AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.4.2.1

Aerobic and anaerobic respiration

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
Available paper years	**2020–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.2.1 Aerobic and anaerobic respiration

Answer 01 · Mark scheme November 2020 | 8464/B/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	eat less fatty food		1	AO2 4.2.2.5 4.2.2.6
01.2	any **two** from: • strengthens muscles • strengthens heart (muscle) • reduces risk of Can younCan(coronary) heart disease / CHD / cardiovascular disease • reduces blood pressure • reduces risk of (Type 2) diabetes • improves mental health / mood • improves mobility	ignore references to losing weight / mass ignore references to immediate effects of exercise on body eg increases heart rate ignore makes you healthier allow makes you stronger allow improves stamina allow keeps your heart healthy allow reduces (blood) cholesterol allow improves circulation allow strengthens bones allow boosts immunity allow reduces risk of (some) cancers allow makes you fitter ignore improves a person's appearance	2	AO2 4.2.2.4 4.2.2.6

4.4.2.1 Aerobic and anaerobic respiration

Answer 01 · Mark scheme

01.3	glucose + oxygen → carbon dioxide + water		1	AO1 4.4.2.1
01.4	C		1	AO2 4.2.1 4.2.2.2
01.5	any **two** from: • lowest / lower resting breathing rate • lowest / lower breathing rate after exercise • lowest / lower increase in breathing rate • least amount of time for breathing rate to return to resting rate	statements must be comparative allow less time for breathing rate to return to resting rate allow shortest recovery time	2	AO3 4.2.2.2 4.4.2.2
01.6	any **two** from: • only based on one measurement • person B may have done less intense exercise • other factors (besides breathing rate) indicate fitness	allow person B may have done a different type of exercise eg stamina / strength / speed allow age / sex / body mass may not have been controlled ignore references to medical conditions	2	AO3 4.4.2.2

4.4.2.1 Aerobic and anaerobic respiration

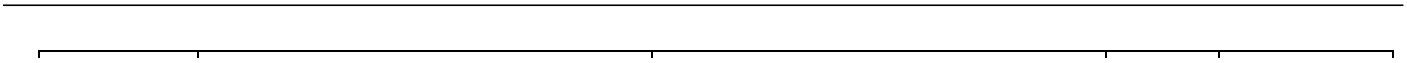
Answer 01 · Mark scheme

01.7	deeper breathing	allow heavier breathing ignore breathing rate increases	1	AO1 4.4.2.2
	increased heart rate	allow blood flows faster ignore more blood flows around body	1	
		allow increased (body) temperature		
		allow (increased) sweating		
		allow increased blood flow to skin		
		do **not** accept lactic acid is produced		
01.8		word takes precedence		AO1 4.4.2.1
	oxygen	allow O_2 ignore O / O^2	1	4.4.2.2
	lactic acid		1	
Total			**13**	

4.4.2.1 Aerobic and anaerobic respiration

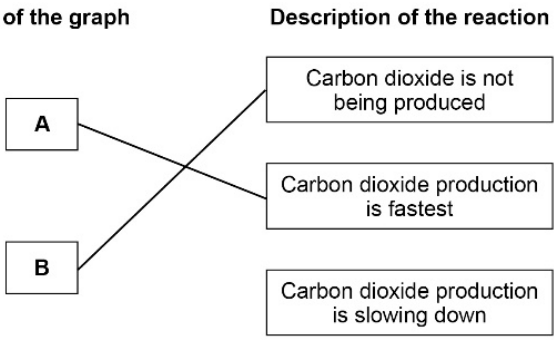
Answer 01 · Mark scheme

November 2020 | 8464/B/1F | Original Q1



4.4.2.1 Aerobic and anaerobic respiration

Answer 02 · Mark scheme November 2021 | 8464/B/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	no oxygen (reacting with the glucose)	ignore there is no air	1	AO2 4.4.2.1
03.2	produces ethanol / alcohol		1	AO1 4.4.2.1
03.3	produces carbon dioxide / gas (which) makes the bread / dough rise	 allow idea related to making the bread lighter **or** affecting its texture	1 1	AO1 AO2 4.4.2.1
03.4	45 (cm^3)		1	AO2 4.4.2.1
03.5	to allow time for the mixture to reach 35 °C		1	AO3 4.4.2.1
03.6	 do **not** accept more than one line from a box on the left		1 1	AO3 4.4.2.1

