OCR GCSE GATEWAY BIOLOGY A · J247

BIOLOGY



MARK SCHEME

B2.2 THE CHALLENGES OF SIZE

SCORE	PERCENTAGE
/327	%

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Question			Answer/Indicative content	Marks	Guidance
1			A	1	
			Total	**1**	
2			C	1	
			Total	**1**	
3			D	1	
			Total	**1**	
4	a		stop evaporation of water (1) so any loss in mass / water is from the plant (1)	1 1	
	b		same temperature (1) same light intensity (1) same windspeed / air movement (1)	3	**allow** same humidity

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Question			Answer/Indicative content	Marks	Guidance
	c		* Please refer to the marking instruction point 10 for guidance on how to mark this question. **Level 3** **(5–6 marks)** **Concludes whether this result would be expected in this experiment and includes scientific reasons in their answer.** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2** **(3–4 marks)** **Draws a conclusion from the data supported with suitable calculations.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1** **(1–2 marks)** **Draws a conclusion from the data without the use of calculations.** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*	6	**AO3.2a: Analyse the information from the experiment and use judgement to ascertain if the result is as expected** • Bigger plants would be expected to lose more mass – because of their larger surface / ora • Smaller plants could have lost more mass in • this experiment – because they may have a higher number of stomata per unit area / ora • Results may be inconclusive as the experiment has not been repeated / there are an insufficient number of repeats **AO3.1a: Apply knowledge and understanding of the experiment with respect to the data** • Convert from water loss to percentage water loss plant A 12.6% plant B 15.4% and explained • Plant A lost more water / lost water more slowly • Plant A lost 261–228 = 33 g, • Plant A rate of water loss – 33/24 = 1.38 g/hr • Plant B lost 273–231 = 42 g • Plant B rate of water loss – 42/24 = 1.75 g/hr • Plant B lost 5 g more mass that plant A **AO2.2: Apply knowledge of transpiration to the different leaf sizes** • both experiments lose mass • that mass can be because of water loss • that water loss is due to transpiration
			Total	**11**	
5	a	i	6:1	1	

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Question			Answer/Indicative content	Marks	Guidance
		ii	7.6×10^{-3} 3.0×10^{-3} 1.5×10^{-3} correct calculation of 1 / time (1)	1	
		ii	answer in standard form (1)	1	
		iii	Comment on the rate of colour change / smaller block changed faster (1)	1	ORA
		iii	Diffusion alone is sufficient in smaller organisms / smaller organisms have a larger surface area to volume ratio / diffusion alone may not be effective in multi cellular organisms (may require circulatory system) (1)	1	
	b		small size (1) • to travel through capillaries (1) • to get in to small vessels / capillaries (1) biconcave disc shape (1) • large surface area : volume (1) haemoglobin (1) • to carry oxygen (1) lack of nucleus (1) (so) more room (for haemoglobin) (1)	5	can only gain explanation marks (bullet points) if correctly linked to a feature max 4 marks if only given features without explanations
			Total	10	

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Question			Answer/Indicative content	Marks	Guidance
6		i	a communicable disease ✓ a disease that is caused by defective alleles a non-communicable disease a disease that is affected by lifestyle ✓	1	Both correct answers are required for the mark
		ii	antibodies (1)	1	
		iii	idea that it stops blood flowing backwards (1)	1	
		iii	inefficient circulation to lungs / less blood would go to the lungs (1)	1	
		iii	Increased ventilation required for gaseous exchange (1)	1	
		iii	idea of less oxygen available to the tissues / fatigue / oxygen debt (1)	1	
			Total	**6**	
7			larger surface area (to take up pollutants) (1)	1	**allow** sticks out more from bark
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
8	a		(more water / mass lost when fan is on because)		**allow** reverse argument
			air movement removes water vapour / reduces water vapour concentration outside leaves / increases water vapour concentration gradient (1)	1	
			so evaporation / diffusion happens more quickly (1)	1	
	b	i	(because otherwise) an increase in light intensity would open stomata (1)	1	
		i	increasing transpiration / ORA (1)	1	
		ii	(because otherwise) an increase in temperature would increase evaporation / ORA (1)	1	
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
9	a	i	6(1)	1	
		ii	7.6×10^{-3} 3.0×10^{-3} 1.5×10^{-3}		
		ii	correct calculation of 1 / time (1)	1	
		ii	answer in standard form (1)	1	
		iii	as size increases the rate of diffusion decreases / as size increases the diffusion distance increases (1)	1	ORA
		iii	idea that would take too long for substances to diffuse in and out of large organisms (1)	1	
		iv	spheres are an improvement because animal cells tend to be round shapes not cubes (1)	1	
		iv	students used cubes because they are easier to cut / prepare (1)	1	**allow** the calculations of surface area:volume are easier
	b		**any five from** small size (1) flexible (1) • to get in to small vessels / capillaries (1) biconcave disc shape (1) • large surface area:volume (1) haemoglobin (1) • to carry oxygen (1) lack of nucleus (1) • (so) more room (for haemoglobin) (1)	5	can only gain explanation marks (bullet points) if correctly linked to a feature max 4 marks if only given features without explanations
			Total	12	

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Question			Answer/Indicative content	Marks	Guidance
10			larger surface area (to take up pollutants) (1)	1	**allow** sticks out more from bark
			Total	1	
11		i	blood in arteries is under higher pressure (1)	1	
		ii	arteries have thicker walls / elastic walls (1)	1	
			Total	2	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>12</td><td>a</td><td></td><td>
<table>
<tr><th>name</th><th></th><th>part</th></tr>
<tr><td>aorta</td><td></td><td>D</td></tr>
<tr><td>left atrium</td><td></td><td>E</td></tr>
<tr><td>right ventricle</td><td></td><td>C</td></tr>
<tr><td>tricuspid valve</td><td></td><td>B</td></tr>
<tr><td>vena cava</td><td></td><td>A</td></tr>
</table>
</td><td>2</td><td>3 or 4 correct (1)
less than 3 correct (0)

Examiner's Comments

The parts of the heart were quite well known but all combinations were seen. The most common error was to reverse boxes 1 and 5. This illustrates that many candidates are still not aware that diagrams are mirror images of the body to identify right and left sides.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>provides a large surface area to volume ratio (1)</td><td>1</td><td>allow large SA / V
allow squeeze through capillaries
ignore arteries / veins / vessels

Examiner's Comments

Many candidates gained credit for the idea that red blood cells can squeeze through capillaries. Only a very small number gained the mark for a large surface area to volume ratio. The most common errors were ‘more of them can travel in blood vessels’ or ‘they can travel faster’.</td></tr>
<tr><td></td><td></td><td>ii</td><td>any two from:
DNA codes for mRNA (1)
mRNA moves (from nucleus) to cytoplasm (1)
(mRNA passed to) ribosomes in cytoplasm (to make haemoglobin / protein) (1)</td><td>2</td><td>Examiner's Comments

This question did differentiate and only a few candidates knew about mRNA and the ribosomes in the cytoplasm. There were many vague, incorrect answers stating that ‘the cytoplasm is where chemical reactions take place’ or ‘the nucleus is in the cytoplasm’.</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
		iii	(haemoglobin combines with oxygen to form) oxyhaemoglobin (in lungs) (1) reverse reaction / breakdown of oxyhaemoglobin happens in tissues / cells to release oxygen (1)	2	**allow** oxyhaemoglobin dissociates releasing oxygen **Examiner's Comments** The majority of answers failed to mention oxyhaemoglobin at all, even though candidates did state that oxygen combined with haemoglobin. Most attempts at the second marking point simply stated that, in the tissues, oxygen passed / diffused into the cells, with no reference to any reverse reaction or release from the combined molecule.
	c		(bone marrow) contains stem cells / undifferentiated cells (1) (stem cells) have genes / have information to develop into different (red or white) cells (1)	2	**allow** have genes for either type of cell **allow** can turn genes on and off as required **Examiner's Comments** A reasonable number of candidates knew about stem cells, but few went on to gain a second mark. The most common error was to repeat the question and say 'and so they can produce both types of cell'. Other candidates said that stem cells had the potential to become red and white blood cells, without explaining how (e.g. by having the genes). Some candidates gave unrelated answers (e.g. bone marrow is for keeping the body healthy, essential for growth or helps fight off disease).
			Total	9	

