TALLENTEX Biology

Sample Paper – 5

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 Golgi apparatus (Golgi body) is a stack of membrane-bound sacs found in eukaryotic cells. What is its **primary function**?

(A) Synthesis of proteins on ribosomes

(B) Production of energy in the form of ATP

(C) Modification, packaging and sorting of proteins and lipids for secretion or delivery to other organelles

(D) Replication of the cell's DNA prior to division

Q2. Meiosis I is a reductional division that separates homologous chromosomes. During which **sub-stage of Meiosis I** does **crossing over** (exchange of genetic segments between non-sister chromatids of homologous chromosomes) take place?

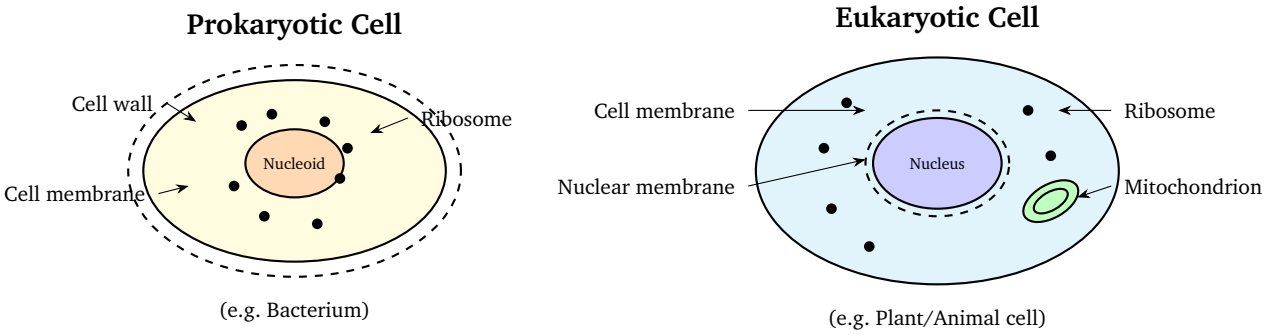
(A) Prophase I

(B) Anaphase I

(C) Metaphase I

(D) Telophase I

Q3. The diagrams below show a **prokaryotic cell** (left) and a **eukaryotic cell** (right).



Which of the following features is present in **eukaryotic cells** but is **absent** in prokaryotic cells?

(A) Cell membrane

(B) Ribosomes

(C) DNA (genetic material)

(D) Membrane-bound nucleus

Q4. Phloem is a complex permanent tissue that conducts organic solutes throughout the plant body. Which cells in the phloem are **primarily responsible** for the translocation of sugars (such as sucrose) from the leaves to other parts of the plant?

(A) Tracheids

(B) Sieve tube elements

(C) Sclerenchyma fibres

(D) Parenchyma cells

Q5. Viruses occupy a borderline position between living and non-living matter. They are considered **non-cellular** because they lack which fundamental feature that characterises all living cells?

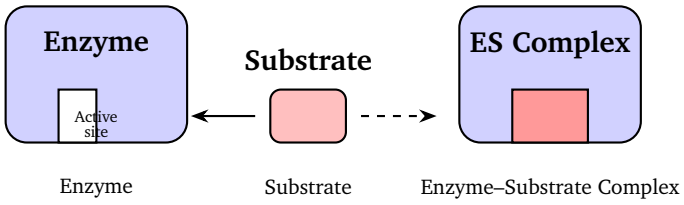
(A) Cellular organisation comprising a plasma membrane, cytoplasm and ribosomes

(B) Genetic material (DNA or RNA)

(C) The ability to cause disease in a host

(D) A protein coat (capsid)

Q6. The diagram below illustrates the **lock-and-key model** of enzyme action.



In the lock-and-key model, the enzyme's active site exactly fits only one type of substrate. Which term best describes this property of an enzyme?

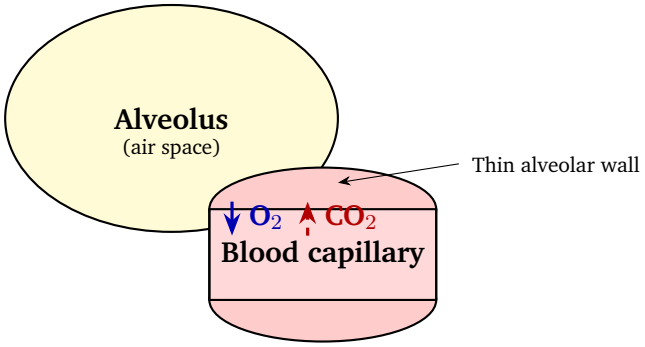
(A) Activation

(B) Inhibition

(C) Specificity

(D) Denaturation

Q7. The diagram below represents a cross-section of an **alveolus** and its surrounding blood capillary, showing the exchange of gases during external respiration.



