

# Mark Scheme

Predicted Practice Paper — Summer 2027

**GCSE Biology 8461/1H**

**Higher Tier Paper 1**

This is an original mark scheme written for a predicted practice paper. It is NOT an official AQA mark scheme and is NOT endorsed by or affiliated with AQA. All questions are original.

For use with the Predicted Practice Paper 1 question paper.

# General marking guidance

These notes offer general guidance, but the specific notes for examiners appertaining to individual questions take precedence.

## 1 Points-based marking.

Award one mark for each marking point listed in the 'Mark scheme points' column. A marking point is awarded only when the candidate's response matches the point or an acceptable alternative given in 'Additional guidance'.

## 2 Marking of lists — right + wrong = wrong.

Where a question asks for a set number of responses but the candidate gives extra responses, each error or contradiction negates each correct response. If the number of errors equals or exceeds the marks available, no marks are awarded. Responses considered neutral are not penalised.

## 3 Accept / allow.

'Accept' gives wording that must be present for the mark. 'Allow' indicates creditworthy alternative answers. Alternative words are shown with a solidus, e.g. allow smooth / free movement.

## 4 Ignore.

'Ignore' is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could still gain the marking point.

## 5 Do not accept.

'Do not accept' marks a wrong answer which means the mark is not awarded, even if the correct answer is given as well.

## 6 Brackets.

Words in brackets (like this) are not essential for the mark but help identify the sense of the answer required.

## 7 Emboldened 'and'.

A bold and in a marking point means both parts of the answer are required to award the mark.

## 8 Use of symbols / formulae.

A correct chemical symbol or formula may be credited instead of a required name, where appropriate in context.

## 9 Spelling (phonetic).

Award marks if the spelling is not correct but the intention is clear, unless there is possible confusion with another technical term (e.g. 'cloroplast' for chloroplast is allowed).

## 10 Interpretation of 'it'.

Answers using the word 'it' are credited only if it is clear that 'it' refers to the correct subject.

## 11 Marking procedure for calculations.

Award marks for each stage of the calculation completed correctly. A correct numerical answer with no working shown earns full marks. Full marks are not awarded for a correct

final answer from incorrect working.

## **12 Errors carried forward (ecf).**

An error can be carried forward within a question part: an incorrect value in one step of a calculation does not prevent subsequent marks being awarded for correct working from that value. Shown by 'ecf'.

## **13 Units and significant figures.**

Units are required only where the mark scheme states them. Do not penalise a different number of significant figures unless the question asks for a specific precision.

## **14 Levels of response.**

Extended questions are marked on levels of response: read the whole answer, start at the lowest level and use it as a ladder to decide whether the answer meets each descriptor, then award a mark within the band. Indicative content is not exhaustive — credit any valid, relevant point at the appropriate level.

## **15 Examiners' judgement.**

The specific notes for individual questions take precedence over these general notes. Where doubt remains, credit a response only if the science is correct.

## **Guidance on the use of abbreviations within this mark scheme**

|                      |                                                                         |
|----------------------|-------------------------------------------------------------------------|
| <b>accept</b>        | wording that must be present for the mark to be awarded                 |
| <b>allow</b>         | creditworthy alternative answers (solidus shows alternatives)           |
| <b>ignore</b>        | information is irrelevant or not enough for the marking point           |
| <b>do not accept</b> | wrong answer: the mark is lost even if the correct answer is also given |
| <b>ecf</b>           | error carried forward from an earlier wrong value                       |
| <b>ora</b>           | or reverse argument — the converse statement is acceptable              |
| <b>max</b>           | maximum mark available (e.g. max 2 if more points are listed)           |