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Question			Answer/Indicative content	Marks	Guidance
13		i	pump (1) blood (1)	2	
		ii	cells become specialised (1)	1	**allow** cells become different / develop into different tissues **allow** cells change **Examiner's Comments** Most candidates gained both marks in part (i) for saying that the heart pumps blood. Part (ii) proved far more difficult, with a small minority able to explain the meaning of 'cell differentiation'. Of those candidates who appreciated that it was something to do with different cells, many thought it was simply describing the fact that cells are different.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
14	a		right (1) pressure (1)	2	**Examiner's Comments** Over half the candidates gained both marks.
	b	i	carry oxygen (1)	1	**ignore** carries carbon dioxide **not** transports food and oxygen
		ii	DNA (1)	1	**allow** deoxyribonucleic acid **ignore** bases **Examiner's Comments** Most candidates could describe the role of red blood cells in part (i). 'Carry blood' or 'carry food', were misunderstandings seen a few times. A very small minority knew in part (ii) that it is DNA that codes for haemoglobin.
	c		(cell) division / mitosis (1) (cell) differentiation / specialisation (1)	2	**Examiner's Comments** Although the question was in the context of white blood cells, it was testing whether candidates knew that the formation of new cells involves both cell division and differentiation. Very few candidates appreciated this. Some misinterpreted the question, and wrote about why new white blood cells need to be made.
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
15		i	(lack of oxygen causes) fewer / no (aerobic) bacteria / fungi (1) (therefore) no / slow / less decay (1)	2	**allow** fewer / no decomposers / microorganisms **ignore** germs / viruses **ignore** fewer / no detritivores **allow** no / slow / less breakdown of dead material **allow for additional marking point**: less / no / slower respiration (by bacteria / fungi / decomposers) (1) **allow** reverse arguments **Examiner's Comments** Only about a third of candidates appreciated that low oxygen levels would mean that few decomposers could survive and therefore the rate of decay would be low. Some candidates clearly thought that 'nutrients' were a type of organism that needed oxygen to survive. Some thought that a lack of oxygen would reduce photosynthesis.
		ii	(release) energy (1) to take in minerals / nutrients (1) by active transport / movement against a concentration gradient (1)	3	**ignore** absorb minerals from the air **Examiner's Comments** Less than half the candidates knew that respiration was needed to release energy. Very few were able to link this to the context and explain that the energy would be needed to absorb minerals by active transport. Weaker answers commonly explained that respiration was needed to bring in oxygen, or that respiration was needed for photosynthesis.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
16			[Level 3] Describes the results AND gives a detailed explanation of the experiment. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Describes the results AND gives a limited explanation of the experiment. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Describes the results of the experiment OR gives a limited explanation of the experiment. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Detailed explanation could include: • air movement increases / maintains concentration gradient • air movement increases / maintains diffusion gradient • air movement lowers **concentration** of water outside plant **ignore** references to osmosis Limited explanation could include: • (increased) air movement / fan causes loss of water • (water is lost by) evaporation / diffusion of water **ignore** references to osmosis Description: • loss of mass / water / readings go down in B / shoot • no change in A (**allow** small decrease) To get full credit for description there needs to be a comparison between A and B. Description of only A or B limits mark to 1/3/5 **if no other marks, allow** air movement increases transpiration for L1, 1 mark Use the L1, L2, L3 annotations in Scoris;

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Question			Answer/Indicative content	Marks	Guidance
					do not use ticks. Examiner's Comments To gain full marks candidates must answer every part of a question, in this case by describing the expected results in both flasks and explaining each. Although all possible marks were frequently seen, the most common score was four, which was gained by correctly describing the results and giving a limited explanation, e.g. that water was being lost from the plant by evaporation. To gain full marks a more detailed explanation was needed in terms of the fan lowering the water concentration of the air, so increasing loss by the plant. A minority wrote about water loss from the leaves being by osmosis. Some candidates said that the readings would change, but did not go on to say how.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
17	a	i	90 (%) (1)	1	**allow** 90.32258 or correct rounding **Examiner's Comments** About half the candidates correctly calculated the percentage drop in pressure as 90%. The common error was to convert 9/93 to a percentage.
		ii	vessel at A = capillary (1) vessel at B = vein (1)	2	**allow** capillary bed / arteriole **ignore** small artery allow venule / named vein e.g. vena cava **Examiner's Comments** Many candidates could not identify either the vessel at A as a capillary, nor the one at B as a vein. A minority correctly identified both. The most common error was to identify A as an artery.
	b		reduces effective blood circulation / blood could fall back into heart / backflow would happen (1) pressure is not maintained / reduces pressure (1)	2	**ignore** references to oxygenated / deoxygenated **ignore** less blood but **allow** less blood pumped around body **ignore** job of valves e.g. valves stop backflow **allow** not enough pressure to push blood around **allow** oedema / idea of fluid building up in tissues / lungs **ignore** references to higher pressure e.g. inside heart **Examiner's Comments** Most candidates gained at least 1 mark, usually for explaining that damaged valves could lead to backflow. A small minority gained both marks, usually for adding that blood pressure would fall. Some candidates seemed to confuse damaged valves with a 'hole in the heart' and wrote about oxygenated and deoxygenated blood mixing.
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
18			links (powerful) pump to the action of the heart (1) links gas exchanger to function of lungs (1)	2	**allow** idea that pump moves the blood around the body **allow** idea that in gas exchanger blood exchanges CO_2 for O_2 / removes CO_2 / gains O_2 inclusion of collecting tube negates mark **Examiner's Comments** The most simply stated answers to this question were most likely to score. Many candidates tried to assign roles to all the labelled parts of the machine thereby confusing their answers.
			Total	2	
19		i	(water lost in) transpiration (1) idea that only a **small** proportion is used in photosynthesis (1)	2	**allow** evaporation from plant **Examiner's Comments** About half the candidates explained that the plant lost water through transpiration or evaporation. Very few also explained that a small proportion of the water added was used in photosynthesis. Some candidates thought that water left the leaves by osmosis.
		ii	more transpiration (1) idea that wind moves away water **vapour** (1)	2	**allow** more water lost through stomata **allow** more evaporation / more diffusion (out of leaf) **ignore** simply 'more water lost' **Examiner's Comments** About half the candidates correctly explained that transpiration increased on windy days. A minority explained this in terms of the wind moving away water vapour.
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
20			[Level 3] Gives a full description of the experiment including the results. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Gives a description of the experiment. or Gives a partial description of the experiment with a description of the results. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Gives a partial description of the experiment or a description of the results Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points about description at level 3 may include: • compare mass loss at different fan speeds / distances • ideas of repeat readings • idea of with and without a plant shoot indicative scientific points about description at all levels • measure transpiration by loss in mass • measure transpiration by loss of water from flask Indicative scientific points regarding results may include: • increasing air movement increases transpiration rate / loss of mass Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments The context of this question was difficult to grasp for many candidates, many referring to respiration and photosynthesis and not to transpiration. Although many answers included changes to fan settings, distance, repeats etc, there were few references to the idea of measuring a difference in mass. Many answers simply stated ‘put it on the balance’.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
21		i	90 (%) (1)	1	**allow** 90.32258 or correct rounding **Examiner's Comments** Few candidates could calculate percentage drop in pressure. Most candidates did a simple subtraction to give an answer of 9%.
		ii	vessel at A = capillary (1) vessel at B =vein (1)	2	**allow** capillary bed / arteriole (1) **ignore** small artery **allow** venule / named vein e.g. vena cava (1) **Examiner's Comments** Very few candidates understood that by the time the blood has reached point A it will be in the capillaries. Some candidates did however gain one mark for veins at point B.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
22		i	idea that not enough mass / materials / substances / nutrients lost from soil to supply the mass / material / substances / nutrients gained by the tree (1) correct **calculation:** soil lost 1kg but tree gained 78kg (1)	2	**allow** the tree gained (much) more mass than the soil lost **allow** total mass changed from 102kg ? 179kg (1) **allow** soil would have been 22kg (if scientists were correct)(1) **allow** the tree gained 77kg from somewhere else (not soil) = 2 marks **allow** tree gained 78kg but soil **only** lost 1kg = (2) (BOD) **Examiner's Comments** Many candidates realised the soil only lost 1kg of mass and the tree gained 78kg. However a number of candidates failed to use the data to answer the question, simply stating the mass must have come from somewhere else.
		ii	**any three from:** enters through root (hairs) (1) by osmosis (1) transported up the stem (1) passes through xylem (1) lost from the leaves by evaporation (1) by the process of transpiration (1)	3	**allow** correct description of osmosis (1) **ignore** diffusion / active transport **for extra marking point allow** **allow** a (small amount) used in photosynthesis (1) **Examiner's Comments** The majority of candidates gained one mark, normally for the idea that the roots take in water and a second for the water moving up the stem or xylem. Few candidates mentioned that water is lost by evaporation from the leaves.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
23			a by-pass operation ✓ a valve replacement inserting a pacemaker inserting a 'heart assist' device (1)	1	more than one tick negates mark Examiner's Comments The majority of candidates identified the need for a by-pass operation although a number of them thought a valve replacement was needed.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
24	a		[Level 3] **Explanation** of why rate of photosynthesis is reduced **AND** **Explanation** of how and why transpiration is affected. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] **Description** of reduced photosynthesis **AND** **Description** of effects on transpiration. **OR** **Explanation** of why rate of photosynthesis is reduced **OR explanation** of how and why transpiration is affected. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] **Description** of reduced photosynthesis **OR** **Description** of effects on transpiration. **OR** **attempts one explanation** without stating if they are increased or decreased Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Indicative scientific points on explanations may include: Explanations of reduced photosynthesis • photosynthesis reduced because of fewer collisions • photosynthesis reduced because reduced enzyme activity • photosynthesis reduced because high winds cause stomata to close so less carbon dioxide taken in Explanation of effects on transpiration. • transpiration increased because of increased diffusion (gradient) or increased evaporation • transpiration increased because of decreased humidity • transpiration may be reduced by low temperatures reducing evaporation or diffusion • transpiration decreased as dry soils means there is less water and the guard cells become flaccid Indicative scientific points on descriptions may include: Description of reduced photosynthesis • lower temperatures or high winds decrease the rate of photosynthesis • high winds close stomata **ignore** effect of dry soil or sunlight on photosynthesis Description of effects on transpiration. • high winds increase rate of transpiration • high winds cause stomata to close so less transpiration • dry soils may reduce transpiration • low temperatures can reduce transpiration