Referring to the diagram above, which gas **moves from the alveolar air into the blood** during external respiration in the lungs?

(A) Carbon dioxide (CO_2)

(B) Nitrogen (N_2)

(C) Water vapour

(D) Oxygen (O_2)

Q8. The ABO blood group system is based on the presence or absence of specific antigens on the surface of red blood cells (RBCs) and corresponding antibodies in the blood plasma. A person with **blood group O** has which of the following?

(A) Only antigen A present on red blood cells

(B) No antigens (neither A nor B) on red blood cells, but both anti-A and anti-B antibodies present in plasma

(C) Both antigen A and antigen B present on red blood cells

(D) Only antigen B present on red blood cells

Q9. Unlike animals, plants do **not** possess specialised excretory organs. How do plants primarily eliminate **gaseous waste products** such as carbon dioxide (produced during respiration) and oxygen (produced during photosynthesis)?

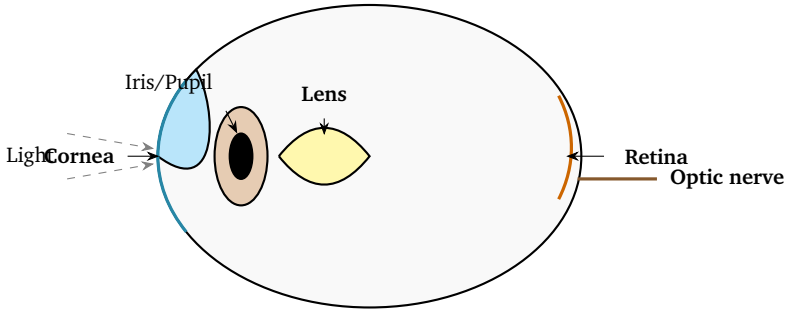
(A) Through stomata (in leaves) and lenticels (in stems and roots) by the process of diffusion

(B) Through root hair cells exclusively, which pump gases out into the soil

(C) By chemically converting these gases into starch and permanently storing them in leaves

(D) Through specialised excretory tubules running along the length of the stem

Q10. The diagram below shows a simplified cross-section of the **human eye**.



Referring to the diagram above, on which part of the eye is a **sharp, inverted image formed** when a nearby object is viewed?

(A) Cornea

(B) Iris

(C) Retina

(D) Pupil

Q11. During a sudden stressful or emergency situation (such as facing danger), the body responds rapidly by releasing a specific hormone into the bloodstream. This hormone prepares the body for immediate action. Which gland secretes this hormone, and what are its primary effects?

(A) Thyroid gland; slows the heart rate and reduces metabolic activity

(B) Pituitary gland; promotes overall body growth and bone elongation

(C) Pancreas; lowers blood glucose concentration by promoting uptake into cells

(D) Adrenal gland; increases heart rate, dilates airways and mobilises glucose to provide rapid energy (fight-or-flight response)

Q12. A gardener wants to germinate seeds quickly. She knows that certain environmental conditions must be met for germination to begin. Which **set of conditions** is essential for seed germination?

(A) Bright light, fresh air and a temperature below 5°C

(B) Adequate water, a suitable (warm) temperature and sufficient oxygen

(C) Complete darkness, water and the total absence of oxygen

(D) Fertilisers dissolved in water, intense light and very high humidity only

Q13. In four-o'clock plants (*Mirabilis jalapa*), a pure red-flowered plant (genotype **RR**) is crossed with a pure white-flowered plant (genotype **WW**). **All** F_1 offspring have **pink flowers** (genotype **RW**). This inheritance pattern, where the F_1 phenotype is *intermediate* between the two parental phenotypes, is called:

(A) Incomplete dominance

(B) Complete dominance

(C) Codominance

(D) Epistasis

Q14. The **enhanced greenhouse effect** is causing the average surface temperature of the Earth to rise, a phenomenon known as global warming. Which of the following gases, primarily released by burning fossil fuels and deforestation, is the **chief contributor** to this enhanced greenhouse effect?

(A) Oxygen (O_2)

(B) Nitrogen (N_2)

(C) Carbon dioxide (CO_2)

(D) Argon (Ar)

Q15. The wing of a bat and the wing of a butterfly both enable the animal to fly. However, when their internal structures are examined, the bat wing is built on a modified vertebrate forelimb skeleton, while the butterfly wing is made of a thin membrane supported by veins – an entirely different structural plan. Organs that perform the **same function** but have **fundamentally different structural origins** are called:

(A) Homologous organs

(B) Vestigial organs

(C) Adaptive organs

(D) Analogous organs

Detailed Solutions

Q1.