**Paper: 8461/1H**

| Question | Answer/marks                                                   | Mark scheme points                                                                                                                                                                                                                                                                                                                  | Additional guidance                                                               |
|----------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 1(a)     | aorta (1 mark)                                                 | <ul style="list-style-type: none"><li>• aorta (1)</li></ul>                                                                                                                                                                                                                                                                         | accept phonetic spelling                                                          |
| (b)      | pulmonary vein (1 mark)                                        | <ul style="list-style-type: none"><li>• pulmonary vein (1)</li></ul>                                                                                                                                                                                                                                                                | do not accept pulmonary artery                                                    |
| (c)      | blood passes through the heart twice per circuit (2 marks)     | <ul style="list-style-type: none"><li>• blood passes through the heart twice for each complete circuit of the body (1)</li><li>• the right side of the heart pumps (deoxygenated) blood to the lungs and the left side pumps (oxygenated) blood to the rest of the body (1)</li></ul>                                               | allow pulmonary circulation and systemic circulation named                        |
| (d)      | blood pressure is maintained (1 mark)                          | <ul style="list-style-type: none"><li>• blood returns to the heart to be pumped again so high blood pressure is maintained (1)</li></ul>                                                                                                                                                                                            | allow oxygen is delivered to tissues more quickly; allow blood flows more quickly |
| (e)      | more muscle needed for higher pressure to the body (3 marks)   | <ul style="list-style-type: none"><li>• the wall of the left ventricle contains more muscle (1)</li><li>• so it contracts more powerfully / generates higher pressure (1)</li><li>• to pump blood all around the body, whereas the right ventricle only pumps blood to the nearby lungs (1)</li></ul>                               |                                                                                   |
| (f)      | thick muscular elastic walls withstand high pressure (3 marks) | <ul style="list-style-type: none"><li>• thick walls containing muscle and elastic tissue (1)</li><li>• withstand the high pressure of blood pumped from the heart (1)</li><li>• elastic tissue stretches and recoils to maintain / smooth out the pressure (1)</li><li>• narrow lumen helps to maintain high pressure (1)</li></ul> | max 3; allow smooth lining reduces friction                                       |

**Paper: 8461/1H**

| Question | Answer/marks                                                          | Mark scheme points                                                                                                                                                                                                                                                                                                                              | Additional guidance                                                               |
|----------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 2(a)     | mitochondrion (1 mark)                                                | <ul style="list-style-type: none"> <li>mitochondrion (1)</li> </ul>                                                                                                                                                                                                                                                                             | accept mitochondria; allow phonetic spelling                                      |
| (b)      | any two: cell wall, chloroplasts, permanent vacuole (2 marks)         | <ul style="list-style-type: none"> <li>plant cells have a (cellulose) cell wall (1)</li> <li>plant cells have chloroplasts (1)</li> <li>plant cells have a permanent vacuole (1)</li> </ul>                                                                                                                                                     | max 2; do not accept chlorophyll for chloroplasts                                 |
| (c)      | $3 \times 10^3$ (2 marks)                                             | <ul style="list-style-type: none"> <li>magnification = image size <math>\div</math> real size = <math>75 \div 0.025</math> (1)</li> <li>= 3000 = <math>3 \times 10^3</math> (1)</li> </ul>                                                                                                                                                      | award 1 mark for 3000 without standard form; allow ecf from an incorrect division |
| (d)      | ribosomes smaller than resolution limit of light microscope (2 marks) | <ul style="list-style-type: none"> <li>a light microscope cannot resolve objects smaller than about 0.2 <math>\mu\text{m}</math> / 200 nm (1)</li> <li>ribosomes are smaller than this, so an electron microscope with higher resolution is needed (1)</li> </ul>                                                                               | allow 'the wavelength of light limits resolution' for the first point             |
| (e)      | no nucleus; no membrane-bound organelles (2 marks)                    | <ul style="list-style-type: none"> <li>bacterial cells have no (membrane-bound) nucleus – a single loop of DNA is free in the cytoplasm (1)</li> <li>bacterial cells have no mitochondria / chloroplasts / membrane-bound organelles (1)</li> <li>bacterial cells have a cell wall (1)</li> <li>bacterial cells are much smaller (1)</li> </ul> | max 2                                                                             |
| (f)      | magnification enlarges; resolution reveals detail (2 marks)           | <ul style="list-style-type: none"> <li>magnification is how many times larger the image is than the real object (1)</li> <li>resolution is the ability to distinguish two separate points / to see fine detail (1)</li> </ul>                                                                                                                   |                                                                                   |
| (g)      | stain on slide; coverslip lowered at an angle (2 marks)               | <ul style="list-style-type: none"> <li>place the cells in a drop of water / stain (e.g. iodine) on a slide (1)</li> <li>lower the coverslip carefully at an angle to avoid trapping air bubbles (1)</li> </ul>                                                                                                                                  |                                                                                   |

