AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.2.2.2

The heart and blood vessels

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**6**
Available paper years	**2018–2025**

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.

4.2.2.2 The heart and blood vessels

Answer 01 · Mark scheme June 2018 | 8464/B/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	is not caused by a pathogen / infective organism	allow not caused by a microorganism / microbe ignore not caused by infection ignore named pathogen unless bacteria, virus and fungus all mentioned	1	AO1 4.2.2.4 4.2.2.5 4.3.1.1 4.3
	(so) is not passed / spread (from person to person)	allow cannot be spread / caught allow is not infectious / contagious	1	AO2 4.2.2.4 4.2.2.5 4.3.1.1 4.3
02.2		allow 'it' for heart		AO1 4.2.2.4
	reduced / restricted / stopped blood flow	it does not matter where blood flow is restricted to – heart / body	1	
	(so) less oxygen reaches heart (muscle / cells)	must reference heart / it allow no oxygen reaches the heart (muscle / cells)	1	
	(so heart muscle / cells) cannot respire (enough)		1	
	or (so heart muscle / cells) do not release (enough) energy	do **not** accept do not make / produce / create energy ignore references to breathing / suffocation ignore blood clots / blockages		

4.2.2.2 The heart and blood vessels

Answer 01 · Mark scheme

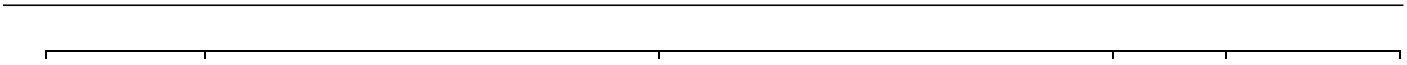
June 2018 | 8464/B/1H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** Relevant points (factors / effects) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (factors / effects) are identified and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content **medical risk factors:** • high blood pressure • high cholesterol • diabetes • genetic factors • medications **lifestyle risk factors:** • smoking • obesity • lack of exercise • high fat / energy diet • eating insufficient fruit / vegetables • alcohol • high salt intake • exposure to air pollution • certain drugs / correct named drug **examples of links:** • smoking – high bp / cholesterol / fatty deposition • obesity – lack of exercise / high bp / cholesterol / fatty deposition / diabetes • exercise – obesity / bp /diabetes • diet – obesity / cholesterol / diabetes • alcohol – bp / cholesterol • high salt intake - high blood pressure • genetic factors – bp / cholesterol / diabetes / obesity • medication – can affect blood / blood vessels / metabolism the main discriminator is the quality of linking both lifestyle and medical factors are required for **level 3**		4.2.2.2 4.2.2.4 4.2.2.5 4.2.2.6
Total			**11**

4.2.2.2 The heart and blood vessels

Answer 01 · Mark scheme

June 2018 | 8464/B/1H | Original Q2



4.2.2.2 The heart and blood vessels

Answer 02 · Mark scheme June 2019 | 8464/B/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	**B**		1	AO2 4.2.2.2
01.2	right atrium		1	AO1 4.2.2.2
01.3	foxgloves		1	AO1 4.3.1.9
01.4		an answer of 54 (cm^3) scores 3 marks		AO2 4.2.2.2
	X = 2800 / 52		1	
	53.846153		1	
	54 (cm^3)	allow correct rounding of an incorrectly calculated value of stroke volume	1	

4.2.2.2 The heart and blood vessels

Answer 02 · Mark scheme

June 2019 | 8464/B/1H | Original Q1

Question	Answers	Mark	AO / Spec. Ref.
01.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3 4.2.2.2 4.2.2.4 4.4.2.1 4.4.2.2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content effect of exercise • during exercise body needs to transfer (more) energy • energy transferred during respiration • rate of respiration increases during exercise • (so) more oxygen is needed effect of beta blockers • beta blockers reduce (the increase in) heart rate (during exercise) • beta blockers reduce stroke volume (or described) • beta blockers reduce cardiac output • (so) heart cannot supply oxygen fast enough / in sufficient quantity to muscle cells effect on breathing rate • breathing rate increases to increase rate / amount of oxygen absorbed • breathing rate increases to increase rate / amount of carbon dioxide removed from body • (but) increased breathing rate cannot fully compensate for changes in heart function A level 3 response should make links between all three sections of indicative content A level 2 response should attempt to link effect of exercise with oxygen / energy requirement **and** beta blockers to effect on heart function. .		
Total		**12**	

4.2.2.2 The heart and blood vessels

Answer 02 · Mark scheme

June 2019 | 8464/B/1H | Original Q1



4.2.2.2 The heart and blood vessels

Answer 03 · Mark scheme

June 2022 | 8464/B/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	it is made up of (different) tissues (that perform specific functions)		1	AO1 4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	some blood would flow back into the ventricle / heart	allow not all the blood would leave the ventricle / heart allow blood clot (may form in the heart) do **not** accept blood would flow back into the right ventricle	1	AO2 4.2.1 4.2.2.2 4.2.2.4 4.4.2.1
	(so) less oxygenated blood would be pumped to the body	ignore references to glucose	1	
	cells require oxygen for respiration **or** less aerobic respiration	allow more anaerobic respiration	1	
	(so) person would become out of breath **or** (so) less energy transferred **or** (so) person would be tired	(so) lactic acid will build up allow the idea of lacking energy do **not** accept less energy produced / made / created	1	

4.2.2.2 The heart and blood vessels

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any **four** from: (advantages of biological valve): • reduced risk of blood clots which could cause heart attack or stroke • reduced risk of blood clots during pregnancy / birth • reduced risk of bleeding during pregnancy / birth • do not need to take anti (blood) clotting drugs • no risk to foetus / baby from drugs • reduced risk of serious bleeds if in an accident • do not need to carry (anti-blood clotting) drugs when travelling • lower risk of rejection / immune reaction (disadvantages of biological valve): • may be rejected • may have to go through surgery more than once • may have to take immunosuppressant drugs • have to wait for (suitable) donor	max **three** marks if only advantages or disadvantages of biological valve given ignore do not need to take blood thinners allow do not need to take drugs for life allow problems related to losing / obtaining drugs when travelling do **not** credit reference to rejection twice allow no risk of side effects from drugs do **not** credit reference to rejection twice ignore risks from surgery unqualified allow an animal might be killed	4	AO3 4.2.2.2 4.2.2.3 4.2.2.4

Total Question 6		9

4.2.2.2 The heart and blood vessels

Answer 04 · Mark scheme

June 2023 | 8464/B/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	right ventricle pumps blood to the lungs left ventricle pumps blood around / to the body	allow right side of heart pumps blood to the lungs allow left side of heart pumps blood to the body if no other marks awarded allow **1** mark for: (two circuits / pumps) one from heart to lungs **and** one from heart to body **or** blood passes twice through heart on each circuit	1 1	AO1 4.2.1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	right atrium		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	pulmonary artery		1	AO1 4.2.2.2