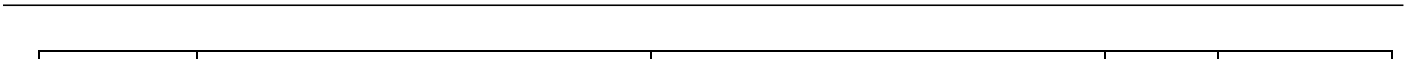
4.4.2.1 Aerobic and anaerobic respiration

03.7	any **one** from: • glucose / sugar / food ran out • ethanol / alcohol killed the cells / yeast	 ignore yeast / cells died unqualified ignore produced ethanol / alcohol unqualified	1	AO2 4.4.2.1
03.8	(2 °C) too cold (for enzymes / yeast to work) (75 °C) enzymes denatured	allow yeast / enzyme was inactive ignore yeast killed allow no / few successful collisions do **not** accept enzymes are denatured allow enzymes destroyed allow description eg change in shape of active site or of enzyme allow yeast killed do **not** accept enzymes killed ignore references to collisions unqualified	1 1	AO2 4.2.2.1 4.4.2.1
03.9	glucose → lactic acid	**1** mark for each chemical must be in this order ignore formulae	2	AO1 4.4.2.1
Total			**13**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 02 · Mark scheme

November 2021 | 8464/B/1F | Original Q3



4.4.2.1 Aerobic and anaerobic respiration

Answer 03 · Mark scheme November 2021 | 8464/B/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nut(s) → bird(s) → cat(s)	allow **1** mark for organisms in correct order (left to right) but arrows incorrect or missing allow **2** marks for cat(s) ← bird(s) ← nut(s) do **not** accept cat(s)bird(s) nut(s) do **not** accept cat(s) →bird(s) →nut(s)	2	AO2 4.7.2.1
03.2	answer must be consistent with food chain given in question **03.1**	if no answer to question **03.1** allow bird(s)	1	AO2 4.7.2.1
03.3	food pathogens		1 1	AO1 4.7.1.3
03.4	13.60 (mm)	allow 13.6 (mm)	1	AO2 4.6.2.2
03.5	structural		1	AO2 4.7.1.4
03.6	variation mutation reproduction generation	must be in this order	1 1 1 1	AO2 4.6.2.2

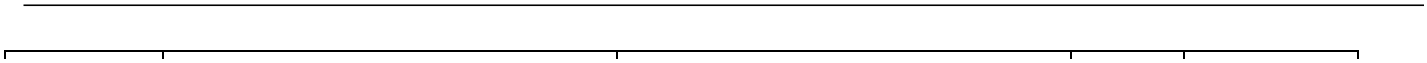
4.4.2.1 Aerobic and anaerobic respiration

03.7	birds have a shorter life cycle than humans		1	AO3 4.6.3.1 4.6.3.4
03.8	bacteria can become resistant to antibiotics		1	AO1 4.6.3.1 4.6.3.4
Total			**13**	

4.4.2.1 Aerobic and anaerobic respiration

Answer 03 · Mark scheme

November 2021 | 8464/B/2F | Original Q3



4.4.2.1 Aerobic and anaerobic respiration

Answer 04 · Mark scheme

June 2023 | 8464/B/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	to produce garden compost		1	AO1 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	microorganism(s) / bacteria / fungi	allow decomposer(s) / microbe(s) allow mould / mushrooms ignore worm(s) / germ(s)	1	AO1 4.7.2.2 4.7.3.3 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	oxygen carbon dioxide	must be in this order only	1 1	AO1 4.7.2.2 4.7.3.3 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$3\,700\,000 \times \frac{46}{100}$		1	AO2 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **one** from: • climate change • global warming	allow it is getting warmer	1	AO2 4.7.3.3 4.7.3.5

4.4.2.1 Aerobic and anaerobic respiration

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	building factories quarrying rocks		1 1	AO1 4.7.3.3