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Question			Answer/Indicative content	Marks	Guidance
					allow absolute ideas e.g. no photosynthesis when cold Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question discriminated the different levels well, the less able candidates would mention that transpiration and photosynthesis were affected by the different conditions but not actually say that the rates increased or decreased. Only the more able candidates used the correct terminology linked to evaporation from the leaves or enzyme activity. A large proportion of the candidates described the processes of photosynthesis and transpiration without actually linking them to the conditions.

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Question			Answer/Indicative content	Marks	Guidance
	b			4	**Function mark is dependent on cell mark** **To gain full marks, functions must be clearly linked to correct cells** e.g. 'xylem and phloem transport water and sugar' (2) e.g. xylem transports water phloem transports sugar and minerals (3)
			xylem (1) (transports) water / minerals (1) phloem (1) (transports) food / sugar (1)		**allow** named mineral e.g. nitrate (1) **not** sugar / food / starch not phylum / phyllem **allow** named food substances e.g. glucose / sucrose / amino acids (1) **not** minerals or starch **ignore** water for phloem **ignore** nutrients for both **ignore** direction of movement **Examiner's Comments** Most candidates identified xylem and phloem although the incorrect spelling of phloem (phylum or phyllem) meant that some lost this mark. A common misconception is that phloem transports minerals.
			Total	**10**	

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Question			Answer/Indicative content	Marks	Guidance
25			**any two from:** movement from (an area of) low concentration to (an area of) high concentration (1) using energy or respiration (1) using carrier (1)	2	 **allow** moves from a **lower** concentration (into the root) (1) **allow** against or up a concentration gradient (1) **ignore** through or across a concentration gradient **allow** using ATP (1) **ignore** uses oxygen **allow** uses membrane proteins (1) **ignore** references to osmosis and diffusion **Examiner's Comments** Candidates often confused active transport with diffusion or osmosis. Only the more able candidates answered correctly in terms of concentration gradients and energy. Some managed to contradict their answer by stating that the movement was against a concentration gradient from an area high concentration to low concentration.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
26		i	D (1) it has a thick(er) wall / muscle OR it should be C but the heart is reversed (1)	2	2nd mark is dependent on the 1st **allow** more muscular **Examiner's Comments** Many candidates made links between D and a thicker muscle wall. There was, however, still evidence of some confusion over what each part of the heart does.
		ii	idea that heart would need to be turned round / placed back to front (1) to allow connection to the correct blood vessels (1)	2	**allow** put the heart in face down / flipped over / reversed / inverted **allow** idea that would need to extend / reach the blood vessels to the heart (1) to allow them to reach the correct chambers (1) arteries / veins need to be swapped around (1) **Examiner's Comments** Some candidates struggled with the applied nature of this question. Most who scored did so for the idea of putting it in back to front. Fewer got the mark for linking up the correct blood vessels.
			Total	**4**	
27			more respiration occurs (1) carbon dioxide is toxic (1)	2	 **allow** poisonous / changes pH **ignore** harmful **Examiner's Comments** Many candidates referred to breathing, anaerobic respiration, lactic acid production etc. but few simply said that the respiration rate will increase.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
28		i	glucose **and** oxygen (1)	1	**Examiner's Comments** Although the question clearly asked for two ticks some candidates only ticked one of the correct answers.
		ii	coronary artery (1)	1	**Examiner's Comments** A minority of candidates could correctly recall the function of the coronary artery.
			Total	2	