4.2.2.2 The heart and blood vessels

Answer 04 · Mark scheme

June 2023 | 8464/B/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	valves prevent backflow of blood	allow valves prevent blood from flowing in the wrong direction	1	AO1
	(because) blood (in veins) is at lower pressure / force (than in arteries)	allow (because) blood travels more slowly (through veins than arteries) allow converse statements eg blood in arteries is at higher pressure (1) (so) do not need valves to prevent backflow (1)	1	AO3 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	any **two** from: • lumen in vein is wider (than in an artery) • (wall of vein) has a thinner layer of muscle (tissue) • (wall of vein) has a thinner layer of elastic tissue	answers must be comparative allow converse statements ignore reference to valves if neither mark awarded allow **1** mark for: veins have thinner walls (than arteries) do **not** accept reference to cell wall	2	AO1 4.2.2.2

Total Question 3	8

Answer 05 · Mark scheme

June 2024 | 8464/B/1H | Original Q7

Question 7

Question	Answers	Mark	AO / Spec. Ref
07	**Level 3:** Relevant points (factors / effects) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (factors / effects) are identified and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	4.2.2.4 4.2.2.6 4.4.2.1 4.4.2.2
	Indicative content **causes of angina / CHD:** • high cholesterol / fat (in blood / diet), obesity • a lack of exercise • smoking / alcohol • increasing age • a family history of atherosclerosis or heart problems **explanation of symptoms:** • fatty deposits in coronary arteries • narrowing of the coronary arteries • reduced blood / oxygen / glucose to the heart (muscle / tissue / cells) • reduced blood / oxygen / glucose to the body • less oxygen / glucose for respiration • less energy released • (more) anaerobic respiration • lactic acid formed • muscle fatigue **treatment using GTN:** • more blood to the heart (muscle / tissue / cells) • more oxygen / glucose to the heart (muscle / tissue / cells) • increased (aerobic) respiration For **Level 1** explanation(s) of the symptoms of angina **or** the treatment using GTN must be included For **Level 3** explanations must include the causes of angina, explanations of the symptoms of angina and treatment using GTN		

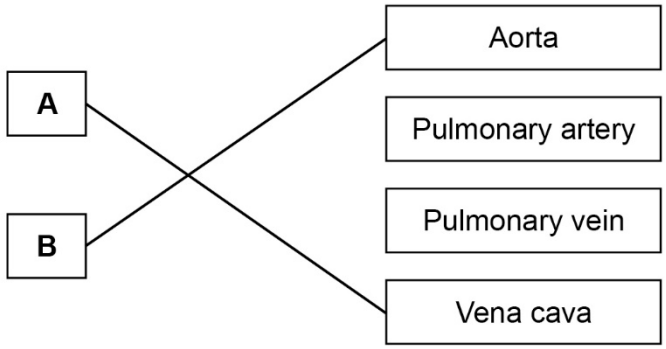
Total Question 7	**6**

4.2.2.2 The heart and blood vessels

Answer 06 · Mark scheme

June 2025 | 8464/B/1H | Original Q1

Question 1

Question	Answers	Mark	AO / Spec. Ref.
01.1	Blood vessel / Name  do **not** accept more than one line from a box on the left	1 1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	F		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(more) respiration (in mitochondria)	do **not** accept anaerobic respiration	1	AO2
	(which) releases more energy	allow (muscles) need more energy do **not** accept energy produced / made / created do **not** accept provides more energy for respiration	1	AO2
	(so the heart) muscle <u>contracts</u>		1	AO1 4.2.2.2 4.4.2.1 4.1.1.2

4.2.2.2 The heart and blood vessels

Answer 06 · Mark scheme

June 2025 | 8464/B/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	any **two** from: • fast / increased heart rate • fast / increased breathing (rate) • tiredness • pale skin • heart attack • difficulty exercising • difficulty gaining weight	 allow irregular heartbeat ignore shortness of breath allow fatigue allow blue skin (due to poor oxygenation) allow cold / cool skin (to the touch) allow cyanosis allow blood clots allow chest pain allow stroke allow increased sweating allow frequent chest infections allow swelling in legs / feet / abdomen	2	AO3 4.2.2.2

4.2.2.2 The heart and blood vessels

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **two** from: • heavy / internal bleeding • infection • damaging blood vessels • damaging the heart • risk from anaesthetic • risk of rejection (of the mesh / tube)	allow named infection e.g. MRSA ignore risk of disease allow blood clots allow stroke allow heart attack allow irregular heartbeat ignore damage unqualified	2	AO3 4.2.2.2

Total Question 1	10

4.2.2.2 The heart and blood vessels

Answer 01 · Examiner comments

June 2018 | 8464/B/1H | Original Q2

Question 2 (standard demand)

02.1 Few students scored the first marking point for saying that a non-communicable disease is not caused by a pathogen. Some students gave examples of non-communicable diseases, such as CHD, diabetes and cancer. Others gave a cause, such as genetics, lifestyle or diet. These were ignored.

89% of students achieved one mark, usually for saying a non-communicable disease cannot be caught or is not infectious. 5% of students achieved full marks.

02.2 The majority of students gained the first marking point for stating that blood flow is reduced in people with CHD.

For the second marking point it had to be clear that this would result in less oxygen reaching the cells of the heart, as the question asked how CHD can cause a heart attack. Many students wrote about less oxygen reaching other parts of the body.

The last marking point needed a link to less respiration or insufficient energy release. Students often incorrectly referred to less energy being made, created or produced.

There were very few three-mark answers seen (2%). Of these, some gave a complete story linking reduced respiration to there being insufficient energy released for the heart muscle to contract.

4.2.2.2 The heart and blood vessels

Answer 01 · Examiner comments June 2018 | 8464/B/1H | Original Q2

02.3 This was a 'level marked', 'extended response question'. The command word was 'Explain', so the main discriminator between the three different levels was the quality of linking ideas. Students were asked to explain how lifestyle and medical risk factors increase the chance of developing CHD. Therefore examples of both types of factor had to be included, with several examples of logical linking of ideas, in order to enter level 3. 77% of students achieved a minimum of three marks. 41% of students gave a level 3 response.

Many students phrased their response in terms of how to reduce the chance of developing CHD, which could achieve full credit if explanations were included. References to doing exercise and not eating too many fatty foods were often seen, but if these were not linked to explanations the answer was limited to level 1. References to bad or unhealthy diets were too vague without going on to mention high levels of fat, sugar or salt.

An answer such as a fatty diet and not enough exercise can lead to obesity, which increases the chance of CHD, gained 3 marks as there is an attempt to link ideas. To be awarded 4 marks better links had to be made, or more factors referred to. Smoking and alcohol consumption were sometimes mentioned. With reference to smoking, a number of students were under the impression that smoking leads to the build-up of tar in the coronary arteries.

