# Biology Paper 2

Sample assessment 2026–27

**Time allowed: 2 hours  Total marks: 70**

**Do not open this paper until instructed. Record every answer in the separate answer booklet.**

## Instructions

- Answer all questions.
- Section A multiple-choice questions come first. Record the selected option in the separate answer booklet.
- Write all extended responses in the separate answer booklet and identify each question clearly.
- A scientific, non-programmable, non-graphing calculator may be used.
- No data or formula booklet is provided for this paper.
- Show all working where relevant.
- No AI is permitted.
- The mark allocation is shown beside each question.

**Answer all 20 Section A multiple-choice questions and all five Section B questions.**
**Record all answers in the separate answer booklet, using the printed identifiers A1–A20 and B1(a)–B5(d).**
**Choose one option A–D for each multiple-choice question.**
**A scientific, non-programmable, non-graphing calculator is permitted. No formula or data booklet is supplied.**
**Show relevant working and use units where appropriate. No AI, internet or unauthorised electronic assistance is permitted.**

## Section A · Multiple-choice questions

Answer all 20 multiple-choice questions. 20 marks.

Question A1: Which change produces the rapid depolarisation of a typical neurone during an action potential? 1
A. Potassium ions entering through voltage-gated channels
B. Sodium ions leaving by simple diffusion through the lipid bilayer
C. Sodium ions entering through voltage-gated channels
D. Chloride ions entering through ATP synthase

Question A2: What is the effect of myelination on impulse conduction along an axon? 1
A. It permits saltatory conduction between nodes.
B. It reverses the direction of every impulse.
C. It prevents any ion movement at nodes.
D. It makes the axon independent of membrane potentials.

Question A3: Which retinal photoreceptors are most sensitive in dim light? 1
A. Ganglion cells
B. Cones
C. Bipolar neurones
D. Rods

Question A4: Which change enables the eye to focus on a nearby object? 1
A. The lens becomes thinner.
B. The lens becomes more convex.
C. The ciliary muscles relax.
D. The suspensory ligaments tighten.

Question A5: During skeletal-muscle contraction, calcium ions bind to which protein to help expose binding sites on actin? 1
A. Myosin
B. Troponin
C. Collagen
D. Haemoglobin

Question A6: Which change occurs in a sarcomere as it shortens? 1
A. Actin filaments become shorter.
B. Myosin filaments become shorter.
C. The A-band disappears.
D. The Z-lines move closer together.

Question A7: Which cells secrete large quantities of antibodies? 1
A. Plasma cells
B. Red blood cells
C. Platelets
D. Ciliated epithelial cells

Question A8: What is phagocytosis? 1
A. Production of an action potential
B. Movement of air into an alveolus
C. Engulfment of particles into a cell in a vesicle
D. Release of glucose from glycogen

Question A9: During normal inspiration, which change helps air enter the lungs? 1
A. Thoracic volume decreases.
B. External intercostal muscles prevent rib movement.
C. The diaphragm relaxes and rises.
D. Alveolar pressure falls below atmospheric pressure.

Question A10: Which adaptation of alveoli most directly reduces the diffusion distance for gases? 1
A. Cartilage in their walls
B. A thin epithelial lining
C. A thick layer of skeletal muscle
D. A waterproof surface

Question A11: Where does glycolysis take place in a eukaryotic cell? 1
A. The inner mitochondrial membrane
B. The mitochondrial matrix
C. The cytoplasm
D. The chloroplast stroma

Question A12: Which molecule combines with the acetyl group from acetyl CoA to form citrate at the start of the Krebs cycle? 1
A. Oxaloacetate
B. Glucose
C. Pyruvate
D. Lactate

Question A13: What is the final electron acceptor in the aerobic mitochondrial electron transport chain? 1
A. Oxygen
B. Carbon dioxide
C. ATP
D. Glucose

Question A14: Where do the light-dependent reactions of photosynthesis take place? 1
A. The nuclear envelope
B. The cell wall
C. The thylakoid membranes
D. The mitochondrial matrix

Question A15: Which molecule is the immediate carbon dioxide acceptor in the Calvin cycle? 1
A. Reduced NADP
B. Ribulose bisphosphate
C. ATP
D. Chlorophyll

Question A16: Which enzyme synthesises an RNA transcript using a DNA template? 1
A. DNA ligase
B. Amylase
C. Restriction endonuclease
D. RNA polymerase

Question A17: Which statement describes the role of transfer RNA in translation? 1
A. It replicates the whole chromosome.
B. It removes all peptide bonds from a protein.
C. It carries an amino acid and has an anticodon complementary to an mRNA codon.
D. It forms the phospholipid bilayer of a ribosome.