Solution

Concept: Golgi apparatus – processing and secretory organelle

The Golgi apparatus (or Golgi body) receives proteins and lipids synthesised by the endoplasmic reticulum and **modifies** them (e.g. by adding sugar chains), **sorts** them, and **packages** them into vesicles for secretion outside the cell or delivery to other organelles such as lysosomes. It is often described as the "post office" or "packaging and dispatch centre" of the cell.

Why other options are wrong:

- **(A)** Protein synthesis occurs on *ribosomes*, not the Golgi apparatus.
- **(B)** Energy (ATP) is produced in *mitochondria* via cellular respiration.
- **(D)** DNA replication occurs in the *nucleus* before cell division.

Answer: (C) Go Back to Q 1

Q2.

Solution

Concept: Crossing over during Prophase I of Meiosis I

During **Prophase I**, homologous chromosomes pair up (synapsis) to form bivalents. At this stage, non-sister chromatids of homologous chromosomes exchange segments at points called **chiasmata** – a process known as **crossing over**. This is the mechanism that generates new combinations of alleles (genetic recombination), increasing variation in offspring.

Why other options are wrong:

- **(B)** In Anaphase I, homologous chromosomes are already separating and moving to opposite poles; no new exchange occurs.
- **(C)** In Metaphase I, bivalents line up at the cell's equatorial plate; crossing over is complete by this stage.
- **(D)** In Telophase I, chromosomes arrive at the poles and the cell begins to divide; crossing over does not occur here.

Answer: (A) Go Back to Q 2

Q3.

Solution

Concept: Key structural difference between prokaryotic and eukaryotic cells

The single most important structural difference is that **eukaryotic cells** have a **membrane-bound nucleus** enclosing their genetic material, whereas **prokaryotic cells** have no nuclear membrane – their DNA lies freely in the cytoplasm in a region called the **nucleoid**. This is the defining distinction between the two cell types.

Why other options are wrong:

- **(A)** A cell membrane (plasma membrane) is present in *both* prokaryotes and eukaryotes.
- **(B)** Ribosomes are present in *both* cell types (though they differ in size: 70S in prokaryotes, 80S in eukaryotes).
- **(C)** Both prokaryotes and eukaryotes contain DNA as their genetic material.

Answer: (D) Go Back to Q 3

Q4.

Solution

Concept: Phloem – translocation of organic solutes by sieve tube elements

In phloem, **sieve tube elements** are elongated cells arranged end-to-end with porous sieve plates between them. They form the main channel through which dissolved organic solutes (primarily sucrose manufactured in leaves) are translocated to all other parts of the plant – including roots, fruits, and storage organs – in a process called **translocation**.

Why other options are wrong:

- **(A)** Tracheids are dead, lignified cells found in *xylem*; they conduct water and mineral salts, not organic solutes.
- **(C)** Sclerenchyma fibres are dead, thick-walled cells that provide *mechanical support*, not transport.
- **(D)** Parenchyma cells in phloem (companion cells and phloem parenchyma) assist the sieve tubes but are not primarily responsible for long-distance translocation.

Answer: (B) Go Back to Q 4

Q5.

Solution

Concept: Non-cellular nature of viruses

All living cells, whether prokaryotic or eukaryotic, must have: (1) a **plasma membrane** bounding the cell, (2) **cytoplasm** (the aqueous internal medium), and (3) **ribosomes** (for protein synthesis). Viruses are entirely devoid of all three – they have no membrane, no cytoplasm, and no ribosomes. They are simply a nucleic acid core wrapped in a protein coat (capsid). Without ribosomes, they cannot carry out protein synthesis independently and must hijack the host cell's machinery. This is why they are called **non-cellular**.

Why other options are wrong:

- **(B)** Viruses DO possess genetic material (either DNA or RNA) – this is present in all viruses.
- **(C)** Causing disease is a *biological effect*, not a structural cellular feature; many viruses also exist as harmless entities.
- **(D)** A protein coat (capsid) is a feature OF viruses, not something they lack.

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept: Enzyme specificity – lock-and-key model

The lock-and-key model (proposed by Emil Fischer, 1894) states that the **active site** of an enzyme has a shape precisely complementary to its specific substrate – just as a lock fits only its own key. This property of acting only on a particular substrate or class of substrates is called **specificity** (or substrate specificity). It arises from the unique three-dimensional shape of the active site, which is determined by the enzyme's amino acid sequence.