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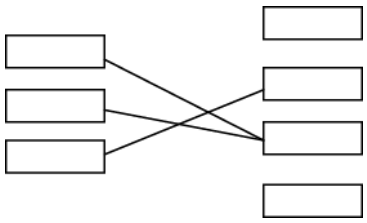
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Question			Answer/Indicative content	Marks	Guidance
29			[Level 3] Answer includes **two** adverse environmental condition with at least **one** fully explained. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer includes **two** adverse environmental conditions coupled with at least **one** explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer includes **two** adverse environmental conditions. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Explanations at level 3 may include: • lower temperatures decrease the rate of photosynthesis • less water uptake or more water loss may reduce photosynthesis as water is required Explanations at level 2 may include: • lack of water in the soil results in lack of water uptake / gets less water • windy so more water lost by transpiration / via stomata / less braches so less photosynthesis Indicative scientific points about the adverse environmental conditions may include: • low temperatures / too cold • lack of water (in soil) (**not** just dry) • windy so more water loss / damage to branches Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Most candidates commented on the adverse conditions, lack of water or cold temperatures. A smaller number could go further and link the wind to larger water loss or the lack of water and cold temperatures to a reduction in photosynthesis.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
30	a	i	drooped / wilted (1)	1	**ignore** drops / dries out flop / shrivel / die etc **Examiner's Comments** Incorrect answers such as 'dead' were quite common but the idea of wilting was understood by a number of the candidates.
		ii	water it (1)	1	**ignore** minerals / nutrients / fertiliser / light **Examiner's Comments** Most candidates appreciated the need to water the plant.
	b		gets enough / more light (1) light needed for photosynthesis (1) for more growth / bigger crop (1)	2	**ignore** simply 'gets light' **ignore** to grow **allow** won't grow as much in the shade **Examiner's Comments** Answers to this question highlighted the need to make comparative comments with candidates failing to score marks by simply stating that plants in the shade get no light and so do not grow.
			Total	**4**	
31			 1 mark for each correct line (3)	3	**allow** oxygen – root hairs as an extra line or as an alternative to oxygen – stomata **Examiner's Comments** Most candidates scored on this question although the most common error was to link the entry of water to the xylem.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
32		i	D (1) it has a thick(er) wall / muscle OR it should be C but the heart is reversed (1)	2	2nd mark is dependent on the 1st **allow** more muscular
		ii	idea that heart would need to be turned round / placed back to front (1) to allow connection to the correct blood vessels (1)	2	**allow** put the heart in face down / flipped over / reversed / inverted **allow** idea that would need to extend / reach the blood vessels to the heart (1) to allow them to reach the correct chambers (1) arteries / veins need to be swapped around (1) **Examiner's Comments** The two parts of this question were quite challenging for the candidates. Some did appreciate the significance of the thickness of the wall of D and the need to reverse the heart in a transplant.
			Total	**4**	
33			**any three from:** get more oxygen / get oxygen more quickly (1) get more glucose / get glucose more quickly (1) to muscles (1) to get rid of extra carbon dioxide (1) for respiration / to release energy (1)	3	marking points referring to glucose, oxygen and carbon dioxide must be comparative **Examiner's Comments** The main problem here was candidates failing to give comparative answers. Answers which simply stated 'to get oxygen and glucose and to get rid of carbon dioxide' did not score.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
34		i	root (hairs) absorb (1) stem transports (1)	2	**allow** xylem / vascular bundles / veins **ignore** shoot Examiner's Comments The majority of candidates correctly answered root and stem although there were some higher level answers that gained credit such as xylem.
		ii	plants / weeds (1)	1	**ignore** herbs Examiner's Comments?? Plants or weeds were equally common correct answers but herbs, herbivores or insects were incorrectly stated by some candidates.
			Total	3	
35		i	0.08 (1)	1	?Examiner's Comments?? Most candidates correctly gave 0.08 seconds. Common incorrect answers included 0.04 and 0.16.
		ii	contraction of ventricles is longer / 0.24 v 0.08 (1) need to pump blood further / to the body (1)	2	**allow** atria only need to pump the blood into the ventricles / do not need to pump as far (1) **ignore** to generate a higher pressure ?Examiner's Comments?? Most candidates gained at least one mark and many gained both. One common incorrect answer was that while the ventricles pump blood to the body, the atria pump it to the lungs.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
36			[Level 3] Gives a full explanation that pesticide movement is driven by transpiration and occurs through the xylem **and** explains why pesticide movement is greater on warm sunny days. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Gives an explanation that pesticide movement is driven by transpiration and occurs through the xylem. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Gives a partial explanation explaining that pesticide movement is linked with transpiration **or** that it occurs through the xylem. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Indicative scientific points at level 3 (HD) may include: **transpiration** is greater when it is warm / sunny because: • (higher temperatures) increase rate of evaporation / diffusion • (on sunny days) stomata open (more widely) Indicative scientific points at levels 1 and 2 (SD) may include: • pesticide moves by transpiration • transpiration involves evaporation / diffusion • transpiration is greater when it is warm / sunny • movement through xylem if refer to stem / veins / vessels / phloem instead of xylem, limit to 5/3/1 marks if refer to just evaporation / diffusion instead of transpiration, limit to 5/3/1 marks if only give L3 indicative points, limit to L1 Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question was well answered with very few candidates gaining no marks and many gaining full marks, although the full range of marks was seen. Candidates usually addressed all parts of the question and attempted to use appropriate scientific terminology. All acceptable answers on the mark scheme were seen.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
37			idea that **all** the blood goes through the lungs (1)	1	**allow** all the blood needs oxygenating ?Examiner's Comments?? Some candidates failed to realise that all blood has to go through the lungs. They reverted to more superficial responses.
			Total	**1**	
38		i	17 500 (ml per minute) (1)	1	Examiner's Comments?? Most candidates correctly calculated 17 500 ml per minute.
		ii	heart (1) because pumps harder / faster (1)	2	**allow** beats harder / faster **allow** pumps more blood **allow** increases pressure of blood that it is pumping ?Examiner's Comments?? Over half the candidates gained full marks. Some thought it was the lungs.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
39			due to contraction of heart (muscle) (1) so that blood reaches all parts of the body (1)	2	**allow** pushed / pumped / squeezed by heart (muscle) **allow** needs lots of force to get through the capillaries **allow** so it gets around the body **allow** arteries have thick wall / narrow lumen (1) **ignore** blood travels through small vessels / narrow vessels ?Examiner's Comments?? To gain full marks candidates had to explain both what causes the high pressure in arteries as well as its purpose. Around half the candidates gained at least one mark, usually for the idea that the pressure ensures blood gets around the whole body. Fewer gained the second mark for explaining that the pressure is generated by the heart pumping or contracting.
			Total	**2**	
40	a		red blood cells – carry oxygen (1) platelets – clotting (of blood) (1)	2	 **allow** stops bleeding **ignore** heals / forms scabs / blocks wounds
	b	i	more (1) smaller (1)	2	**allow** answer ringed, underlined or ticked more than one answer= 0
		ii	28% (2) But if incorrect or incomplete $\frac{7 \times 40}{10}$ (1)	2	
		iii	Camels (blood has lower percentage of red blood cells because) often have to go for long periods of time without water ORA (1)	1	
			Total	**7**	

