

Section 1 — Multiple Choice (20 marks)

Choose the best answer for each question.

Question 1

1 mark

A red blood cell placed into a solution moves water out of the cell across its selectively permeable membrane, causing the cell to shrink.

Identify the process responsible.

- A) Facilitated diffusion
- B) Active transport
- C) Osmosis
- D) Phagocytosis

Question 2

1 mark

An enzyme's active site changes shape slightly as the substrate binds, moulding around it to form a closer fit.

This best describes the:

- A) Lock-and-key model
- B) Induced-fit model
- C) Enzyme + end products stage
- D) Competitive inhibition model

Question 3

1 mark

A resting adult uses roughly 40 kg of ATP per day, yet the body stores only around 250 g of ATP at any one time.

Identify how the body's ATP demand is met.

- A) ATP is broken down faster than it is synthesised
- B) ATP is continuously hydrolysed and resynthesised (recycled)
- C) Only some cells require ATP at any given moment
- D) ATP is stored in the liver in large reserves for later use

Question 4

1 mark

Lipase is an enzyme responsible for:

- A) The catabolic reaction of lipids into fatty acids and glycerol
- B) The anabolic reaction of fatty acids into lipids
- C) The catabolic reaction of glycerol into lipids
- D) The anabolic reaction of lipids into fatty acids

Question 5

1 mark

Identify the term that describes a stem cell capable of differentiating into any cell type, including extra-embryonic tissue such as the placenta.

- A) Pluripotent
- B) Multipotent
- C) Totipotent

D) Unipotent

Question 6

1 mark

Ribosomes attached to the outer surface of the endoplasmic reticulum give it a "rough" appearance. This region of the cell is primarily the site of:

- A) Lipid synthesis
- B) Protein synthesis
- C) ATP synthesis
- D) DNA replication

Question 7

1 mark

Identify the correct action of the stomata and guard cells of a plant during a period of drought stress (stomatal closure).

	Stomata	Guard cells	CO₂ / O₂ exchange
A)	Closed	Water moves out (lose turgor)	Minimal exchange
B)	Open	Water moves in (gain turgor)	Normal exchange continues
C)	Closed	Water moves in (gain turgor)	Minimal exchange
D)	Open	Water moves out (lose turgor)	Normal exchange continues

Question 8

1 mark

The loop of Henle in the nephron is primarily responsible for:

- A) Filtration of blood plasma and dissolved solutes
- B) Establishing a concentration (osmotic) gradient in the medulla that enables water reabsorption
- C) Secretion of hydrogen ions and potassium ions into the filtrate
- D) Reabsorption of all glucose and amino acids from the filtrate

Question 9

1 mark

In the pressure flow (mass flow) hypothesis of phloem transport, water moves into the phloem at the source by osmosis because:

- A) Sucrose concentration is high there, due to active loading from photosynthesising cells
- B) Sucrose concentration is low there, due to unloading at the source
- C) The xylem has a higher water potential than the phloem at the source
- D) ATP is used to directly pump water molecules into the phloem

Question 10

1 mark

Baroreceptors located in the carotid sinus and aortic arch primarily detect:

- A) Blood glucose concentration
- B) Changes in blood pressure
- C) Blood temperature
- D) Blood pH

Question 11**1 mark**

Vasodilation of blood vessels near the skin surface, occurring in response to a rise in core body temperature, is an example of:

- A) Negative feedback
- B) Positive feedback
- C) A learned behavioural response
- D) An adaptive immune response

Question 12**1 mark**

A neuron with a long axon, a cell body positioned off to one side of the axon, and terminal branches that synapse directly onto a muscle fibre is best classified as a:

- A) Sensory neuron
- B) Interneuron
- C) Motor neuron
- D) Relay neuron

Question 13**1 mark**

Non-infectious diseases can be

- A) fungal.
- B) autoimmune.
- C) contagious.
- D) vector-borne.

Question 14**1 mark**

The following description is of an unknown pathogen:

A single-celled microscopic organism, 1–10 micrometres in diameter, with no membrane-bound nucleus, that reproduces independently by binary fission.