Many responses were limited to level 2 because there was no reference to any medical risk factors. Where medical factors were included it was often in relation to diabetes or genetic factors. A family history of heart problems was sufficient for this idea. High blood cholesterol was sometimes given as a medical risk factor.

Answer 02 · Examiner comments June 2019 | 8464/B/1H | Original Q1

Question 1 (standard demand)

01.1 Around 64% of students correctly identified the blood vessel that carries deoxygenated blood away from the heart to the lungs. The most common incorrect response was vessel C, which carries oxygenated blood away from the heart to the body.

01.2 Around 37% of students knew that pacemaker cells are found in the right atrium. Almost as many students thought that these cells are found in the left ventricle.

01.3 Half of the students knew that digitalis originates from foxgloves. The most common incorrect response was willow.

4.2.2.2 The heart and blood vessels

Answer 02 · Examiner comments June 2019 | 8464/B/1H | Original Q1

01.4 Around 72% of students gained full marks for calculating stroke volume and correctly rounding their answer to two significant figures. More students are showing their working for calculations which helps them achieve compensation marks should their final answer be incorrect.

The first marking point was for reorganisation of the equation. This could be written in words, but writing out the equation as a triangle was not creditworthy. 96% of students gained two or more marks. This was usually for the first two marking points. There were some errors seen in the rounding of the answer, either to 53 or to more than two significant figures.

01.5 Around 13% of students gave a detailed account and achieved Level 3 in this extended response question. They logically linked the effect of beta blockers to the supply of oxygen to respiring muscles, and the need to breathe faster or deeper. Some went on to explain that anaerobic respiration might occur, leading to a build-up of lactic acid and an oxygen debt.

Half of the students were limited to a Level 2 response because they did not explain why the breathing rate would need to increase.

Answer 03 · Examiner comments

June 2022 | 8464/B/1H | Original Q6

Question 6 (standard, standard/high & high demand)

06.1 42% of students scored the mark for saying the heart is an organ because it is made up of different tissues working together. Some said it is made up of similar tissues, which was ignored.

06.2 Students were asked to explain the effect that a leaky heart valve would have on a person. 56% of the students scored at least one mark, which was usually for saying that some blood would flow back into the heart. If the wrong chamber was named then this mark could not be awarded. As the question required an explanation the remaining marks had to link logically, so just saying the person would get tired was insufficient.

06.3 Information about biological and mechanical heart valves was given in the question. When describing advantages and disadvantages of the biological valves, the student had to add some value to the information provided. Saying that biological valves have a reduced risk of blood clots adds little to the information given, so is not creditworthy. Something extra had to be added, as detailed in the mark scheme, as the question was set at high demand.

The advantage of a biological valve that the woman would not need to take anti-blood clotting drugs was often given, but reference to blood thinners was insufficient. If students just said ‘they wouldn’t have to take drugs’ this had to be qualified by adding ‘…for life’.

The disadvantage that the valve may be rejected was seen, and saying that it is unethical to use valves from animals was allowed.

Some students evaluated the use of biological and mechanical valves. To score marks they had to make the advantages and disadvantages for a biological heart valve over a mechanical valve clear.

4.2.2.2 The heart and blood vessels

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.2.2.2 The heart and blood vessels

Answer 04 · Examiner comments June 2023 | 8464/B/1H | Original Q3

Question 3

03.1 Very few students scored both marks for describing what is meant by a double circulatory system. More than a third scored 1 mark for saying the heart pumps blood to the lungs to be oxygenated, and then to the body, without reference to the sides of the heart. A few confused which side of the heart pumps blood to the lungs, and which side pumps blood to the body, so were limited to 1 mark.

03.2 Fewer than half the students correctly named the right atrium as where the pacemaker is located. Incorrect responses included the other chambers of the heart, as well as the blood vessels associated with the heart.

03.3 Three fifths of students identified the pulmonary artery as the vessel that carries deoxygenated blood. The pulmonary vein was the most common incorrect response chosen by a quarter of students.

03.4 More than two thirds of students scored 1 mark for saying that valves in veins prevent the backflow of blood. A quarter of students scored both marks by going on to explain why valves are present in veins but not in arteries. A comparative statement about blood pressure in the two types of vessel was needed to score the second mark.

Answer 04 · Examiner comments June 2023 | 8464/B/1H | Original Q3

03.5 When comparing the structure of a vein to that of an artery comparative statements were needed. Many students just gave a simple description of one of the vessels, such as an artery has a thick wall. Three fifths of students gained at least 1 mark, but only a fifth of students scored both marks. The most common correct responses were for saying a vein has a wider lumen and an artery has a thicker wall. There were very few references to muscle or elastic tissue in the walls. Quite a lot of students compared the blood pressure, direction of blood flow or gases dissolved in the blood of veins and arteries. As these are not structural differences they were not creditworthy. References to size or surface area of the vessels were ignored.

Answer 05 · Examiner comments

June 2024 | 8464/B/1H | Original Q7

Question 7 (standard/high & high demand)

07 This was an 'extended response' style of question and is marked holistically. There are overall generic descriptions for the three levels of response at the top of the mark scheme, giving a hierarchy of responses. Within each level there are 2 marks.

This question was generally not well answered although 98% of students made an attempt, there were some very good responses, with 39% gaining 3 or more marks. However, many students only gave part of the story and therefore were limited in the level they could achieve with less than 3% giving a Level 3 response.

The question was in the context of angina and reduced blood flow to the heart. Some students referred to complete blockages rather than a narrowing of the coronary artery, which was incorrect for this context and the level of demand of the question.

For Level 1 students needed to give an explanation of the effects of angina. Many students *only* referred to the causes of angina, which was insufficient at this level and so gained no marks; however, where students gave an explanation linked to the causes this was then given credit.

To enter Level 2 students needed to link two of their ideas together: for example, 'fatty deposits in the coronary artery lead to reduced blood flow to the heart'. However, many students were not able to articulate where the reduced blood flow was to, limiting their response to Level 1. Some students gave excellent explanations of angina and how the treatment worked but then did not give any causes of angina, which limited their response to Level 2.

Some students stated that GTN spray acted as a stent despite being told in the stem that it widens the coronary arteries. Others just repeated the stem of the question without explaining how widened arteries would help reduce the symptoms.

Very few students could link the idea that the coronary arteries supply the heart with blood/oxygen which results in less respiration ultimately reducing blood flow around the body leading to muscle fatigue.

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4.2.2.2 The heart and blood vessels

Answer 05 · Examiner comments June 2024 | 8464/B/1H | Original Q7

0 7 Angina is a condition many people get as coronary heart disease (CHD) develops.

Angina can cause chest pain and tiredness.

People with angina are sometimes treated with a drug called GTN.

GTN widens the coronary arteries.