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Question			Answer/Indicative content	Marks	Guidance
41		i	**any two from:** has a nucleus ora (1) has mitochondria ora (1) has chloroplasts ora (1)	2	**not** cell wall **not** cytoplasm **not** cap
		ii	some genes can be lost from some cells: ☐ both aerobic and anaerobic respiration can occur: ☐ cells are able to differentiate and specialise: ✓ organisms are able to clone themselves: ☐	1	more than one answer = 0
		iii	nervous or hormone system to communicate between cells / transport or circulation or cardiovascular system to carry nutrients / oxygen / blood / CO_2 around the organism excretory or gas exchange system to exchange materials with the surroundings (1)	1	**ignore** named organs e.g. kidney / heart etc. for system **allow** explained alternative systems e.g. respiratory system / reproductive / digestive
			Total	**4**	
42		i	2.5 (1)	1	
		ii	the shrew needs / uses lots of oxygen (1) shrew red blood cell has a large surface area to volume ratio (1) this means that it can pick up / release oxygen **quickly** (1)	3	 **ignore** references to shrew's body surface area to volume ratio **ignore** pick up more oxygen
			Total	**4**	
43			root (hairs) (1) leaves / stomata (1)	2	**ignore** pores
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
44			as air movement increases so does the rate of transpiration / ora(1) (rate increases) due to increase in diffusion (through the stomata) /ora (1) identifies valid reason for not increasing further (1)	3	**allow** idea that increasing speed of fan increases transpiration rate / ora (1) **allow** idea that increasing wind speed increases transpiration rate / ora (1) **allow** as air movement increases so does the uptake of water / ora (1) **ignore** movement of air bubble **allow** (rate increases) due to increase in evaporation / ora(1) **allow** idea that increasing wind speed decreases humidity / ora (1) **allow** more or faster water loss from diffusion / evaporation (1) e.g. limited by number of stomata / temperature / humidity (1) **allow** limited by another factor / no longer the limiting factor (1) **ignore** stomata close
			Total	3	
45			B ✓	1 (AO 1.1)	Examiner's Comments This is an AO1.1 question testing recall of cell types. In general, this was successfully done, however, the number of candidates who thought the cells were sperm cells indicates a lack of knowledge of cells.
			Total	1	
46			A ✓	1 (AO 1.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
47	a	i	marked correctly on diagram ✓	1 (AO 1.1)	ALLOW centre of X anywhere inside the shaded area  <u>Examiner's Comments</u> The question required candidates to demonstrate a knowledge of the structure of the heart AO1.1. Candidates made responses in all four chambers in almost equal numbers. Lower ability candidates put their response inside blood vessels or in some cases did not respond at all. Candidates should be encouraged to attempt all questions, especially those that can be answered using, for example, a choice of placing a letter on a diagram or completing sentences using words from a list.
		ii	aorta / arteries✓ lungs✓	2 (AO 2 x 1.1)	<u>Examiner's Comments</u> This question targeted knowledge of the circulatory system AO1.1. Generally, the sequence of blood circulating the body was a well understood with many getting maximum marks. In some cases, either the artery/aorta or lungs were identified but not both.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	double (circulation)✓	1 (AO 1.1)	ALLOW double Examiner's Comments This AO1.1 question assessed if candidates can recall the name of the circulation if blood travels through the heart twice in one circuit. Some candidates correctly identified double circulation but many just referred to blood circulation and seemed to be unaware of double circulatory systems.
		ii	Any two from: increases the pressure of the blood / higher blood pressure✓ increases the flow rate of the blood✓ idea of faster transport of materials✓	2 (AO 2 x 1.1)	ALLOW pushes blood more DO NOT ALLOW pushes more blood unqualified ALLOW to make the blood flow faster IGNORE makes blood flow fast ALLOW more oxygen / glucose to the tissues ALLOW keeps the blood well oxygenated / gets more oxygenated blood ALLOW faster removal of carbon dioxide from blood Examiner's Comments This AO2.1 question required an understanding of the advantages of a double circulatory system. Increased flow rate was the most common correct response. Some candidates were able to identify the increased pressure, or materials will be able to be transported faster/ in greater amounts. Only higher ability candidates gained maximum marks. A common misconception is that it allows more blood to travel around. Candidates do not seem to be aware that it is the same volume of blood but travelling faster.

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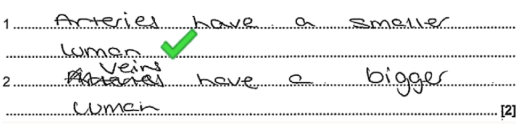
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Question			Answer/Indicative content	Marks	Guidance
	c		left side thicker (than the right side)✓ left pumps blood further✓	2 (AO 2 x 1.1)	ALLOW it's thicker / it's more muscular ALLOW left ventricle thicker than right IGNORE left is bigger ALLOW left pushes blood all around the (rest of the) body / right only pushes to lungs ALLOW left side must generate more pressure IGNORE left side contains blood at high pressure <u>Examiner's Comments</u> In this AO1.1 question, there were some candidates who mistakenly identified the right side of the heart, however, these were in the minority. The main issue was candidates linking the thickness of the heart wall to resisting pressure, rather than to needing to generate pressure.

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Question			Answer/Indicative content	Marks	Guidance
	d	i	Any two from: artery thicker walled/ ORA ✓ artery more muscle tissue/ ORA ✓ artery narrower bore/lumen/ ORA ✓	2 (AO 2 x 2.1)	 ALLOW artery (more) elastic ALLOW artery has smaller area for blood to pass through <u>Examiner's Comments</u> The AO2.1 diagram specifically directed candidates to consider applying their knowledge of the structures of the blood vessels to the diagrams. The main reason for not gaining marks was candidates not referring to the structure. Many just said the artery was thicker, without identifying which part of the artery. More able candidates were able to refer to differences in the wall and the lumen. Candidates often limit the mark gained in multiple mark questions by repeating their initial response in a different way.  Examination technique can be developed to encourage candidates to avoid this. **Exemplar 1**  1 Arteries have a smaller lumen 2 Veins have a bigger lumen [2] This candidate has assumed they have given two separate differences. However, there response covers the same marking point so only scores 1 mark. It is clear with the way the response is set out that the candidate thought they were giving two separate marking points but had just described the difference in size of lumen.

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Question			Answer/Indicative content	Marks	Guidance
		ii	**Any one from:** veins have valves✓ arteries take blood away from the heart / veins take blood to the heart✓ blood flows faster / higher pressure in arteries /ORA✓	1 (AO 1.1)	IGNORE valves unqualified ALLOW arteries carry oxygenated / veins carry deoxygenated blood Examiner's Comments This recall AO1.1 question was well answered. Most candidates identified that arteries carried blood away from the heart or veins back to the heart. Some candidates identified veins having valves.
			Total	11	

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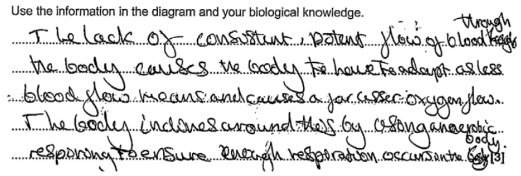
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Question			Answer/Indicative content	Marks	Guidance
48		i	guard cell✓	1 (AO 1.1)	IGNORE stomatal cells Examiner's Comments This AO1.1 question assessing recall of knowledge of guard cells proved challenging. Very few candidates could name the guard cell. Most candidates referenced organelles such as chloroplasts and mitochondria. Some responded with cell membrane and even cytoplasm (already labelled).  The question did ask for the name of the cell and candidates need to check carefully that they have responded to the question.
		ii	allows gaseous exchange (of CO_2 and O_2)✓ allows water evaporation (to help transpiration)✓	2 (AO 2 x 1.1)	ALLOW to release/let water out of the leaf/plant IGNORE to let water enter the leaf/plant Examiner's Comments These two marks were assessing AO1.1. Most candidates seemed to be confused with the role of stomata. The most common misconception was that the function of stomata was to let water into the leaves.  The role of gas exchange seemed poorly understood as only a limited number of candidates were able to show an understanding of the gases that move through the stomata.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
49	a		blood vessels / arteries are blocked/narrowed ✓ (heart muscle) gets less blood ✓ (heart muscle) gets less oxygen ✓	3 (AO 2.1)	ALLOW atheroma / plaque formed IGNORE no blood IGNORE no oxygen IGNORE references to blood circulation to body cells <u>Examiner's Comments</u> Over half of candidates scored at least one mark here mainly for less blood flow (to the heart muscle). A lot of candidates got confused with the blood flow to the heart muscle with blood flow to the body cells, therefore not gaining credit. Exemplar 8 demonstrates this confusion and is not credited any marks. Exemplar 8  Use the information in the diagram and your biological knowledge. The lack of consistent, potent flow of blood through the body causes the body to have to adapt as less blood flow means and causes a far lesser oxygen flow. The body includes around this by using anaerobic respiring to ensure enough respiration occurs in the body. [3]
	b	i	idea that it widens/opens the (lumen) of the artery ✓ more blood/oxygen will be able to reach the heart muscle ✓	1 (AO 2.2) 1 (AO 3.1b)	IGNORE expands the artery <u>Examiner's Comments</u> Most common credited mark was for the idea the stent widens/opens up the artery. Few candidates stated that more blood/oxygen would be able to reach the heart muscle.