Why other options are wrong:

- **(A)** Activation refers to increasing the rate of a reaction or activating an enzyme (e.g. by a cofactor); it is not a property describing selectivity.
- **(B)** Inhibition is the process of *slowing down* or stopping enzyme activity, usually by an inhibitor molecule.
- **(D)** Denaturation is the irreversible unfolding of an enzyme's shape (e.g. due

to high temperature or extreme pH), causing it to lose activity – not the same as specificity.

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept: External respiration – alveolar gas exchange

During **external respiration** (gas exchange in the lungs), oxygen (O_2) from the inhaled air inside the alveolus diffuses across the thin alveolar wall and the capillary wall **into the blood**, because the partial pressure of O_2 is higher in the alveolar air than in the deoxygenated blood arriving from the body. Simultaneously, carbon dioxide (CO_2) moves in the opposite direction (blood $\rightarrow$ alveolus) and is expelled when we exhale.

Why other options are wrong:

- **(A)** Carbon dioxide moves *from blood into the alveolus* (the reverse direction), to be exhaled.
- **(B)** Nitrogen is an inert gas and does not participate in gas exchange; it enters and leaves the lungs unchanged.
- **(C)** Water vapour is exhaled from the blood into the alveolus, not absorbed from the air.

Answer: (D) Go Back to Q 7

Q8.

Solution

Concept: ABO blood group system – Blood group O

In the ABO system:

- Group A: antigen A on RBCs, anti-B antibodies in plasma
- Group B: antigen B on RBCs, anti-A antibodies in plasma
- Group AB: both A and B antigens, no antibodies (universal recipient)
- Group O: **no A or B antigens** on RBCs, **both anti-A and anti-B antibodies** in plasma (universal donor)

A person with blood group O is a universal donor for red blood cells precisely because their RBCs carry no surface antigens that could trigger an immune reaction in the recipient.

Why other options are wrong:

- **(A)** Only antigen A on RBCs describes Blood group A, not O.
- **(C)** Both A and B antigens describe Blood group AB.
- **(D)** Only antigen B on RBCs describes Blood group B.

Answer: (B) Go Back to Q 8

Q9.

Solution

Concept: Excretion in plants – gaseous waste removal via stomata and lenticels

Plants lack kidneys, lungs, or other specialised excretory organs. Gaseous metabolic by-products (O_2 from photosynthesis, CO_2 from respiration) are eliminated primarily by **diffusion** through:

- **Stomata** – tiny pores in the epidermis of leaves (and young stems), each flanked by guard cells that regulate opening and closing.
- **Lenticels** – small, loosely packed pores in the bark of woody stems and roots that allow direct gaseous exchange.

Because the concentration gradient naturally drives gases from a region of higher concentration to lower concentration, no active pumping is needed.

Why other options are wrong:

- **(B)** Root hairs mainly absorb water and mineral salts from soil; they are not the primary route for gaseous excretion.
- **(C)** Plants cannot convert CO_2 or O_2 into starch; starch is synthesised from glucose produced during photosynthesis, not from waste gases directly.
- **(D)** Plants have no excretory tubules; such structures exist only in animals (e.g. nephrons in mammals, Malpighian tubules in insects).

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept: Eye – image formation on the retina

When light from an object enters the eye, it is **refracted** (bent) mainly by the cornea and then fine-tuned by the **lens** through a process called accommodation. The lens focuses the converging rays onto the **retina** – the light-sensitive layer lining the back of the eye. The image formed on the retina is **real, inverted and diminished**. Photoreceptor cells (rods and cones) in the retina convert light energy into electrical nerve impulses that travel via the optic nerve to the brain, which interprets the image as upright.

Why other options are wrong:

- **(A)** The cornea refracts (bends) incoming light but does not itself form the final focused image.
- **(B)** The iris is a muscular diaphragm that controls the size of the pupil and hence the amount of light entering the eye; it does not form images.
- **(D)** The pupil is the opening (aperture) in the centre of the iris through which light passes; it is not a surface on which images form.

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept: Adrenaline (epinephrine) – the fight-or-flight hormone

Adrenaline (epinephrine) is secreted by the **adrenal medulla** (inner part of the adrenal glands, located above each kidney). In an emergency, it rapidly:

- Increases heart rate and blood pressure (to pump more blood to muscles)
- Dilates the bronchioles (airways), increasing oxygen supply
- Stimulates glycogen breakdown in the liver, raising blood glucose for quick energy
- Redirects blood flow away from digestive organs toward skeletal muscles

This cluster of responses is the classic **"fight-or-flight"** reaction that prepares the body to confront or escape a perceived threat.