Explain:

- the causes and symptoms of angina
- how GTN reduces the symptoms of angina.

[6 marks]

people who eat more saturated fatty foods, allows more plaque to build up in the coronary arteries, this causes the blood to clot, so less oxygenated blood carried to the heart, so less respiration can occur in cells resulting in more anaerobic respiration causing muscle fatigue, so less oxygenated blood pumped around the body so less blood to cells causing tiredness. Another cause is excessive alcohol use, which results in high blood pressure so more clots due to plaque build up. By taking GTN, the arteries are widened to allow more oxygenated blood carried to the heart so more diffusion occurs, so more respiration occurs, so less fatigue as less anaerobic respiration takes place, and more oxygenated blood carried to body cells for growth and repair and to carry more energy to cells.

In this response, the student clearly gives symptoms of angina, an excellent explanation of the cause of angina and an excellent explanation how GTN reduces these symptoms. This is a top Level 3 answer and gained 6 marks.

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4.2.2.2 The heart and blood vessels

Answer 05 · Examiner comments

June 2024 | 8464/B/1H | Original Q7

Contact us

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4.2.2.2 The heart and blood vessels

GCSE

Combined Science: Trilogy

8464/B/1H Combined Science: Trilogy Biology Paper 1H

Report on the exam

Published: August 2025

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Overview

This paper is one of the six examined components for Combined Science: Trilogy. All of these papers follow a similar structure and test the same assessment objectives.

This paper has 70 marks available to students and is made up of six questions.

- Approximately 40% of marks assess AO1; 40% of marks assess AO2; and 20% of marks assess AO3.
- Approximately 40% of marks target Standard demand, 40% of marks target Standard/High demand and 20% of marks target High demand.

Questions 1 and 2 on this paper and questions 5 and 6 on the Foundation Tier paper are common. These questions are identical and are targeted at Standard demand.

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/High demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade is based on their attainment across all six papers.

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4.2.2.2 The heart and blood vessels

Summary of overall performance

Overall, students performed well on factual recall questions and straightforward mathematical calculations, whereas extended responses and the application of knowledge to unfamiliar contexts proved more challenging.

Strongest performance was observed in questions that tested basic recall or calculations. This was most noticeable in Questions **01.1**, **02.1** and **02.2**.
Students also performed well in the mathematical elements of the paper, particularly in **06.3** and **06.5**, where they demonstrated confidence in calculations involving standard form and percentages.

Moderate performance was seen in questions requiring straightforward application of knowledge, such as in **02.4**, and in **03.2**. Questions **05.2** and **06.1**, were also quite well answered by a significant proportion of students.

In contrast, a number of questions revealed significant difficulties for students, such as in **01.3**.
The extended response in **02.5** proved particularly challenging, as many students could describe the primary immune response but struggled to explain the secondary response in sufficient detail. Similarly, in **03.4** and **04.1**, students often gave imprecise answers which often lacked explanatory detail.

It is vital that students read all the information in each question and use it appropriately in their answers. Understanding the meaning of command words is particularly important. For example, ‘explain’ and ‘evaluate’ were often interpreted as ‘state’ or ‘describe’, leading to students missing out on marks. Question **06.6** was a notable example of this.

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Question 1 (Standard demand)

01.1 This question was generally well answered. A significant proportion of students (48%) achieved both marking points, demonstrating strong understanding of the topic. Many responses showed accurate labelling and good recall of the key blood vessels associated with the heart.

Where only one mark was awarded, this was most commonly for the correct identification of the vena cava.

01.2 61% of students gained the mark for this question.

01.3 This question was generally well answered, with most students recognising the involvement of respiration. However, many did not explain that more energy was required, and the misconception that energy is 'produced' rather than 'released' in the mitochondria was common.

Only a small proportion demonstrated understanding that the heart muscle needs to contract, with few using this precise term. Confusion between the processes of respiration and breathing was common.

Overall, 35% of students achieved two or more marks, while only 7% gained full marks. Most gained partial credit for identifying respiration but struggled to explain how energy is used by the heart.

01.4 This question was well answered, with 71% of students gaining at least one mark. Tiredness and chest pain were the most frequently identified symptoms.

Some responses repeated the same idea using different wording, for example 'heart attack' and 'blood clot'. Terms such as 'heart murmur' or 'palpitations' were credited as irregular heartbeat, while 'heartburn' was not.
Descriptions of increased breathing rate were often too vague, and few students mentioned pale skin.

01.5 This question was generally well answered, with over 80% of students gaining at least one mark. Many correctly identified infection or rejection as valid risks, while fewer mentioned the risk from anaesthetic.

Weaker responses often rephrased the question, giving vague statements such as 'there is a risk from surgery', which were not creditworthy. Some students speculated about long-term outcomes, for example 'the heart tissue not growing' or 'the patch being too small'. These were outside the scope of the question and not accepted.

Answers referring to bleeding had to make clear that it resulted from the operation and involved a significant loss of blood, with terms such as 'heavy blood loss' being credited. General references to 'risk of disease' were also not sufficient.

Descriptions such as the heart being punctured or stopping were credited as examples of damage to the heart, but unqualified terms like 'harming the heart' or 'death' were not.

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Question 2 (Standard demand)

02.1 This question was very well answered, with 95% of students correctly identifying touch or direct contact as a method of transmission. Many also referred accurately to coughing, sneezing, or droplets, which were credited.

Vague examples like hugging or playing together were not creditworthy, as they did not clearly imply skin-to-skin contact. In contrast, examples such as kissing, high fives, or transmission via contaminated surfaces like shared towels were accepted.

02.2 This question was very accessible, with many students correctly stating that antibiotics are used to treat bacterial infections.

A common misconception was the claim that chickenpox is not a virus, revealing a misunderstanding of the nature of the disease. References to 'it' were interpreted as referring to chickenpox and were credited where appropriate.

02.3 Many students correctly referred to dead pathogens, which was creditworthy. However, vague answers such as 'dead cells', 'dead disease', or 'dead chickenpox' were not accepted, as students needed to identify that it was the pathogen, not the disease itself, used in the vaccine.

Unqualified statements such as 'a small amount' were insufficient unless clearly linked to the dead pathogen or the antigen. Terms such as 'inert' or 'dormant' were accepted as synonymous with inactive when applied correctly to the pathogen.

02.4 This question was generally well answered, with 87% of students gaining at least two marks. Many demonstrated a clear understanding of the concepts being assessed.

Errors most often arose from repeating the same idea using different wording, for example stating that the drug was tested 'to check for toxicity' and 'to check for side effects'. These were treated as equivalent and not credited twice. References to allergic reactions were also accepted as side effects, and statements such as 'to check it doesn't kill the person' were credited as showing awareness of the ultimate risk.

Terms such as 'efficient' and 'effective' were accepted as equivalent to efficacy. However, references to 'reliability' or 'accuracy' were not sufficient, as they do not directly address whether the drug works as intended. Overall, this was an accessible question, though more precise language would have improved some responses.