Question A18: Which statement distinguishes somatic gene therapy from germline gene modification? 1
A. Somatic gene therapy changes every cell in an embryo.
B. Somatic gene therapy must be inherited by all offspring.
C. Somatic gene therapy cannot change gene expression.
D. Somatic gene therapy targets body cells and is not intended to be inherited.

Question A19: A respiring sample produces 12 $cm^3$ of carbon dioxide while consuming 15 $cm^3$ of oxygen. What is its respiratory quotient, defined as carbon dioxide produced divided by oxygen consumed? 1
A. 1.25
B. 0.80
C. 3.0
D. 180

Question A20: Two unlinked genes assort independently. What is the probability of an aabb offspring from AaBb × aabb? 1
A. 1/4
B. 1/8
C. 1/2
D. 1/16

## Section B · Extended-response questions

Answer all 5 extended-response questions. 50 marks.

### Question B1: Nervous coordination and muscle — 10

A laboratory investigation uses a substance that blocks acetylcholine receptors on a skeletal-muscle fibre. It does not prevent action potentials reaching the motor-neurone terminal.

(a) Describe how arrival of an action potential normally causes neurotransmitter release from a presynaptic terminal. [3]

(b) Describe three events in the actin–myosin cross-bridge cycle that allow filaments to slide. [3]

(c) Explain why blocking the acetylcholine receptors can prevent contraction even though action potentials still reach the motor-neurone terminal. [2]

(d) A person has an unusually long eyeball, causing distant objects to focus in front of the retina. Explain how a diverging lens corrects this problem. [2]

### Question B2: Respiratory defence and immunity — 10

A group of learners compares antibody concentration after a first exposure to an antigen and after a later exposure to the same antigen. The later response begins sooner and reaches a higher concentration.

(a) Describe how ciliated epithelium and mucus help protect the respiratory system. [2]

(b) Describe how a specific antigen can lead to antibody production by B lymphocytes. [4]

(c) Explain why the later response to the same antigen can be faster and greater. [2]

(d) The learners conclude that the higher antibody concentration proves complete protection against every infection. Give two reasons why this conclusion is not supported. [2]

Question B3: Respiration and ATP synthesis 10

Isolated mitochondria receive oxygen and respiratory substrates. A test substance allows protons to cross the inner mitochondrial membrane without passing through ATP synthase. Oxygen is still consumed, but ATP production falls.

(a) Describe how the electron transport chain and ATP synthase normally produce ATP. [4]

(b) Explain the decrease in ATP production caused by the test substance. [2]

(c) In an untreated sample, 24 nmol of oxygen are consumed over 6.0 minutes. In a treated sample of the same mitochondrial mass, 36 nmol are consumed over 6.0 minutes. Calculate the percentage increase in mean oxygen-consumption rate. [2]

(d) State one variable that should be controlled in this comparison and explain why controlling it improves the investigation. [2]

Question B4: Photosynthesis and limiting factors 10

The following are constructed mean results for equal leaf areas measured at the same temperature.
Net oxygen production is measured in μmol $min^{-1}$. Light intensity uses arbitrary units.
At light intensity 100: lower $CO_2$ 2.0; higher $CO_2$ 2.0.
At light intensity 200: lower $CO_2$ 4.0; higher $CO_2$ 4.0.
At light intensity 400: lower $CO_2$ 5.0; higher $CO_2$ 7.0.
At light intensity 800: lower $CO_2$ 5.0; higher $CO_2$ 9.0.

(a) Describe how the light-dependent reactions generate reduced NADP and release oxygen. [4]

(b) Use the results to explain the effect of carbon dioxide concentration at low and high light intensities. [2]

(c) Calculate the increase in net oxygen production from 400 to 800 light units for each carbon dioxide treatment. Include units. [2]

(d) Explain why net oxygen production is not a direct measure of gross photosynthetic oxygen production, and identify one additional measurement that could improve the estimate. [2]

Question B5: Genetic information and technology 10

A short DNA template segment is 3′–TAC GGA CTT–5′. Use these mRNA codons: AUG = methionine; CCU = proline; GAA = glutamate. A separate inheritance example involves two heterozygous parents, Aa × Aa, where a is a recessive allele.

(a) Describe the main stages of one polymerase chain reaction (PCR) cycle. [4]

(b) Write the mRNA sequence transcribed from the DNA segment, showing its 5′ and 3′ ends. Then state the amino-acid sequence specified by the supplied codons. [4]

(c) State the probability that an offspring of Aa × Aa has genotype aa. [1]

(d) State one reason why informed consent matters before an individual’s DNA profile is used for a new research purpose. [1]