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Question			Answer/Indicative content	Marks	Guidance
		ii	advantage: avoids an operation ✓ disadvantage: could be side effects of the drug / must take it on a regular basis ✓	2 (AO 2 × 2.1)	ALLOW named side effect e.g. liver damage/upset stomach ALLOW may forget to take the drug / misuse of the drug Examiner's Comments Most candidates didn't gain the marks for the advantage of taking statins because they just repeated the question and stated it lowers the level of cholesterol in a person's blood. A number of candidates achieved the disadvantage marking point, with the most common answer being that they have to take it on a regular basis. A number of candidates stated that the blood cholesterol would become too low, which wasn't credited.
			Total	7	
50			C ✓	1 (AO 1.2)	
			Total	1	
51			D ✓	1 (AO 2.2)	
			Total	1	
52			C ✓	1 (AO 1.1)	Examiner's Comments This question was the most accessible question in section A, with most candidates correctly answering C.
			Total	1	
53			A ✓	1 (AO 1.1)	
			Total	1	

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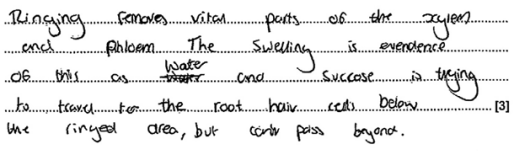
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Question			Answer/Indicative content	Marks	Guidance
54	a	i	photosynthesis makes sugars in guard cells ✓ epidermal cells (dont photosynthesise so) lower in sugar than guard cell ✓ **and any two from:** epidermal cells higher osmotic / water potential than guard cells ✓ ORA water enters guard cells (by osmosis) ✓ ORA increasing turgidity of guard cell opens stomata ✓ ORA due to thicker inner cell wall ✓ opening / size of stoma affects transpiration rate ✓	4 (AO 2 × 1.1) (AO 2 × 2.1)	**ALLOW** correct description of transpiration linked to the size of stoma Examiner's Comments Candidates found this question one of the most challenging on the paper. Few candidates demonstrated a good knowledge of the mechanism of stomatal opening. Many candidates seemed to reverse the question and tried to explain how the rate of transpiration controlled photosynthesis in guard cells.
		ii	they have differentiated ✓ have a **specific** job to do (in the leaf/plant) ✓	2 (AO 2 × 1.1)	**ALLOW** they have adapted (to their function) **ALLOW** no other cells do the same job **ALLOW** they can open / close stomata they have adapted to a **specific** job / they are adapted to open and close stomata = 2 marks Examiner's Comments There were some good answers focussing on the structural differentiation of guard cells and the fact that they have a specific role.

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Question			Answer/Indicative content	Marks	Guidance
	b		phloem is removed ✓ swelling caused by a build-up of food/sugar ✓ food/sugar produced in the leaves / moving downwards cannot get past (the ringed area)✓	3 (AO 3 × 3.2b)	ALLOW phloem is on the outside IGNORE nutrients / minerals / ions ALLOW glucose / sucrose ALLOW translocation to roots is prevented <u>Examiner's Comments</u> This was another challenging question for many candidates. They needed to observe from the transverse section, that it was the phloem that was removed from the stem. Candidates needed to apply that information to the build-up of sugar on the pathway down the stem. A number of candidates explained the swelling as a defence mechanism. Others such as exemplar 9, put the swelling change down to xylem and phloem and did not gain marks. Exemplar 9  Ringing removes vital parts of the xylem and phloem. The swelling is evidence of this as water and sucrose is trying to travel to the root hair cells below the ringed area, but can't pass beyond. [3]
			Total	9	
55			B	1 (AO 2.2)	<u>Examiner's Comments</u> This is an AO2.2 question testing the ability to apply knowledge of ratios. Several candidates answered A, with correct workings shown for the surface area and volume. This indicates that the candidate could not apply their knowledge of surface area and volume to producing a ratio.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
56	a		xylem cell ✓	1 (AO 1.1)	Examiner's Comments This AO1 question was targeting candidates' knowledge of plant transport structure, with many candidates opting between xylem and phloem in almost equal numbers.
	b		Any two from: dead cells ✓ thick/strengthened cell wall ✓ hollow (lumen) ✓	2 (AO 1.1)	ALLOW ECF from the cell selected in 16(b) ALLOW lignin present/lignified IGNORE cellulose ALLOW waterproof walls ALLOW forms continuous walls/column for water/ continuous tube IGNORE contain water Examiner's Comments Very few gave 2 correct responses to this AO1 question. Most common responses related to thick cell walls, lignified cells and dead cells. Some candidates did not score due to just referencing normal plant cell features such as a rigid cell wall or cell membrane rather than adaptations shown by xylem. Some candidates who had put phloem for (c) were able to get the ECF (error carried forward), but usually only 1 mark for perforated end or no nucleus but rarely both. This does indicate a need to reinforce the difference between xylem and phloem and the differences in their adaptations.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
57	a	i	phloem ✓	1 (AO 2.1)	Examiner's Comments This AO1 question was targeting candidates' knowledge of the location of plant transport structures. Like in the previous question on adaptations, many candidates opted between xylem and phloem in almost equal numbers.
		ii	idea that sugar / food / nutrients removed (by the greenfly) ✓ Any one from: So less left for growth ✓ So less for respiration / energy / ATP ✓	2 (AO 2.1)	IGNORE xylem / root hair IGNORE water / minerals ALLOW so not enough for growth / so unlikely to grow / difficult to grow healthily ALLOW less sugar translocated/transported to other parts Examiner's Comments This AO2.1 question tested candidates' ability to apply knowledge of plant transport. Many candidates thought the greenfly was feeding from the xylem or that phloem transported water, and therefore focused on the plant having insufficient water for growth. Others thought that the greenfly was damaging the plant and the need for repair of the damage would prevent growth.

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Question			Answer/Indicative content	Marks	Guidance
	b		MRI / X-ray imaging / new technology allows new evidence to be collected ✓ ideas/explanations have changed to fit new observations/technologies ✓	2 (AO 3.1b)	**ALLOW** idea MRI etc. shows precise position of water whereas older techniques give approximate position **ALLOW** couldn't see what they can see now with new methods **ALLOW** tissue easily disturbed by injected dyes / AW **ALLOW** modern methods give more accurate results **ALLOW** different techniques give different results so different conclusions drawn Examiner's Comments This AO3.1 question required evaluation. A lot of candidates thought that plants may have evolved in the last 50 years so water moves differently. However, most just restated the question without addressing the idea of collecting new evidence, so did not demonstrate an ability to evaluate.
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
58	a		blood travels through pump/heart twice ✓ on full circuit around body ✓	2 (AO1.1)	ALLOW idea that there are two pumps / idea that blood is pumped twice ALLOW idea that blood passes **separately** to lungs and body Examiner's Comments In this AO1.1 question many candidates described the diagram but got confused. Some wrote about blood vessels rather than the heart. Candidates that gained credit identified that blood passes through the heart twice but were often unable to identify that this happens on a complete full circuit of the body.
	b		bird ✓ bird has 4 chambered heart ✓ bird has double circulation✓	3 (AO 2.1)	If bird is not ticked or bird not selected in answer, then zero for question ALLOW bird has heart with 4 sections/compartments/named four chambers ALLOW description of double circulation Examiner's Comments In this AO2.1 question many candidates were identifying the bird, and some went on the justify their choice. However, most candidates often repeated similar descriptions to their previous answer, with few clearly identifying birds as having double circulation. It was very rare to see candidates who had recognised both birds and humans as having 4 chambers to the heart. Some did gain credit for this mark for correctly naming all 4 chambers.