02.5 This extended response question was assessed holistically. Many students demonstrated a clear understanding of the primary immune response, often describing in detail how white blood cells produce specific antibodies. These responses typically met the criteria for Level 2, with 50% of students achieving this level.

Fewer students were able to describe the secondary immune response in sufficient detail to reach Level 3, with only 10% achieving this. Stronger answers successfully linked features such as the faster production of antibodies and the role of memory cells in enabling a quicker, more effective response. High-level responses also referred to the production of complementary antibodies and explained how this led to a rapid destruction of pathogens. Statements such as antibodies being 'produced sooner' were creditworthy, while vague phrases such as pathogens being 'fought off quickly' were not.

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4.2.2.2 The heart and blood vessels

The function of white blood cells was generally well understood, and many students correctly described antibody production. However, credit for specificity required clarity that the antibodies produced were complementary or specific to the pathogen or its antigens. Simply stating that antibodies were produced was insufficient.

Confusion between antigens and antibodies was common and often affected the accuracy of responses. Overall, while the primary response was well described by most students, a lack of detail about the secondary immune response prevented many from progressing beyond Level 2. This question highlighted that the secondary immune response remains an area of weakness for many.

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4.2.2.2 The heart and blood vessels

Source appendix · Full source examiner report

0 2 . 5 Explain how a vaccine for chickenpox gives immunity against the disease.

You should refer to how the body responds to:

- the vaccine
- chickenpox pathogens that enter the body after vaccination.

[6 marks]

A Chickenpox Vaccine contains a dead or inert pathogen. This is then injected into the patients bloodstream. This causes the immune System to react to the new foreign pathogens. Lympho -cytes (White blood cells) ~~target~~ produce antibodies which are Specific to the antigens on the surface of the pathogen and then memory cells remember what antibodies to produce for the particular antigens of the bacteria. Thus, if you are actually injected you can produce antibodies quicker and kill the pathogens

Extra Space

This response was awarded 4 marks but had the potential to reach 6 with slightly more detail. The initial explanation of what a vaccine is was ignored, as this was assessed in a previous question.
The student correctly states that white blood cells produce antibodies, which satisfies the requirements for Level 2 and earns 3 marks. They further add that the antibodies are specific to the antigens—this additional piece of indicative content increases the mark within Level 2.

Credit is given for the mention of memory cells, and the student continues by stating that antibodies are produced more quickly upon infection. While this begins to reference the secondary response, it lacks a second linked idea, such as explaining that pathogens are destroyed more rapidly. Had this been included, the response could have progressed into Level 3, with up to 6 marks awarded.

This example reflects a common pattern seen on the Higher Tier, students providing accurate information but not developing it fully enough to access the Level 3 marks.

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Question 3 (High demand)

03.1 58% of students were awarded the mark for this question.

03.2 This question differentiated well between students of varying ability. Most were able to gain the first two marks by correctly selecting two distances from the graph that doubled and applying the inverse square law. A small number of students selected distances that did not double, such as 10 cm and 60 cm, which prevented them from achieving the calculation marks.

A few students used the incorrect formula 1/d rather than $1/d^2$, resulting in no credit. Others referred to the rate of oxygen production rather than calculating light intensity, which was also not credited. However, the majority used the correct formula and expressed their answers in an acceptable form.

Stronger answers correctly stated that light intensity 'decreases by a factor of four' or an equivalent phrase. Many, however, gave only vague statements such as 'light intensity decreases as distance increases', which were insufficient. A small number incorrectly stated that intensity 'reduced by 25%'.

03.3 This question was generally well answered, with 54% of students achieving at least one mark. Many correctly described that an increase in temperature leads to a higher rate of photosynthesis or faster oxygen production. Responses referring to the 'rate of bubble production' were credited, as the bubbles were identified as oxygen in the figure. However, answers that only mentioned an increase in oxygen volume or used vague terms such as 'rate of reaction' without linking this to photosynthesis were not sufficient.

Although many students described an 'increase of energy', It was often unclear what had more energy and vague statements about an energy increase for 'the plant' were not creditworthy. The idea of *more frequent* collisions was generally not well described. Responses that referred only to collisions, without further qualification did not gain credit.

Overall, most students gained at least one mark. However, only a minority demonstrated the particle-level understanding required to achieve full marks.

03.4 This question was challenging, with only 37% of students gaining at least one mark. References to other limiting factors, such as carbon dioxide, were not credited.

Many students correctly stated that high temperatures lead to less oxygen production, but only those who linked this to enzyme denaturation gained full marks. Responses that referred vaguely to cells or pondweed being denatured were not accepted.

Incorrect answers often suggested that oxygen production would increase or remain unchanged. Some students gave irrelevant points about experiment accuracy, which were not creditworthy.

Overall, while many achieved partial marks, few used precise biological terminology or explained the cause-and-effect relationship needed for full credit.

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Question 4 (Standard and High demand)

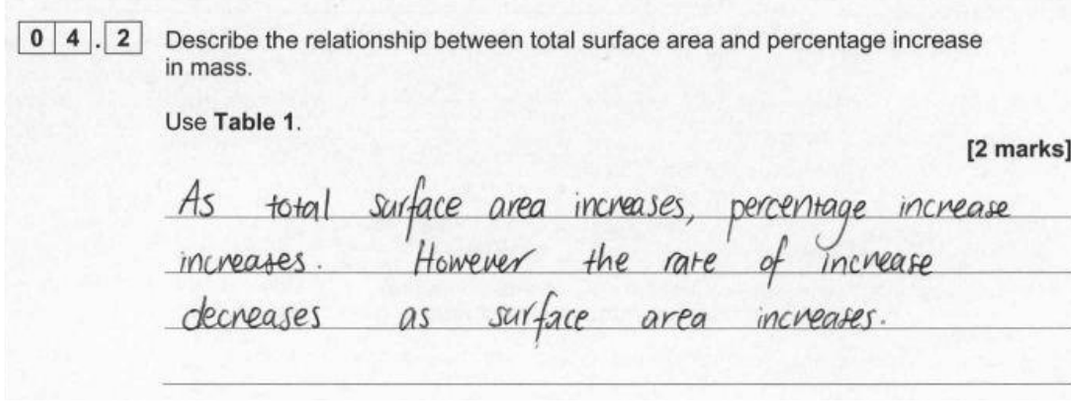
04.1 To gain credit, students needed to state that the potato pieces had different *starting* masses, making answers such as 'they have different mass', insufficient.

References to precision, accuracy, or comparability were not credited unless clearly linked to the variation in starting mass. Few students fully explained why using percentage change is more valid, with many giving vague responses such as 'more accurate' or 'more reliable'.

