", which further amplify the absorptive surface area (by up to 600-fold compared to a flat surface).
- Each villus contains a network of **blood capillaries** that absorb glucose, amino acids, vitamins, and minerals, which enter the portal circulation to the liver.
- A central **lacteal** (lymph capillary) absorbs fatty acids and glycerol (as chylomicrons) into the lymphatic system.

Why other options are wrong:

- **(A)** Digestive enzymes are produced by intestinal glands and the pancreas —

not by villi/microvilli themselves; villi are absorption structures.

- **(C)** Mucus secretion is the function of goblet cells, which are individual cells interspersed among enterocytes — not the villi as a whole.
- **(D)** Peristalsis is generated by smooth muscle layers in the intestinal wall (muscularis externa), not by villi.

Answer: (B) Go Back to Q 6

Q7.

Solution

Concept: Lactic acid fermentation vs. alcoholic fermentation — comparing products

When oxygen is unavailable, cells use anaerobic pathways to regenerate NAD^+ from NADH so that glycolysis can continue producing ATP.

Feature	Lactic acid fermentation	Alcoholic fermentation
Organism/cells	Human muscle cells, some bacteria	Yeast, some plants
Starting material	Pyruvate	Pyruvate
End products	Lactic acid only (no CO_2)	Ethanol + CO_2
CO_2 released?	No	Yes

In **lactic acid fermentation**: pyruvate is directly reduced to lactic acid by NADH (catalysed by lactate dehydrogenase). No CO_2 is released.

In **alcoholic fermentation**: pyruvate is first decarboxylated to acetaldehyde (releasing CO_2), then acetaldehyde is reduced to ethanol by NADH.

Why other options are wrong:

- **(A)** Lactic acid fermentation does *not* produce CO_2; only alcoholic fermentation does.
- **(B)** Both do not produce ethanol; lactic acid fermentation produces lactic acid, not ethanol.
- **(D)** The descriptions are swapped — lactic acid fermentation produces lactic acid, alcoholic fermentation produces ethanol.

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept: Diaphragm movement during breathing (inhalation and exhalation)

Breathing is driven by changes in thoracic (chest) volume:

Inhalation (inspiration):

- The diaphragm muscle **contracts**, causing it to **flatten and move downward**.
- External intercostal muscles also contract, lifting the ribcage upward and outward.
- Together, these actions **increase the volume of the thoracic cavity**.
- By Boyle's Law ($P \propto 1/V$), the air pressure inside the lungs drops below atmospheric pressure, so air flows **in**.

Exhalation (expiration):

- The diaphragm **relaxes** and resumes its **dome shape**, moving upward.
- The ribcage moves down and inward, decreasing thoracic volume.
- Lung pressure rises above atmospheric, forcing air **out**.

Why other options are wrong:

- **(A)** This is the description of *exhalation* (diaphragm domes upward), not inhalation.
- **(B)** During exhalation, the diaphragm *relaxes and rises* (does not flatten); air is pushed *out*, not drawn out by vacuum.
- **(C)** The diaphragm is the most important muscle of breathing; intercostal muscles assist but cannot alone account for the full range of ventilation.

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept: Hepatic portal vein — nutrient transport from intestine to liver

After nutrients (glucose, amino acids, vitamins, minerals) are absorbed through the epithelial cells of the small intestinal villi, they enter the **capillary network** within each villus. These capillaries drain into progressively larger vessels and ultimately converge to form the **hepatic portal vein**. This specialised blood vessel carries all nutrient-rich blood *directly* from the small intestine (and other digestive organs such as the stomach, spleen, and pancreas) to the **liver**. The liver then regulates the nutrient levels before blood enters the systemic circulation (via the hepatic vein to the inferior vena cava).