| Question | Answer/marks                                                     | Mark scheme points                                                                                                                                                                                                                                                                                                                                                                                                               | Additional guidance                                                                                                         |
|----------|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 3(a)     | 11.0 % (2 marks)                                                 | <ul style="list-style-type: none"> <li>percentage change = <math>(2.72 - 2.45) \div 2.45 \times 100</math> (1)</li> <li>= 11.0 (%) (1)</li> </ul>                                                                                                                                                                                                                                                                                | allow 11.02 %; award 1 mark for the correct method with a wrong final answer; allow ecf from their values read from Table 1 |
| (b)      | mass gain at low concentration, loss at high (osmosis) (3 marks) | <ul style="list-style-type: none"> <li>as the sugar concentration increases, the percentage change in mass decreases / becomes negative (1)</li> <li>at low concentrations water moves into the cells by osmosis (down the water concentration gradient), so the mass increases (1)</li> <li>at high concentrations water moves out of the cells, so the cells shrink / become plasmolysed and the mass decreases (1)</li> </ul> | the description mark requires the trend; allow 'turgid' and 'flaccid' with correct context                                  |
| (c)      | see levels-of-response mark scheme (6 marks)                     | <ul style="list-style-type: none"> <li>marked on levels of response (see framework)</li> </ul>                                                                                                                                                                                                                                                                                                                                   |                                                                                                                             |
| (d)      | e.g. length of cylinders / time in solution (1 mark)             | <ul style="list-style-type: none"> <li>length of the potato cylinders (1)</li> <li>time the cylinders were left in solution (1)</li> </ul>                                                                                                                                                                                                                                                                                       | max 1; accept any one valid control variable from the method                                                                |

| Question | Answer/marks                                            | Mark scheme points                                                                                                                                                                                                                                                                                                                                  | Additional guidance                                                                                    |
|----------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 4(a)     | correctly plotted graph with line of best fit (4 marks) | <ul style="list-style-type: none"> <li>both axes labelled with quantities and units; suitable scales chosen covering more than half the grid (1)</li> <li>all six points plotted accurately (1)(1)</li> <li>appropriate line of best fit drawn (1)</li> </ul>                                                                                       | allow $\pm$ half a small square for plotting; the line must be a smooth curve, not dot-to-dot          |
| (b)      | rate rises with light intensity then plateaus (2 marks) | <ul style="list-style-type: none"> <li>as light intensity increases, the rate of photosynthesis increases (1)</li> <li>the rate levels off / stays constant above 500 lux (1)</li> </ul>                                                                                                                                                            | allow figures quoted from Table 2                                                                      |
| (c)      | another factor limits the rate (2 marks)                | <ul style="list-style-type: none"> <li>light intensity is no longer the limiting factor (1)</li> <li>another factor limits the rate, e.g. carbon dioxide concentration or temperature (1)</li> </ul>                                                                                                                                                |                                                                                                        |
| (d)      | 6.5 bubbles per minute (2 marks)                        | <ul style="list-style-type: none"> <li>intensity at 40 cm = <math>(20 \div 40)^2 = \frac{1}{4}</math> of the intensity at 20 cm (1)</li> <li>rate = <math>26 \div 4 = 6.5</math> bubbles per minute (1)</li> </ul>                                                                                                                                  | allow 6–7 bubbles per minute; allow ecf from an incorrect fraction                                     |
| (e)      | control variables for a valid comparison (2 marks)      | <ul style="list-style-type: none"> <li>temperature and the pondweed are control variables (1)</li> <li>so that only light intensity affects the rate / the results are valid (1)</li> </ul>                                                                                                                                                         | allow 'temperature affects enzyme activity in photosynthesis'                                          |
| (f)      | e.g. repeats and mean; gas syringe (2 marks)            | <ul style="list-style-type: none"> <li>repeat the bubble counts at each light intensity and calculate a mean (1); this improves reliability / allows anomalies to be spotted (1)</li> <li>measure the volume of gas collected in a gas syringe instead of counting bubbles (1); bubble counting is imprecise / this is more accurate (1)</li> </ul> | max 2; the improvement and its reason are both required for each mark pair – accept any one valid pair |