Some incorrectly attributed the use of percentage change to differences in surface area, which was not relevant. Others noted that it made results 'easier to compare', but did not go on to explain why.

04.2 This question was well answered, with 86% of students correctly identifying a positive correlation, stating that as surface area increases, the percentage increase in mass also increases.

A common error was the incorrect use of the term 'directly proportional', which was not credited as the relationship was not linear. Only 3% of students demonstrated higher-level understanding by noting that the rate of increase slowed, showing awareness of the diminishing trend in the data.


0 4 . 2 Describe the relationship between total surface area and percentage increase in mass.

Use **Table 1**.

[2 marks]

As total surface area increases, percentage increase increases. However the rate of increase decreases as surface area increases.

This is a rare response that was awarded 2 marks. The student successfully describes a decreasing rate, which meets the criteria for marking point 2. This level of detail and understanding was not commonly seen, as many students did not refer to the full pattern shown in the table.

04.3 To gain credit, students needed to state both the direction of water movement and name the process as osmosis. While most correctly identified osmosis, many omitted the direction of movement.

Explanations were credited if they described water moving from a high to low concentration of water, although this less precise wording often caused confusion. The preferred description was water moving from a dilute solution to a more concentrated solution across a partially permeable membrane. Statements referring to movement from low to high solute concentration were also accepted.

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Confusion about concentration remained common, with many students not distinguishing between water and solute concentration. Although most could name osmosis, unclear explanations of the gradient and movement direction often prevented full marks.

0 4 . 3 Explain why the potato pieces increased in mass.

[2 marks]

Osmosis is the movement of water from a high concentration to a low concentration through a semi-permeable membrane. ~~The~~ Some of the distilled water moved into the potatoes through osmosis.

This response was awarded 1 mark for a correct description of the movement of water into the potato by osmosis.
However, a common misconception is evident in the explanation that 'water moves from a high concentration to a low concentration.' While this is frequently seen, it lacks precision. The addition of 'water' before both references to concentration would have been acceptable, though not ideal.
This error highlights a widespread misunderstanding of the principles of osmosis, particularly in relation to concentration terminology.

04.4 This question was particularly challenging, with only 4% of students gaining any marks. It required application of knowledge about osmosis in a broader context.

Few students recognised that all potato pieces would eventually reach the same percentage change in mass after 24 hours. Many incorrectly stated that the pieces would have the same mass, showing misunderstanding of what percentage change represents.

Credit was also given for identifying that it is the potato *cells*, not the whole pieces or the potato, that becomes turgid.

Common misconceptions included the belief that concentrations would equalise, and osmosis would stop, that percentage change would increase indefinitely, or that cells would burst. The role of the cell wall in preventing bursting was rarely acknowledged.

Overall, this question highlighted significant gaps in students' understanding of osmosis, particularly in distinguishing between plant tissues and plant cells.

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4.2.2.2 The heart and blood vessels

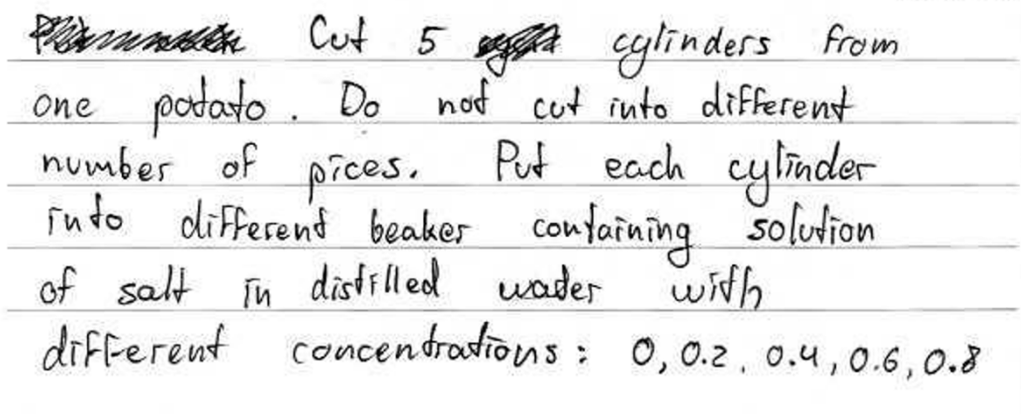
04.5 This question was poorly answered, with only 8% of students meeting both criteria. Many responses lacked precision and failed to clearly describe how the method should be adapted. Few students stated that the independent variable should be different concentrations of salt solution. References to at least three concentrations and the use of units such as g/dm^3 clarified that solutions, not masses of salt, were being tested. Vague statements such as 'add some salt to water' were not credited. Many students also failed to recognise that surface area needed to be replaced as the independent variable, often attempting to include both variables in the same method.

For controlling surface area, responses needed to state that all potato pieces should have the same surface area and not just the 'same size' or 'same shape' which were too vague. Students could also gain credit by stating that the cylinders should not be cut further or should be cut into the same number of pieces, as this implied control of surface area. Very few students addressed this point at all.

Overall, most responses demonstrated confusion around the concept of concentration and lacked the clarity required to access the marks.

Describe how the student could change the method to investigate the effect of salt concentration on potato tissue.

[2 marks]



This is a rare example of a 2-mark response. The student correctly refers to not cutting the pieces of potato, which demonstrates an understanding of the need to control the size and surface area of the samples. They also clearly state that different concentrations of salt solution were used, which shows an awareness of how to create the range of conditions needed to observe a pattern in mass change.

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Question 5 (Standard and High demand)

05.1 49% of students gained 1 mark on this question. 34% gained full marks for this question.

05.2 This question proved challenging, with 63% of students failing to achieve the mark. While many correctly identified the palisade layer, a wide range of incorrect responses was seen.

Common errors included confusing the palisade tissue with the upper epidermis, spongy mesophyll, or simply writing 'mesophyll', which was too vague to credit. Other incorrect answers suggested other plant tissues and sub-cellular structures.

Overall, the question highlighted that while some students had a good grasp of leaf anatomy, many lacked precise knowledge of the location and function of palisade tissue.