Why other options are wrong:

- **(B)** The hepatic *artery* brings *oxygenated* blood to the liver from the aorta; it does not carry absorbed nutrients from the intestine.
- **(C)** The hepatic *vein* carries blood *away* from the liver to the inferior vena cava — it is on the exit side.
- **(D)** The superior mesenteric *artery* supplies oxygenated blood *to* the small intestine; it is an arterial supply, not the venous return carrying absorbed nutrients.

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept: Loop of Henle — water reabsorption in the kidney

The **loop of Henle** is a U-shaped tubular structure located in the renal medulla, consisting of a descending limb (permeable to water but not salts) and an ascending limb (impermeable to water but actively transports NaCl out). This arrangement creates a **countercurrent multiplier system**: the ascending limb pumps NaCl into the medullary interstitium, making the surrounding tissue hypertonic (very high solute concentration). When the filtrate later flows through the **collecting duct**, the osmotic gradient draws water out of the duct (facilitated by aquaporins when ADH is present), producing **concentrated urine**. A longer loop of Henle (as in desert animals like the kangaroo rat) produces more concentrated urine, conserving water.

Why other options are wrong:

- **(A)** Blood filtration under high pressure occurs in the *glomerulus* (within Bowman's capsule), not in the loop of Henle.
- **(C)** Secretion of urea into the tubule occurs mainly in the *distal convoluted tubule* and collecting duct; some urea recycling occurs through the collecting duct, but the loop itself primarily handles NaCl and water.
- **(D)** The *ureter* carries urine from the kidney to the urinary bladder; it is a separate structure outside the nephron.

Answer: (B) Go Back to Q 10

Q11.

Solution

Concept: Cerebellum — balance, posture, and fine motor control

The human brain is divided into three major regions, each with distinct functions:

Region	Primary functions
Cerebrum (cortex)	Thinking, memory, voluntary movement, senses, language
Cerebellum	Balance, posture, coordination of fine motor movements
Medulla oblongata	Involuntary functions: heartbeat, breathing, blood pressure
Hypothalamus	Temperature regulation, hunger, thirst, endocrine control

The **cerebellum** (Latin: "little brain") receives sensory input from the vestibular system (inner ear), proprioceptors (muscles and joints), and the visual system, and integrates this information to coordinate smooth, precise movements. Damage to the cerebellum causes ataxia (loss of balance and coordination) and dysmetria (inability to control distance and speed of movements).

Why other options are wrong:

- **(A)** The cerebrum is responsible for voluntary thought, memory, sensory perception, and speech — not specifically balance.
- **(B)** The medulla oblongata controls involuntary vital functions (heartbeat, respiration, blood pressure) and is part of the brainstem.
- **(D)** The hypothalamus regulates homeostasis (temperature, hunger, thirst) and links the nervous and endocrine systems via the pituitary gland.

Answer: (C) Go Back to Q 11

Q12.

Solution

Concept: Abscisic acid (ABA) — seed dormancy and stomatal closure

Abscisic acid (ABA) is a plant hormone that acts primarily as a growth inhibitor and stress response regulator. Its key functions include:

- **Seed dormancy**: ABA promotes dormancy in seeds by inhibiting germination. It maintains the seed in a quiescent (resting) state until environmental conditions (moisture, temperature, light) are favourable. The ratio of ABA to gibberellins determines whether a seed germinates or stays dormant.
- **Stomatal closure**: Under drought conditions, ABA concentration rises in leaf cells and triggers guard cells to lose water (by releasing K^+ ions), causing stomata to **close**, thereby reducing water loss by transpiration. This is why ABA is called the "stress hormone."
- ABA also promotes leaf senescence and can inhibit growth in adverse conditions.

Why other options are wrong:

- **(A)** Promoting seed germination and shoot elongation is the function of *gibberellins*; ABA does the opposite of promoting germination.
- **(B)** Stimulating cell division is the function of *cytokinins*; fruit set is associated with *auxins* and gibberellins.
- **(C)** Promoting flowering in short-day plants involves the phytochrome system and florigen; root growth promotion is associated with auxins at low concentrations. ABA does not specifically do these.