Total Question 1	**8**

4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Mark scheme

June 2025 | 8464/B/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	glucose		1	AO2 4.4.2.1 4.4.2.2
	oxygen		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	40 − 15		1	AO3
	25 (minutes)		1	AO2 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		allow a correct calculation given to 2 significant figures using person **A** for **2** marks		AO2 4.4.2.2
	$\frac{104-60}{60} \times 100$	allow $\frac{44}{60} \times 100$	1	
	73.3(3333333…)		1	
	73 (%)		1	
		allow **2** marks for $\frac{102 - 60}{60} \times 100 = 70$ (%)		
		allow **1** mark for 0.73		

4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **two** from: person **B** • has a lower resting heart rate • has a smaller increase in heart rate • has a lower maximum heart rate • reaches their maximum heart rate later • has a shorter recovery time	answers must be comparative allow converse if clearly referring to person **A** allow takes longer to reach their maximum heart rate allow takes a shorter time to reach resting heart rate allow has a lower oxygen debt if no other marks awarded allow **1** mark for person **B** has lower heart rate	2	AO3 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	suitable scale for *y*-axis	a bar height must use at least half of graph paper	1	AO2 4.4.2.2
	bars plotted correctly	allow a tolerance of $\pm \frac{1}{2}$ small square the bars can be in any order ignore the width of the bar ignore if bars are touching	1	
	bars labelled correctly	allow the use of a correct key	1	

4.4.2.1 Aerobic and anaerobic respiration

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	∝		1	AO1 4.4.2.2

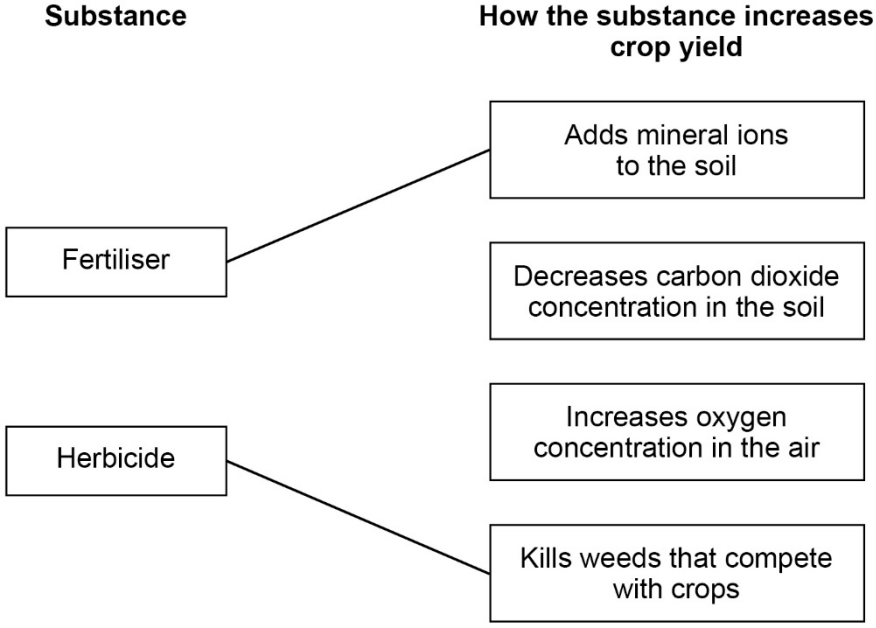
Total Question 4	**13**

4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Mark scheme

June 2025 | 8464/B/2F | Original Q2

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	 do **not** accept more than one line from a box on the left	1 1	AO1 4.7.1.1 4.7.1.2 4.7.3.2 4.6.2.4 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	owls		1	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	insects eat pests on the crop insects pollinate the crop		1 1	AO2 4.7.1.1 4.7.2.1