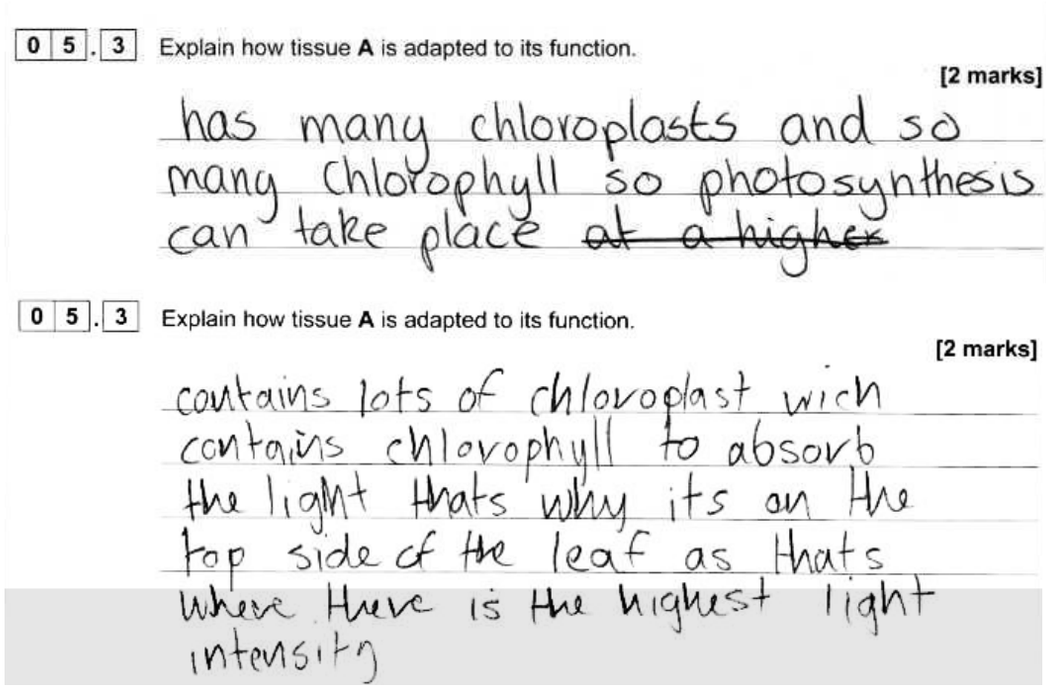
05.3 This question was challenging, with 62% of students failing to achieve any marks. It required understanding of the adaptations of palisade mesophyll tissue and how these relate to its role in photosynthesis. While some students identified one appropriate adaptation or function, few provided the full explanation needed for both marks.

Many students correctly stated that the cells contain many chloroplasts or a large amount of chlorophyll. However, common errors included mentioning a 'large surface area', omitting the quantifier 'many', or failing to link the adaptation to its function. Responses such as 'contains chloroplasts for photosynthesis' were too vague, whereas answers specifying that the many chloroplasts absorb light for photosynthesis were awarded full credit.

Some students incorrectly described the position of the palisade cells at the top of the leaf or referred to unrelated processes such as water absorption or gas exchange. Confusion between palisade and spongy mesophyll tissues was also frequent.

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4.2.2.2 The heart and blood vessels



Two examples of responses that were both limited to 1 mark.

In the first example, the student is awarded for correctly stating that the cell contains many chloroplasts. However, further credit is not gained, as the response only references photosynthesis and does not specifically mention the absorption of light—an essential part of that marking point.

In the second example, the student is again awarded marking point 1 for correctly identifying the presence of many chloroplasts. This time, the student does mention light absorption but does not go on to link this to the process of photosynthesis.

In both cases, the students demonstrated partial understanding but did not provide enough detail to access full marks. This pattern was common across responses, where students often gave either the function (photosynthesis) or the mechanism (light absorption), but not both.

05.4 This question was challenging, with many students demonstrating only partial understanding. While 77% gained at least one mark, only 26% achieved three or more. Few were able to provide a full, coherent sequence of the pathway of water.

Most students gained credit for stating that water enters the root hair cells from the soil. However, answers that referred only to 'roots' or incorrectly described the process as active transport were not credited.

Fewer students successfully described water moving up the xylem, as many omitted the direction of flow or confused the xylem with the phloem, sometimes incorrectly referring to translocation instead of transpiration.

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References to water moving to the leaves were rare, with many responses diverting into discussions of photosynthesis, which was not relevant to the mark scheme.

Only a small number of students mentioned stomata or described their role in water leaving the leaf. Evaporation or transpiration as the final stage of water loss was more commonly stated, although it had to be correctly located to gain credit.

Overall, while the early and final stages of the process were better understood, students often lacked the precision and sequencing needed for full marks. This question highlighted persistent misconceptions about water transport and the role of specific plant structures.

Question 6 (High demand)

06.1 61% of students gained the mark for this question.

06.2 This question required students to apply their knowledge of ciliated cells in a new context. To gain credit, answers needed to describe the movement caused by the cilia (e.g. push, sweep, waft, pass through) and correctly identify what was being moved (e.g. egg, ovum, fertilised egg, or embryo). Phrases such as 'pass the egg through' were accepted, and incorrect references to the egg's destination were ignored. References to sperm were not credited.

Many students struggled, often confusing the roles of cilia and mucus. A common error was stating that cilia trap bacteria or pathogens, a function associated with mucus in the respiratory system rather than the oviduct.

06.3 Students generally performed well on this question, with 47% achieving full marks. Most were able to recall and correctly rearrange the equation, demonstrating strong mathematical skills.

The most common error was incorrect conversion from millimetres to micrometres, which prevented many from gaining the conversion mark. Some students also substituted values incorrectly, leading to an incorrect final answer.

Overall, performance was good, and many students showed confidence with both standard form and the calculation process. Clear working remains important, as it allows credit to be given for correct steps even when the final answer is incorrect. Students should also cross out incorrect attempts to make their reasoning clear.

06.4 This question proved difficult for many students, as it required clear application of knowledge about oxygen transport and respiration.

Many recognised that anaemia reduces oxygen transport but often used vague phrasing such as 'less oxygen is taken to the body', which was not credited. To gain the mark, answers needed to specify that oxygen was not reaching cells, muscles, or another specific destination. Irrelevant organs, such as the liver, and absolute statements like '*no* oxygen is taken to the cells' were not accepted.

Fewer students successfully identified the shift to anaerobic respiration and the associated production of lactic acid. Responses that referred only to 'less energy' or 'less aerobic respiration' were insufficient, and mentioning anaerobic respiration without lactic acid was also insufficient.

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4.2.2.2 The heart and blood vessels

Overall, while many students understood the initial effect of reduced oxygen transport, few linked this to the physiological consequences of anaerobic respiration, revealing gaps in applying respiration knowledge in unfamiliar contexts.

0 6 . 4 Explain why a person with anaemia is likely to experience muscle fatigue.

[2 marks]

Because red blood cells carry oxygen around the body so if there aren't enough of them, the muscles don't have enough oxygen to respire meaning less energy.

This response was awarded 1 mark. The student correctly identifies that less oxygen reaches the muscles. A more general statement such as 'less oxygen to the body' would not have been sufficient at this level.
However, the student does not mention anaerobic respiration or the production of lactic acid, both of which were required to achieve further credit. This reflects a common issue where students recognise the reduction in oxygen delivery but do not link it to the consequences on respiration.

06.5 This question was generally well answered, with 67% of students gaining full marks. Many demonstrated strong mathematical skills and successfully applied standard form.