**Paper: 8461/1H**

| Question | Answer/marks                                                    | Mark scheme points                                                                                                                                                                                                                                                                                                                                  | Additional guidance                                                                 |
|----------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 5(a)     | see levels-of-response mark scheme (6 marks)                    | <ul style="list-style-type: none"><li>marked on levels of response (see framework)</li></ul>                                                                                                                                                                                                                                                        |                                                                                     |
| (b)      | independent: pH; control: e.g. temperature (2 marks)            | <ul style="list-style-type: none"><li>independent variable: pH (1)</li><li>control variable: temperature / volume or concentration of starch or amylase solution / time between samples (1)</li></ul>                                                                                                                                               | do not accept 'amount' without qualification                                        |
| (c)      | 0.0167 (2 marks)                                                | <ul style="list-style-type: none"><li>rate = <math>1 \div 60</math> (1)</li><li>= 0.0167 (to 3 significant figures) (1)</li></ul>                                                                                                                                                                                                                   | allow 0.017 (2 s.f.); award 1 mark for the correct method with a wrong final answer |
| (d)      | active site shape changed so substrate no longer fits (3 marks) | <ul style="list-style-type: none"><li>pH 8 is above the optimum pH, so the shape of the active site changes (1)</li><li>the starch / substrate no longer fits into the active site (it is no longer complementary) (1)</li><li>fewer enzyme-substrate complexes form, so fewer successful collisions per second and the rate is lower (1)</li></ul> | do not accept 'the enzyme is killed'                                                |

| Paper: 8461/1H |                                                                     |                                                                                                                                                                                                                                                                                                                           |                                                                  |
|----------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Question       | Answer/marks                                                        | Mark scheme points                                                                                                                                                                                                                                                                                                        | Additional guidance                                              |
| 6(a)           | bacterium / bacteria (1 mark)                                       | <ul style="list-style-type: none"> <li>• bacterium / bacteria (1)</li> </ul>                                                                                                                                                                                                                                              |                                                                  |
| (b)            | droplet infection (2 marks)                                         | <ul style="list-style-type: none"> <li>• coughing / sneezing releases droplets containing the virus (1)</li> <li>• the droplets are inhaled by another person / land on surfaces and are then touched (1)</li> </ul>                                                                                                      |                                                                  |
| (c)            | clot; phagocytosis; antibodies/antitoxins (3 marks)                 | <ul style="list-style-type: none"> <li>• blood clots to seal the cut (1)</li> <li>• white blood cells engulf and digest the pathogens (phagocytosis) (1)</li> <li>• white blood cells produce antibodies (1)</li> <li>• white blood cells produce antitoxins (1)</li> </ul>                                               | max 3                                                            |
| (d)            | dead/weakened pathogen stimulates antibody + memory cells (3 marks) | <ul style="list-style-type: none"> <li>• the vaccine contains a dead / weakened / inactive form of the pathogen (1)</li> <li>• this stimulates white blood cells to produce antibodies (1)</li> <li>• memory cells remain, so on reinfection antibodies are produced rapidly before the person becomes ill (1)</li> </ul> | the third point requires both speed and the link to memory cells |
| (e)            | antibiotics act on bacteria, not viruses (1 mark)                   | <ul style="list-style-type: none"> <li>• antibiotics kill bacteria but measles is caused by a virus (1)</li> </ul>                                                                                                                                                                                                        |                                                                  |

**Paper: 8461/1H**

| Question | Answer/marks                                                 | Mark scheme points                                                                                                                                                                                                                                                                                                                                  | Additional guidance                                                                                    |
|----------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 7(a)     | word and symbol equations for aerobic respiration (2 marks)  | <ul style="list-style-type: none"><li>• (i) glucose + oxygen → carbon dioxide + water (1)</li><li>• (ii) <math>C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O</math> (1)</li></ul>                                                                                                                                                                   | in (i) allow 'energy' as an additional product; in (ii) all formulae and the balancing must be correct |
| (b)      | breathing rate rises in exercise, falls back after (2 marks) | <ul style="list-style-type: none"><li>• breathing rate increases during exercise, from 14 to 45 breaths per minute (1)</li><li>• it decreases after exercise, returning to near the resting rate by 15 minutes (1)</li></ul>                                                                                                                        | data must be quoted for the first point                                                                |
| (c)      | see levels-of-response mark scheme (6 marks)                 | <ul style="list-style-type: none"><li>• marked on levels of response (see framework)</li></ul>                                                                                                                                                                                                                                                      |                                                                                                        |
| (d)      | Benedict's (brick red) and biuret (purple) tests (4 marks)   | <ul style="list-style-type: none"><li>• add Benedict's solution to the sample and heat (in a water bath) (1)</li><li>• a brick-red / orange precipitate shows reducing sugars are present (1)</li><li>• add sodium hydroxide solution then copper(II) sulfate solution (1)</li><li>• a purple / lilac colour shows protein is present (1)</li></ul> | heating is required for the Benedict's mark; accept 'biuret solution' for the reagents                 |