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Question			Answer/Indicative content	Marks	Guidance
	c	i	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 4 award 2 marks** 25 000÷5800 = 4.3 ✓ = 4 (nearest whole number) ✓	2 (AO 2.2) (AO 1.2)	**ALLOW** ECF mark for correct rounding if calculation is incorrect Examiner's Comments This question tested AO1.2 and AO2.2. Most candidates did this correctly although some stated 4.3 and did not gain the second marking point. There were a minority who just subtracted the two numbers.
		ii	**Any two from:** muscles need more energy / more ATP / more respiration ✓ muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production ✓ other organs not needed (in exercise) ✓	2 (AO 3.2a)	need to include only one comparative word e.g. more, to be able to score the first two marking points, e.g. muscles need **more** oxygen for energy = 2 marks **ALLOW** to remove more heat **ALLOW** other organs not prioritised / blood diverted from other organs Examiner's Comments This AO3.2 question proved challenging. Most responses focused on increased blood flow but gave no indication of why this was needed. Marks were often gained for muscles needing 'more oxygen' or 'other organs not needed', with a few marks being given for the lactic acid/respiration ideas.
			Total	9	

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Question			Answer/Indicative content	Marks	Guidance
59	a		blood travels through pump/heart twice ✓ on full circuit around body ✓	2 (AO 1.1)	ALLOW idea that there are two pumps / idea that blood is pumped twice ALLOW idea that blood passes **separately** to lungs and body Examiner's Comments There were many concise and correct answers, stating that the blood flows through the heart twice on each circuit. Some candidates tried to describe the flow of blood, but their answers did not differentiate between a single or a double system.
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 award 2 marks 25 000÷5800 = 4.3 ✓ = 4 (nearest whole number) ✓	2 (AO 2.2 1.2)	ALLOW ECF mark for correct rounding if calculation is incorrect Examiner's Comments The majority of candidates extracted the correct numbers from the table, completed the calculation and gave their answer to the nearest whole number.

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Question			Answer/Indicative content	Marks	Guidance
		ii	**Any two from:** muscles need more energy / more ATP / more respiration ✓ muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production ✓ other organs not needed (in exercise) ✓	2 (AO 3.2a)	need to include only one comparative word e.g. **more**, to be able to score the first two marking points, e.g. muscles need more oxygen for energy = 2 marks **ALLOW** to remove more heat **ALLOW** other organs not prioritised / blood diverted from other organs <u>Examiner's Comments</u> The main error here made by candidates was that they did not give a comparative answer. Exemplar 1 clearly states that more oxygen is required for more respiration and so scores both marks. Only one comparative statement was required but a number of candidates did not give any, simply stating that muscles need more blood because they need oxygen. **Exemplar 1** The blood flow to the muscles increases because they are contracting more and hence require more glucose and oxygen for more respiration. the increased blood flow provides the muscle cells with significant amounts of glucose and oxygen. [2]
	c		bird ✓ bird has 4 chambered heart ✓ bird has double circulation✓	3 (AO 2.1)	If bird is not ticked or bird not selected in answer, then zero for question **ALLOW** bird has heart with 4 sections/compartments/named four chambers **ALLOW** description of double circulation <u>Examiner's Comments</u> The majority of candidates chose the correct organism and stated that the fish had a double circulatory system and had a four-chambered heart. A description of the double system was accepted.

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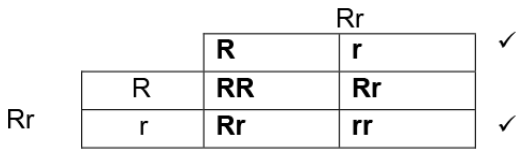
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Question			Answer/Indicative content	Marks	Guidance
			Total	9	

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Question			Answer/Indicative content	Marks	Guidance
60	a		clots the blood ✓ prevents bleeding / allows wounds to heal / forms a scab ✓	2 (AO 1.1)	IGNORE clump blood ALLOW prevents pathogens getting into the body <u>Examiner's Comments</u> There was some confusion in the responses describing the role of platelets whereby candidates thought platelets had a role in the specific immune response. Only higher ability candidates gained a mark here.
	b		 ✓ ✓ ratio 3 : 1 ✓	3 (AO 2.1) (AO 3.2b)	correct gametes = one mark correct genotypes of offspring = 1 mark ALLOW ECF for ratio ALLOW 3 in 4 <u>Examiner's Comments</u> The majority of candidates achieved two or three marks correctly identifying the gametes and genotypes. Most went onto correctly identifying the ratio if they achieved the gametes mark. Very few candidates achieved the error carried forward mark.

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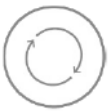
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Question			Answer/Indicative content	Marks	Guidance
	c		**Any three from:** variation with some rats resistant and some who are not ✓ (resistant rats) more likely to survive/less likely to be killed ORA ✓ (resistant rats more likely) reproduce ORA ✓ pass on the allele / gene for resistance ORA ✓	3 (AO 2.1)	**IGNORE** selective breeding **ALLOW** mutation for resistance **ALLOW** offspring produced / breed together **ALLOW** pass on advantageous gene **IGNORE** trait is passed on / genes are passed on Examiner's Comments Candidates had to apply their knowledge of natural selection to explain why the percentage of resistant rats was increasing. There were a range of marks given for this question. Most none scoring responses were too vague and not using key terms. Most candidates did not appreciate that there was variation for resistance within the population.
	d		**Any two from:** (stops/less) respiration ✓ (no/less) energy/ATP ✓ key process interrupted e.g. cell metabolism/protein synthesis/chemical reactions/active transport ✓	3 (AO 2.1)	Examiner's Comments This question was one of the most challenging application of knowledge and understanding questions. The most common awarded mark was appreciation that energy release would be affected. A lot of responses were very general and would say the rat can't breathe or can't get any oxygen.
			Total	11	

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Question			Answer/Indicative content	Marks	Guidance
61	a		platelets are needed for blood clotting ✓ the rat would keep bleeding/bleed to death ✓	2 (AO 2.1)	Examiner's Comments Many candidates were able to score both marks on this AO2.1 question although some did not mention platelets. A significant number of candidates, however, linked the poison to clotting incorrectly, saying blood would clot too much or in the wrong place. In that type of response, there were references to heart attacks and strokes. Some candidates referred to wounds clotting.
	b		parents are Rr and Rr ✓ offspring are RR, Rr, Rr, rr ✓ rr identified as being non-resistant ✓	3 (AO 2.2)	ALLOW all marks from a Punnett square ALLOW ECF on offspring Examiner's Comments Many candidates scored on this AO2.2 question. The most frequent way candidates did not get maximum marks was by omitting to identify the correct offspring genotype. Candidates needed to annotate rr. A significant number of candidates only identified the non-resistant rate, not noticing that homozygous dominant rats were also present in that ratio; and therefore only stating 25% were homozygous. Candidates should be encouraged to routinely include the phenotypic ratio.  AfL Some candidates made errors on the Punnett square diagram. The main error was to cross R with r and derive RR. Candidates should be encouraged to check their answers for this type of error.