4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • as a habitat for (beneficial) insects / animals • to keep (larger) animals out **or** to keep people out • (to increase) biodiversity • to reduce wind speed • as a habitat for predators of crop damaging organisms • to prevent / reduce soil erosion	allow as a shelter / space for (beneficial) insects / animals allow to protect (the crop) from (larger) animals allow to protect (the crop) from people ignore keep insects / birds out ignore to protect the crop unqualified ignore to stop pests eating the crop allow to increase the number of insects / plants allow descriptions of increasing biodiversity allow act as wind break ignore to reduce pests unqualified ignore so more (crop) can be grown	1	AO2 4.7.3.6 4.7.3.1 4.7.1.1

4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5		allow converse if clearly referring to soil		
	water takes more time to drain (through)	allow there will be more water (in the peat compost) allow water drains / moves slow**er** allow water drains / moves more slowly ignore water drains slow / slowly	1	AO3 4.7.3.3
	(so) water is more likely to be taken up by plants **or** (so) do not need to water plants (as) frequently **or** (which is an advantage because) young plants cannot reach water that is deep (in soil / compost)	allow (so) there is more time for plants to take up water allow (so) reduces water use ignore references to cost allow **2** marks for water more likely to be taken up by plants before it drains away	1	

4.4.2.1 Aerobic and anaerobic respiration

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(A) respiration (B) photosynthesis	answer line takes precedence	1 1	AO1 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	(burning peat) releases / increases carbon dioxide (which) causes / increases global warming	allow (burning peat) releases / increases CO_2 ignore burning releases carbon do **not** accept peat contains carbon dioxide allow (which) is a greenhouse gas allow (which) causes the greenhouse effect ignore (which) causes / increases climate change	1 1	AO1 4.7.2.2 4.7.3.3 4.7.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	bacteria fungi		1 1	AO1 4.7.2.2 4.7.3.3

4.4.2.1 Aerobic and anaerobic respiration

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	farming (cattle / biofuel / crops / animals)	allow examples of farming a crop / animal allow building allow named type of building eg houses / factories allow mining allow landfill allow reforestation / rewilding	1	AO1 4.7.3.4

Total Question 2	**15**

4.4.2.1 Aerobic and anaerobic respiration

Answer 02 · Examiner comments November 2021 | 8464/B/1F | Original Q3

Question 3 (low & standard demand)

Ths question was about anaerobic respiration. Two of the questions tested understanding of the equation for fermentation. The equation shows that fermentation is anaerobic because there is no oxygen reacting with the glucose. Many students thought it showed an anaerobic reaction because carbon dioxide was being produced or being used. In a later question some students thought fermentation stopped because the carbon dioxide had all been used up. Few students knew that fermentation is used to make beer and wine because ethanol or alcohol is produced, but more said yeast is used to make bread because it makes the dough rise. Hardly any students linked this to the production of carbon dioxide.

Most students recognised that the steepest part of the graph represented when the rate of gas production was the fastest, but more than half thought that the horizontal line on the graph showed that gas production was slowing down, when it had actually stopped being produced. Two-thirds of students scored a mark for saying no carbon dioxide was being produced at 2 ºC because it was too cold, or because it was not hot enough. Some said the enzymes were denatured at 75 ºC. A tenth of students identified the names of both the reactant and the product for anaerobic respiration in animal cells. Many students wrote down more than one reactant or product.

Answer 03 · Examiner comments November 2021 | 8464/B/2F | Original Q3

Question 3 (low demand)

Many students could not give the food chain. Some students obtained one mark out of two for having the organisms in the correct order, but used dashes or commas instead of arrows. More students could give the primary consumer in the food chain. Reading from the graph was generally answered well. Fewer students could complete the sentences about evolution.

4.4.2.1 Aerobic and anaerobic respiration

Answer 04 · Examiner comments June 2023 | 8464/B/2F | Original Q1

Question 1 (Low demand)

01.1 Students were asked to identify why peat is removed from peat bogs. One-third of students were able to do this.

01.2 The most common correct answer for the name of one type of organism that causes decay was bacteria. Frequently seen incorrect responses included insects, or named insects. Either the question was not well read or there was frequent confusion that a gas was an organism, with various gases being named, perhaps as a result of question **01.3**.

01.3 The most common error was to confuse oxygen and carbon dioxide as a product and reactant in respiration, but all combinations of the words in the answer spaces were seen.

01.4 50% of students could identify how the percentage could be calculated.