Why other options are wrong:

- **(A)** The thyroid gland secretes thyroxine, which regulates *basal metabolic rate*; it does not slow the heart during emergencies.
- **(B)** The pituitary gland secretes growth hormone (GH) for body growth; it is not the primary gland involved in acute stress response.
- **(C)** The pancreas secretes insulin (and glucagon) to regulate blood glucose; insulin *lowers* blood glucose, the opposite of the adrenaline effect.

Answer: (D) Go Back to Q 11

Q12.

Solution

Concept: Conditions required for seed germination

A dormant seed needs three essential abiotic conditions to germinate:

- **Water (moisture):** softens the seed coat, activates enzymes, and is needed for metabolic reactions.
- **Adequate/warm temperature:** enzymes work optimally within a specific temperature range (typically 15–35°C for most crop plants).
- **Oxygen:** required for aerobic cellular respiration, which provides the energy (ATP) needed by the germinating embryo to grow.

Light is *not* universally required for germination (many seeds germinate in the dark); fertilisers are not required at the germination stage.

Why other options are wrong:

- **(A)** Low temperature (below 5°C) inhibits enzyme activity and generally prevents germination.
- **(C)** Absence of oxygen would prevent aerobic respiration; most seeds cannot germinate under anaerobic conditions.
- **(D)** Fertilisers supply mineral nutrients for established plants but are not a germination requirement; the seed uses its own stored food reserves.

Answer: (B) Go Back to Q 12

Q13.

Solution

Concept: Incomplete dominance – blending of phenotype in F_1

In **incomplete dominance**, neither allele completely masks the other. When a homozygous red (RR) plant is crossed with a homozygous white (WW) plant, the F_1 genotype is RW. Because R does not completely dominate W, the resulting pigment production is intermediate, producing a **pink** flower colour. This intermediate phenotype is the hallmark of incomplete dominance. When F_1 pink plants are selfed, F_2 gives a 1 red : 2 pink : 1 white ratio.

Why other options are wrong:

- **(B)** In complete dominance, the F_1 would show *only* the dominant parental phenotype (all red or all white), not an intermediate colour.
- **(C)** In codominance, *both* traits are fully expressed simultaneously (e.g. red AND white patches on the same flower), not a blended intermediate.
- **(D)** Epistasis involves gene interaction between two *different* gene loci, where one gene masks the expression of another; it does not describe a single-locus blending phenomenon.

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept: Enhanced greenhouse effect – role of carbon dioxide

The **greenhouse effect** is a natural phenomenon: certain atmospheric gases (greenhouse gases) trap outgoing infrared radiation from Earth's surface, warming the planet. The **enhanced** (or anthropogenic) greenhouse effect refers to the intensification of this process due to human activities. **Carbon dioxide (CO_2)** is the principal greenhouse gas contributing to global warming because:

- It is released in massive quantities by burning fossil fuels (coal, oil, natural gas) and deforestation.
- It persists in the atmosphere for centuries.
- Its concentration has increased from ≈280 ppm (pre-industrial) to over 420 ppm today.

Why other options are wrong:

- **(A)** Oxygen (O_2) is not a greenhouse gas; it does not absorb infrared radiation significantly.
- **(B)** Nitrogen (N_2) makes up ≈78% of the atmosphere but is not a greenhouse gas and does not trap heat.
- **(D)** Argon (Ar) is an inert noble gas; it has no role in the greenhouse effect whatsoever.

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept: Analogous organs – same function, different evolutionary origin

Analogous organs are structures in different species that perform the **same function** but have **different structural (evolutionary) origins**. The bat wing evolved from the modified forelimb of a vertebrate ancestor (bones: humerus, radius, ulna, elongated digits with a membrane stretched between them), while the butterfly wing is an entirely different structure derived from the insect body wall (thin chitinous membrane with hollow wing veins). Their similarity in function (flight) arose through **convergent evolution** – independent adaptation to similar environmental pressures.

Why other options are wrong:

- **(A)** Homologous organs have the *same basic structural plan* (same evolutionary origin) but may perform *different functions* (e.g. human arm, whale flipper, bird wing – all are modified vertebrate forelimbs).
- **(B)** Vestigial organs are remnants of structures that were functional in ancestors but have reduced or lost their function in modern species (e.g. the human appendix, coccyx).
- **(C)** "Adaptive organs" is not a standard biological term used in NCERT classification of organ types.

Answer: (D) Go Back to Q 15

Answer Key

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