Answer: (D) Go Back to Q 12

Q13.

Solution

Concept: Menstrual cycle — timing of ovulation

The menstrual cycle averages approximately 28 days and is regulated by hormones from the hypothalamus, anterior pituitary, and ovaries. The key phases and events are:

1. **Day 1–5**: Menstruation (shedding of the endometrium); FSH begins to rise.

2. **Day 6–13**: Follicular phase — a Graafian follicle develops in the ovary; oestrogen levels rise, rebuilding the endometrium.
3. **Day 14**: **Ovulation** — a sharp **LH surge** (Luteinising Hormone surge) triggers the Graafian follicle to rupture and release the mature ovum (egg). This typically occurs around the middle of the cycle.
4. **Day 15–28**: Luteal phase — the ruptured follicle becomes the corpus luteum, secreting progesterone to maintain the endometrium in preparation for possible implantation.

Why other options are wrong:

- **(B)** Day 1 marks the *onset of menstruation* (breakdown of the endometrium), not ovulation.
- **(C)** Day 28 is the end of the luteal phase; if fertilisation has not occurred, progesterone drops and menstruation begins again on day 1.
- **(D)** Day 7 falls in the mid-follicular phase; ovulation has not yet occurred — the follicle is still maturing.

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept: Codominance — AB blood group (I^AI^B genotype)

In the ABO blood group system, there are three alleles: I^A, I^B, and i. A person with genotype I^AI^B (blood group AB) expresses **both** the A antigen and the B antigen on the surface of their red blood cells *simultaneously*. Neither allele is masked or blended; both are fully and independently expressed. This is called **codominance** — both alleles contribute equally and distinctly to the phenotype in the heterozygous condition.

Key distinction from incomplete dominance: In incomplete dominance, the heterozygote shows an *intermediate (blended) phenotype* (e.g., red $\times$ white $\rightarrow$ pink). In codominance, both traits appear fully and distinctly (no blending).

Why other options are wrong:

- **(A)** Incomplete dominance produces a *blended intermediate* phenotype — e.g., a red-flowered plant $\times$ white-flowered plant giving pink flowers in F1. AB blood type is not a blend.

- **(C)** Complete dominance means one allele entirely masks the other — e.g., $I^A i$ gives blood group A (the i allele is hidden). In $I^A I^B$, neither allele is hidden.
- **(D)** Sex-linked inheritance involves genes located on the sex chromosomes (X or Y); blood group genes are located on chromosome 9, not sex chromosomes.

Answer: (B) Go Back to Q 14

Q15.

Solution

Concept: Carbon cycle — fixation and release of carbon

The **carbon cycle** describes how carbon atoms move between the atmosphere, living organisms, soil, and oceans.

Carbon fixation (atmospheric $CO_2 \rightarrow$ organic compounds):

- **Photosynthesis**: producers (plants, algae, cyanobacteria) use solar energy to convert CO_2 and water into glucose and other organic molecules. This is the primary route by which inorganic carbon enters the biosphere.

Carbon release (organic compounds $\rightarrow CO_2$):

- **Cellular respiration**: all living organisms (producers and consumers) break down glucose to release CO_2.
- **Decomposition**: decomposers (bacteria and fungi) break down dead organic matter, releasing CO_2 and methane.
- **Combustion**: burning of fossil fuels and biomass releases carbon stored over millions of years (a major driver of increased atmospheric CO_2).

Why other options are wrong:

- **(A)** This completely reverses the cycle — respiration *releases* CO_2; photosynthesis *fixes* it.
- **(B)** Burning of fossil fuels *releases* carbon (not fixes it); transpiration releases *water vapour*, not CO_2.
- **(D)** Decomposers release CO_2 during decomposition, they do not "fix" carbon from the atmosphere; nitrogen fixation is part of the nitrogen cycle, not the carbon cycle.

Answer: (C) Go Back to Q 15

Answer Key

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