01.5 Many students could state the reason as climate change or global warming. Incorrect or insufficient answers included 'they are melting', 'because they are decaying' (both of which are simply rephrasing what has been given in the question and not creditworthy), 'people are taking peat' and 'we aren't making them anymore'.

Some students had made the correct connection between the reduction of frozen peat bogs and temperature but were not awarded the mark as they had just said that temperature 'changes' or has 'changed over the years' which was insufficient as the 'change' could be colder temperatures.

01.6 Over 50% of students could identify two activities that decrease the area of land available for other animals and plants.

Question 2 (Low demand)

Answer 05 · Examiner comments

Question 4 (Low and Standard demand)

04.1 97% of students gained at least one mark, with 57% gaining both marks.

04.2 Some students correctly identified the region of the graph where the heart rate was elevated and sustained and used this to accurately calculate the exercise duration.

A significant number of students misinterpreted the graph. The most common error was to select the point where the heart rate had returned to its resting level and take that as the end of exercise, resulting in an incorrect answer of 35 minutes.

Others assumed that only the rising and falling sections of the graph indicated exercise or incorrectly believed that the period of maximum heart rate represented rest.

04.3 Most students completed the calculation correctly and rounded appropriately to two significant figures.

Most accurately identified both the maximum and resting heart rates from the graph and substituted these values into the correct formula. However, some students struggled with interpreting the *y*-axis scale, leading to the use of incorrect values.

The most commonly error was using 102 instead of 104 for person B's maximum heart rate. Similarly, some students incorrectly used person A's data. Both of these were able to gain compensatory marks. Only those alternative responses listed in the mark scheme were credited.

04.4 This question had good discrimination, over 66% of students gained 1 mark and over 27% gained both marking points.

To gain credit, students needed to make comparative statements using data from the graph. For example, 'Person A has a resting heart rate of 86, but Person B's resting heart rate is lower at only 60' would be awarded 1 mark as it is clearly comparative.
In general, 'lower resting heart rate' and 'lower maximum heart rate' for person B were the most common correct answers. The converse was also acceptable, such as 'Person A has a higher resting heart rate'.

Responses such as 'the heart rate came down faster' or 'went up slower' were too vague unless they clearly referenced before and after exercise or specified resting or maximum heart rate. Similarly, references to the time spent exercising or time taken to reach maximum heart rate did not gain credit.

The strongest responses used clear, comparative language and focused on key measures of fitness such as resting heart rate, maximum heart rate or recovery time — phrased with reference to either before or after exercise.

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4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Examiner comments June 2025 | 8464/B/1F | Original Q4

0 4 . 4 A student stated:

'Person **B** is fitter than person **A**.'

Give **two** pieces of evidence to support the student's statement.

Use **Figure 8**.

[2 marks]

1 their heart rate goes upto 104 maximum whereas Person A goes upto 136 bpm

2 Person B's resting heart rate is 60 whereas person A's is 86 bpm

This response was awarded 0 marks. The student simply quotes data taken directly from the graph without making any comparative statements.
To gain credit, the response needed to go beyond quoting figures and make a clear comparison—for example, stating that 'Person A's heart rate increases to a maximum of 104 bpm, whereas Person B's goes up to a higher rate of 136 bpm.'
This was a common issue across responses, where students showed they could extract relevant data but did not develop their answers to include the comparative language required by the question.

04.5 73% of students gained more than two marks on this question. Students who chose a suitable linear scale generally went on to plot and label their bars correctly.

The most common issue was selecting an appropriate scale for the *y*-axis. A significant number of students used non-linear scales, such as 0, 5, 10, 20, 30, which made it difficult to plot accurate bars. Others chose unsuitable interval sizes, such as attempting to scale by 4.4 arbitrary units per centimetre, which led to considerable difficulty in producing consistent or readable graphs.
Some students also used overly simplistic scales, such as intervals of 10, which did not allow for appropriately sized or well-distributed bars.

In addition to scale errors, a number of students mislabelled their bars, mixing up categories or omitting labels entirely. A fairly large proportion also used incorrect graph types, such as scatter graphs or line graphs, instead of the required bar chart.