**Paper: 8461/1H**

| Question | Answer/marks                                                       | Mark scheme points                                                                                                                                                                                                                                                                                                                                                                                                     | Additional guidance                                                                 |
|----------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 8(a)     | D → C → A (after B) (1 mark)                                       | <ul style="list-style-type: none"><li>• D then C then A (1)</li></ul>                                                                                                                                                                                                                                                                                                                                                  | accept 'B, D, C, A'                                                                 |
| (b)      | produces identical cells;<br>increases cell number (2 marks)       | <ul style="list-style-type: none"><li>• mitosis produces two genetically identical daughter cells (1)</li><li>• increasing the number of cells for growth (1)</li></ul>                                                                                                                                                                                                                                                | allow 'for repair' as well as growth                                                |
| (c)      | 7 % (2 marks)                                                      | <ul style="list-style-type: none"><li>• percentage = <math>28 \div 400 \times 100</math> (1)</li><li>• = 7 (%) (1)</li></ul>                                                                                                                                                                                                                                                                                           | award 1 mark for the correct method with a wrong final answer                       |
| (d)      | differentiate and transplant;<br>risk e.g. rejection (3 marks)     | <ul style="list-style-type: none"><li>• the stem cells can differentiate into specialised (nerve) cells (1)</li><li>• the cells are transplanted to replace / repair the damaged cells (1)</li><li>• risk: rejection by the immune system / the cells may divide uncontrollably / infection may be transferred / ethical objections (1)</li></ul>                                                                      | accept any one valid risk                                                           |
| (e)      | mouse lymphocytes fused with<br>tumour cells → hybridoma (5 marks) | <ul style="list-style-type: none"><li>• a mouse is injected with the antigen (1)</li><li>• lymphocytes that produce the antibody are removed from the mouse (1)</li><li>• the lymphocytes are fused with (myeloma / tumour) cells to form hybridoma cells (1)</li><li>• the hybridoma cells divide rapidly / can be cloned (1)</li><li>• producing large quantities of identical (monoclonal) antibodies (1)</li></ul> | the sequence must be in order for the full 5; allow 'cancer cells' for tumour cells |

## Levels-of-response mark scheme

Extended 6-mark questions are marked with levels of response. Read the whole answer, choose the level that best describes it overall, then award a mark within that band. Indicative content lists points that may appear — it is not exhaustive.

### Question 3(c) (6 marks)

Evaluate the student's method.

| Level               | Marks   | Descriptor                                                                                                                                                                                                                             |
|---------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 3             | 5-6     | A judgement is made about the method, supported by a range of logically linked strengths and improvements. Each strength and improvement is developed with a reason. The account is clear and uses appropriate scientific terminology. |
| Level 2             | 3-4     | Some strengths and/or improvements are identified with some reasons, but the account is not fully developed or logically linked throughout. A judgement may be simple or missing.                                                      |
| Level 1             | 1-2     | One or two simple points about the method are made, with little or no development or reasoning. No judgement is made.                                                                                                                  |
| No relevant content | 0 marks |                                                                                                                                                                                                                                        |

For Level 3, the answer must include both strengths AND improvements, each with reasons, plus a judgement about the method.

#### Indicative content:

- strength: the cylinders were cut to the same starting length (40 mm), so the surface area exposed to the solution was controlled and the results can be fairly compared
- strength: each cylinder was left for the same time (24 hours), so time was controlled
- strength: the cylinders were blotted dry before reweighing, so water on the surface did not add extra mass
- strength: percentage change was used, allowing fair comparison even though the starting masses differed slightly
- improvement: repeat each concentration and calculate a mean, to identify anomalous results and improve reliability
- improvement: control the temperature (e.g. in a water bath), because temperature affects the rate of osmosis
- improvement: use the same volume of solution in each tube, so the concentration does not change as water moves
- improvement: cut the cylinders with a cork borer so they all have the same diameter and the surface area is fully controlled
- judgement: the method gives a valid trend, but without repeats and temperature control the results may not be reliable

### Question 5(a) (6 marks)

Explain how food is digested and absorbed in the human digestive system.

| Level               | Marks   | Descriptor                                                                                                                                                                                                             |
|---------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 3             | 5-6     | Relevant enzymes, their substrates and products are identified in detail and logically linked to absorption in the small intestine. The account is clear, well structured and uses appropriate scientific terminology. |
| Level 2             | 3-4     | Some enzymes and absorption adaptations are identified with partial explanation. The account has some logical linking but is not fully clear or complete.                                                              |
| Level 1             | 1-2     | One or two simple statements about digestion or absorption are made, with little or no explanation.                                                                                                                    |
| No relevant content | 0 marks |                                                                                                                                                                                                                        |

For Level 3, the answer must cover both digestion (enzymes → products) and absorption adaptations.