Identify what type of microorganism it is.

- A) Virus
- B) Protist
- C) Bacterium
- D) Prion

Question 15**1 mark**

Identify which of these characteristics is part of the innate (non-specific) immune response in vertebrates.

- A) Memory B cells producing antibodies specific to a previously encountered pathogen
- B) Cytotoxic T cells recognising a specific viral antigen
- C) Interferons released by virus-infected cells to protect neighbouring cells
- D) Antibody-mediated agglutination of a specific pathogen

Question 16**1 mark**

Which of the following best explains why the secondary immune response is typically faster and produces more antibodies than the primary response?

- A) Memory B and T cells generated during the first exposure are already present and respond rapidly
- B) The pathogen mutates and becomes less virulent on second exposure
- C) Antibody diversity decreases with each subsequent exposure
- D) Naive B cells are only required during the secondary response

Question 17**1 mark**

Which strategy would most effectively reduce the reproduction number of a respiratory pathogen during an outbreak?

- A) Delaying contact tracing
- B) Encouraging large indoor gatherings
- C) Promoting hand hygiene, mask use and isolation of cases
- D) Reducing testing and surveillance rates

Question 18**1 mark**

The table below contains information collected from four patients who contracted a new gastrointestinal illness. Predict the potential source of the outbreak using the information provided.

	Case 1	Case 2	Case 3	Case 4
Meals eaten	Café A, home	Café A, restaurant B	Café A, home	Restaurant B only
Onset	Day 1	Day 1	Day 2	Day 3
Symptom	Vomiting	Vomiting	Vomiting	Nausea

- A) Home-prepared food B) Café A C) Restaurant B D) Cannot be determined

Question 19**1 mark**

Oxygen moves from the air in the alveoli into pulmonary capillary blood down its partial pressure gradient, without the use of ATP. This process is called:

- A) Diffusion
- B) Osmosis
- C) Active transport
- D) Facilitated diffusion

Question 20**1 mark**

Identify the statement that describes a feature of eukaryotic cells.

- A) Genetic material exists as a single circular chromosome free in the cytoplasm
- B) They lack a nuclear membrane
- C) They may contain membrane-bound organelles such as mitochondria
- D) They are always unicellular

Section 2 — Short Response (20 marks)

Question 21

4 marks

The table below lists partial pressures of oxygen and carbon dioxide in systemic arterial blood as it enters capillaries, and in respiring body cells.

	Systemic blood (entering capillaries)	Body cells
Oxygen (kPa)	89	40
Carbon dioxide (kPa)	44	46

Analyse the data to predict the direction that gases will be exchanged between systemic blood and body cells. Use the data to support your prediction.

Question 22

3 marks

Explain why mast cells and neutrophils are described as part of the innate immune response, while B cells and T cells are described as part of the adaptive immune response.

Question 23**4 marks**

(i) Recall the balanced chemical equation for photosynthesis. [1]

(ii) Identify the location in the chloroplast, and the net inputs and outputs, of the light-dependent and light-independent (Calvin cycle) reactions of photosynthesis. Fill in the blanks. [3]

Stage	Location	Inputs	Outputs
Light-dependent reactions		Light energy Water NADP+ ADP + Pi	Oxygen ATP NADPH
Light-independent reactions (Calvin cycle)	Stroma		G3P / Glucose ADP + Pi NADP+

Question 24**3 marks**

An experiment measured the relative rate of reaction of an enzyme (invertase) at different pH values.

pH	2	4	4.5	6	8	10
Relative rate	5	72	100	68	10	2

Predict the optimum pH for this enzyme. Justify your response using the data and your understanding of enzyme structure.

Question 25**4 marks**

Identify two virulence factors that a pathogen may possess (other than adherence factors, invasion factors, capsules or toxins). Explain how each factor can aid in pathogenesis.

Question 26**2 marks**

Explain how antidiuretic hormone (ADH) assists in osmoregulation when the body is dehydrated.