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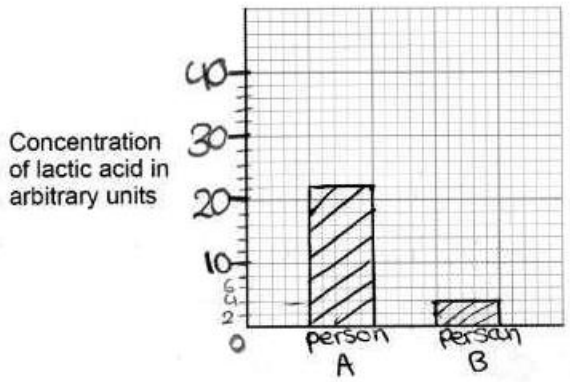
4.4.2.1 Aerobic and anaerobic respiration

Answer 05 · Examiner comments



This response was awarded 2 marks and is a typical example of a student who selected a scale that was too small to make full use of the graph space. Despite this, the student correctly plotted the bars according to their chosen scale and accurately labelled each bar.

While the scale limited the clarity and precision of the graph, the technical accuracy of the plotting and labelling met the requirements for 2 marks. This was a common pattern across responses where students demonstrated sound graphing skills but lost marks due to poor scale selection.

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Answer 06 · Examiner comments

June 2025 | 8464/B/2F | Original Q2

Question 2 (Low and Standard demand)

02.1 The correct role of fertiliser was seen more frequently than that of herbicide, but many students did not seem familiar with either term.

02.2 Fewer than half of students could identify the secondary consumer in the food chain. 'Mice' was the most commonly selected answer, presumably with students focussing on the 'secondary' rather than understanding the term 'secondary consumer'.

02.3 Most often, students could identify that insects pollinating the crop would increase yield, but fewer students realised that insects eating pests on the crop would also increase crop yield.

02.4 Many students gave a correct suggestion about why farmers increase the size of hedgerows. Most frequently this was the idea of keeping animals or people out or increasing the number of insects. Reponses suggesting that this gives more space for crops to grow was a frequent misconception, along with incorrect ideas of what hedges are and how much of a barrier they represent, for example, preventing insects passing through or preventing the spread of disease. Some students mistakenly thought hedgerows would keep birds out. Overall, there was a lack of appreciation for the role of hedgerows in increasing biodiversity.

02.5 Student can never be given credit to repeating information in the question, so statements such as 'the water drains slow' could not be awarded mark point 1. If students went a little further to state that 'the water drains more slowly', the response was then comparative and the mark could be awarded.

Peat comes from peat bogs.

0 2 . 5 Peat can be used to produce garden compost.

Table 1 compares peat compost with a sample of soil.

Table 1

	Mineral ion concentration	Speed at which water drains through
Peat compost	Low	Slow
Soil	High	Fast

Young plants have short roots.

Explain **one** advantage of growing young plants in peat compost instead of in soil.

[2 marks]

They have a low mineral ion concentration
A slow speed at which water drains
through.

This student has not added any information that is not taken directly from Table 1, therefore no marks could be awarded. If the student had stated 'A slower speed at which water drains through' then the mark would be awarded for that comparative response.

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4.4.2.1 Aerobic and anaerobic respiration

Answer 06 · Examiner comments June 2025 | 8464/B/2F | Original Q2

02.6 'Transpiration' was frequently given as an incorrect answer. Presumably because students are more familiar with plants transpiring, than with plants respiring.

02.7 Students were provided with the information that peat contains carbon compounds and that burning peat contributes to climate change. Therefore, neither of those ideas could be awarded credit. The most common response that did not gain credit was that 'burning peat releases carbon and contributes to climate change'. Some students were incorrectly linking carbon dioxide with the ozone layer.

02.8 Nearly 50% of students could identify that both bacteria and fungi cause decay. The most common incorrect answer was 'algae'.

02.9 The wide mark scheme indicates the many and varied ways that students could answer this question. All the ideas on the mark scheme were seen. When the mark was not awarded, this was usually because students had not read or understood the question and they responded in terms of 'fewer trees giving out oxygen'.