#### Indicative content:

- carbohydrases: amylase (salivary glands, pancreas, small intestine) breaks down starch into sugars (maltose → glucose)
- proteases: pepsin (stomach) and trypsin (small intestine) break down proteins into amino acids
- lipase (pancreas, small intestine) breaks down lipids into fatty acids and glycerol
- bile (made in the liver, stored in the gall bladder) emulsifies fats, giving a larger surface area for lipase, and neutralises stomach acid to give the optimum pH for enzymes
- the small intestine has villi and microvilli giving a very large surface area for absorption
- the walls of the villi are one cell thick, giving a short diffusion distance
- a rich blood supply maintains a steep concentration gradient for diffusion
- glucose and amino acids are absorbed by diffusion and active transport into the blood; water is absorbed in the large intestine

### Question 7(c) (6 marks)

Explain the changes in the athlete's body during and after the sprint, in terms of respiration.

| Level               | Marks   | Descriptor                                                                                                                                                                                                                         |
|---------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 3             | 5-6     | A detailed, logically linked account covering aerobic and anaerobic respiration during exercise and the repayment of the oxygen debt afterwards. Points are developed into clear chains of reasoning with appropriate terminology. |
| Level 2             | 3-4     | Some relevant points about respiration during and/or after exercise are made with partial explanation. Linking is incomplete and the account is not fully clear.                                                                   |
| Level 1             | 1-2     | One or two simple statements about exercise and respiration are made, with little or no explanation.                                                                                                                               |
| No relevant content | 0 marks |                                                                                                                                                                                                                                    |

For Level 3, the answer must cover both the sprint itself and the recovery period.

#### Indicative content:

- during the sprint the muscles contract more and need more energy transferred by respiration
- heart rate and breathing rate increase, supplying more oxygen and glucose to the muscles and removing more carbon dioxide
- aerobic respiration supplies energy at first: glucose + oxygen → carbon dioxide + water
- when the oxygen supply cannot meet demand, anaerobic respiration takes place: glucose → lactic acid
- less energy is released per glucose molecule in anaerobic respiration, and lactic acid builds up causing muscle fatigue
- an oxygen debt is created during the sprint
- after the sprint, breathing and heart rate stay high to repay the debt
- lactic acid is carried in the blood to the liver, where it is oxidised to carbon dioxide and water (requiring extra oxygen) or converted back to glucose

## Worked answers — calculation questions

Full worked solutions for every calculation question. Method marks are shown at each step; ecf applies as described in the general guidance.

### Question 2(c) — Magnification of the cell image

$$\begin{aligned}\text{magnification} &= \text{image size} \div \text{real size} \text{ (method mark)} \\ &= 75 \div 0.025 \\ &= 3000\end{aligned}$$

**Answer:  $3 \times 10^3$**

### Question 3(a) — Percentage change in mass

$$\begin{aligned}\text{change in mass} &= 2.72 - 2.45 = 0.27 \text{ g (method mark)} \\ \text{percentage change} &= 0.27 \div 2.45 \times 100 \text{ (method mark)} \\ &= 11.0204...\end{aligned}$$

**Answer: 11.0 %**

### Question 4(d) — Inverse-square-law prediction

$$\begin{aligned}\text{intensity} &\propto 1 \div \text{distance}^2, \text{ so at 40 cm the intensity is } (20 \div 40)^2 = \frac{1}{4} \text{ of the} \\ &\text{intensity at 20 cm (method mark)} \\ \text{rate} &= 26 \div 4 \text{ (method mark)} \\ &= 6.5\end{aligned}$$

**Answer: 6.5 bubbles per minute**

### Question 5(c) — Rate of reaction at pH 7

$$\begin{aligned}\text{rate} &= 1 \div \text{time taken} = 1 \div 60 \text{ (method mark)} \\ &= 0.01666...\end{aligned}$$

**Answer: 0.0167 (3 significant figures)**

### Question 8(c) — Percentage of cells in mitosis

$$\begin{aligned}\text{percentage} &= 28 \div 400 \times 100 \text{ (method mark)} \\ &= 7\end{aligned}$$

**Answer: 7 %**