The most common errors were in the percentage calculation, which led to incorrect final answers despite correct method or structure. Magnitude errors, often caused by misplacing zeros, were also frequent.
Students who made calculation errors but correctly expressed their answer in standard form were often able to gain partial credit.

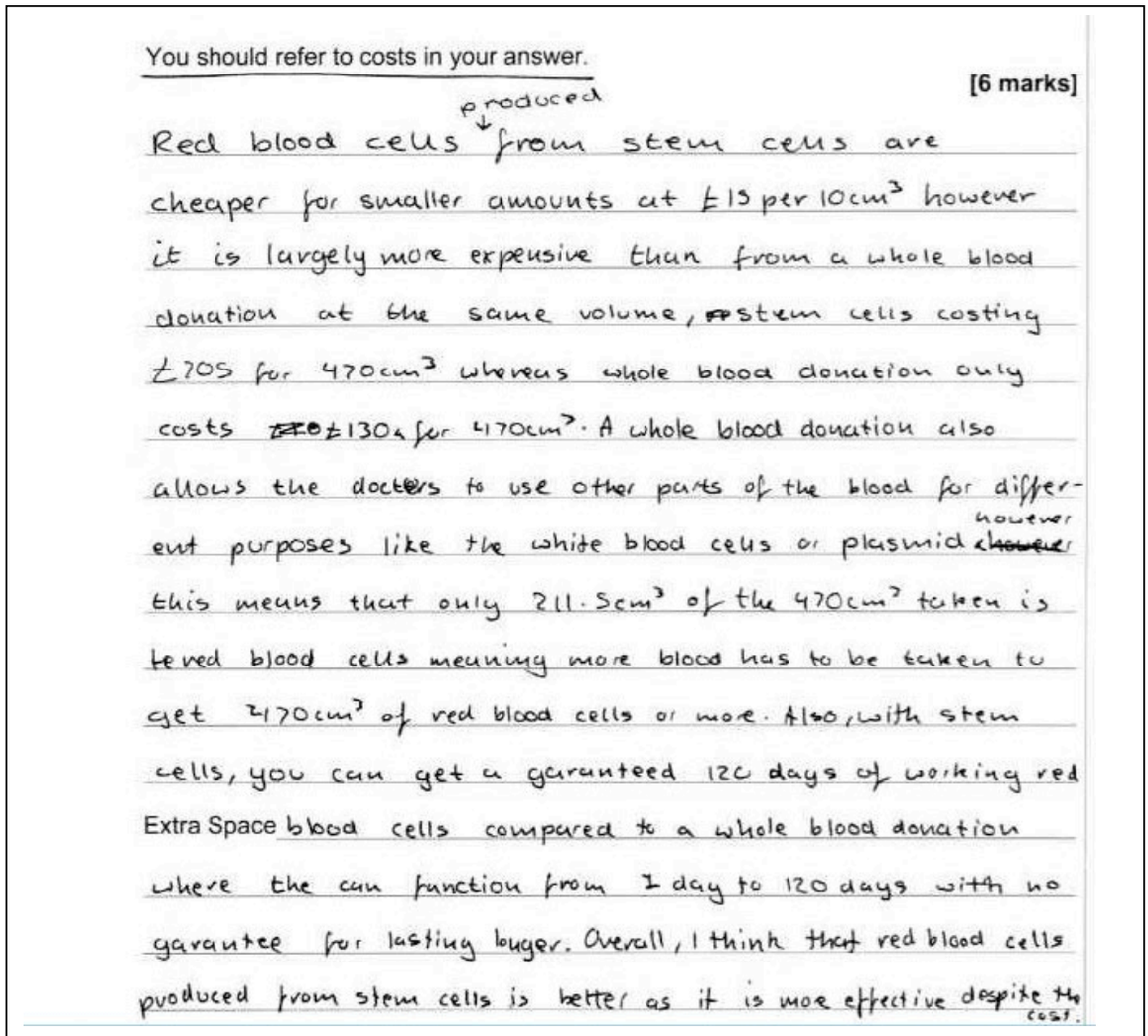
06.6 Most students (83%) accessed Level 1 by identifying relevant points, 47% reached Level 2, but only 1% achieved Level 3. The question highlighted weaknesses in data interpretation, comparative reasoning, and structuring evaluations.

Many students correctly identified advantages of stem cell-derived red blood cells, including longer shelf life, smaller sample requirements, and lower risk of infection. Some gained credit by framing these as disadvantages of whole blood donation. However, many answers simply re-stated information from the table without comparison or explanation.

Disadvantages of stem cells were rarely mentioned. While cost was often noted, few students developed this point or compared it effectively with the lower cost of whole blood donation. Misconceptions were common, particularly references to ethical concerns about embryonic stem cells, which were not relevant in this context. Few students recognised benefits such as reduced risk of rejection or potential advantages for patients with rare blood types.

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4.2.2.2 The heart and blood vessels



You should refer to costs in your answer. **[6 marks]**

Red blood cells produced from stem cells are cheaper for smaller amounts at £15 per 10cm³ however it is largely more expensive than from a whole blood donation at the same volume, ~~F~~stem cells costing £705 for 470cm³ whereas whole blood donation only costs ~~£0~~£130 for 470cm³. A whole blood donation also allows the doctors to use other parts of the blood for different purposes like the white blood cells or plasmid ~~however~~ however this means that only 211.5cm³ of the 470cm³ taken is red blood cells meaning more blood has to be taken to get 470cm³ of red blood cells or more. Also, with stem cells, you can get a garanteed 120 days of working red blood cells compared to a whole blood donation where the can function from 1 day to 120 days with no garantee for lasting longer. Overall, I think that red blood cells produced from stem cells is better as it is more effective despite the cost.

Extra Space

This is a rare example of a response that was awarded 5 marks.

The student correctly states that red blood cells produced from stem cells are more expensive and identifies the specific cost as £705, meeting two of the cost-related points.

They then note that whole blood donation includes other components, such as white blood cells, and despite the incorrect reference to plasma, this is accepted as being in line with the indicative content principles. The student also explains that these additional components can be used for different purposes. This was sufficient to award credit relating to the advantages of whole blood donation.

The response continues with an extended discussion about the lifespan of different types of blood cells. Although somewhat lengthy, the student eventually makes the point that red blood cells derived from stem cells last longer—earning credit for an advantage of stem cell blood.

In total, this response gained credit for cost-related points, advantages of whole blood donation, and an advantage of stem cell blood. Had the student included a further distinct advantage of stem cell blood, they would have been awarded the full 6 marks.

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4.2.2.2 The heart and blood vessels

Cost evaluation was key to higher marks. Many students performed calculations correctly, allowing progression beyond Level 1, but errors occurred when comparing unequal volumes. Correct intermediary calculations were still credited.

Overall, while most students identified some valid points, only a very small proportion produced well-developed evaluations supported by data analysis.

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4.2.2.2 The heart and blood vessels

Contact us

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