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Question			Answer/Indicative content	Marks	Guidance
	c		Rr/heterozygous rats more likely to survive than RR/homozygous rats as they need less vit K / ORA ✓ therefore, when two Rr rats mate rr rats will be born ✓	2 (AO 2.2)	ALLOW rats that need less vit K are more likely to survive Examiner's Comments Where candidates successfully answered this AO2.2 question, it was from developing ideas from the previous question and linking the vitamin K survival rate in the heterozygous rat to when two Rr rats mate rr rats will be born. Many responses to this question showed confusion. Candidates referred to a variety of incorrect explanations such as non-resistant alleles becoming dominant and rats finding enough vitamin K to become non-resistant but immune to warfarin. Other incorrect responses included non-resistant rats surviving because they don't need much vitamin K and rats in some areas not getting access to warfarin.
			Total	7	
62			D ✓	1 (AO1.1)	
			Total	1	
63			C ✓	1 (AO1.1)	
			Total	1	
64			D ✓	1 (AO2.1)	
			Total	1	
65			B ✓	1 (AO2.2)	
			Total	1	
66			B ✓	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
67	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 : 1 award 2 marks 24 : 8 or 3 ✓ 3 : 1 ✓	2 (AO2.2)	ALLOW answer in the table but answer on answer line takes preference
		ii	higher SA:V ratio faster rate of diffusion / ORA ✓	1 (AO3.2b)	ALLOW positive correlation ALLOW reference to less time instead of faster rate IGNORE they are directly proportional
		iii	reduces (total) SA of alveoli/air sacs / reduces SA : Vol ratio of alveoli/air sacs ✓ so diffusion (of oxygen) reduced ✓	2 (AO2 x 3.1a)	ALLOW harder for oxygen to diffuse IGNORE oxygen cannot diffuse into the blood in emphysema
	b		sickle red blood cells release/take up/carry/deliver/transport less oxygen ✓ sickle cells have a smaller surface area (to vol ratio) / tend to get stuck in blood vessels/capillaries / cannot pass through blood vessels/capillaries so easily ✓	2 (AO1.1) (AO2.1)	IGNORE less oxygen binds to RBCs / sickle cells cannot carry oxygen IGNORE references to smaller volume / less Hb / less space on the RBCs
			Total	7	

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Question			Answer/Indicative content	Marks	Guidance
68			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Provides a detailed explanation linking cholesterol to heart disease. **AND** Provides a detailed analysis to explain if this link is supported by the graph. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Provides a detailed explanation linking cholesterol to heart disease. **OR** Provides a detailed analysis to explain if this link is supported by the graph. **OR** Provides a basic explanation linking cholesterol to heart disease. **AND** Provides a basic analysis of the information to explain if this link is supported by the graph. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Provides a basic explanation linking cholesterol to heart disease. **OR** Provides a basic analysis of the information to explain if this link is supported by the graph. **OR** Demonstrates knowledge of the importance of the blood supply to the heart muscle. *There is an attempt at a logical structure with a line of reasoning. The information is*	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1b)	**AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle.** • coronary artery carries blood to heart/muscle • blood takes oxygen/glucose to the heart/muscle • heart/muscle carries out aerobic respiration/needs energy • energy is needed for the heart/muscle to contract **AO2.1 Apply knowledge and understanding of the requirements of the heart muscle** • cholesterol build up (partially) blocks the blood flow in the artery • this reduces blood/oxygen/glucose carried to the heart/muscle • heart/muscle carries out less aerobic respiration/less energy released • heart/muscle can't contract as forcefully **AO3.1b Analyse information and ideas to interpret the results on the study** **Support the link:** • men with heart disease had (on average) a higher blood cholesterol level. • Men without heart disease had (on average) a lower blood cholesterol level. • build-up of cholesterol can lead to heart disease **Doesn't support the link:** • considerable overlap between the two groups • men can still have heart disease with low blood cholesterol levels • Men without heart disease can still have high blood cholesterol levels

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Question			Answer/Indicative content	Marks	Guidance
			in the most part relevant. 0 marks *No response or no response worthy of credit*		
			Total	6	
69			A ✓	1 (AO1.1)	
			Total	1	
70			C ✓	1 (AO1.1)	
			Total	1	
71			C ✓	1 (AO1.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
72	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3 : 1 award 2 marks 24 : 8 or 3 ✓ 3 : 1 ✓	2 (AO2.2)	ALLOW answer in the table but answer on answer line takes preference
		ii	higher SA:V ratio faster rate of diffusion / ORA ✓	1 (AO3.2b)	ALLOW positive correlation ALLOW reference to less time instead of faster rate IGNORE they are directly proportional
		iii	reduces (total) SA of alveoli/air sacs / reduces SA : Vol ratio of alveoli/air sacs ✓ so diffusion (of oxygen) reduced ✓	2 (AO2 x 3.1a)	ALLOW harder for oxygen to diffuse IGNORE oxygen cannot diffuse into the blood in emphysema
	b		sickle red blood cells release/take up/carry/deliver/transport less oxygen ✓ sickle cells have a smaller surface area (to vol ratio) / tend to get stuck in blood vessels/capillaries / cannot pass through blood vessels/capillaries so easily ✓	2 (AO1.1) (AO2.1)	IGNORE less oxygen binds to RBCs / sickle cells cannot carry oxygen IGNORE references to smaller volume / less Hb / less space on the RBCs
			Total	7	

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Question			Answer/Indicative content	Marks	Guidance
73	a	i	water evaporates (on surface of spongy mesophyll) ✓ water (vapour) passes/diffuses through the stomata/pores ✓	2 (AO1.1)	Need evaporate or a description of the process
		ii	measure distance gas bubble moves ✓ over certain time / specified time ✓ vary distance of lamp from potometer ✓	3 (AO1.2)	ALLOW measure position of bubble before and after time taken for bubble to move a certain distance = 2 marks
		iii	absorbs heat/thermal energy (from lamp) / keeps (plants at) constant temperature ✓ heat/temperature would affect transpiration ✓	2 (AO2.2)	IGNORE references to photosynthesis
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 57 (mm^3) award 3 marks π x 0.5^2 x 72 ✓ = 56.52 ✓ = 57 (mm^3) ✓	3 (AO3 x 2.2)	ALLOW one mark for an answer of 226.08 and 2 marks for an answer of 230 (1.0 has been used as r) ALLOW one mark for clear evidence of incorrect answer correctly rounded to two sig figs.
		ii	42 (mm) / Trial 1 at 40cm ✓ reading taken too quickly after moving the lamp / error in measurement (distance bubble moved/time) / heat sink not in the way/radiating heat / change in room temp/air movements / potometer/light not at correct distance ✓	2 (AO2 x 2.2)	
		iii	Idea that they should remove/ignore the anomalous result (before processing) ✓	1 (AO1.2)	ALLOW repeat that reading
		iv	the mean is 73 mm ✓ the range of values is 71 to 75 / range is 4 mm / 2mm is half the range ✓	2 (AO2 x 1.2)	ALLOW adding or subtracting 2 from 73 covers all the readings this is the mean ± half the range = 2 marks
			Total	15	

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Question			Answer/Indicative content	Marks	Guidance
74	a		**Any two from:** anaemia / tiredness / lack of energy due to lack of red blood cells ✓ inability to fight off infections / prone to infections due to lack of white blood cells/WBC ✓ slow blood clotting due to lack of platelets ✓	2 (AO2 x 1.1)	**DO NOT ALLOW** incorrectly matched symptom to blood cell type **ALLOW** less immunity / reduced immune response / weakened immune system due to lack of white blood cells/WBC **ALLOW** (recurring) nosebleeds / bruise easily due to lack of platelets
	b	i	people may be ill with infection / have a pathogen / just recovering from infection ✓ therefore have produced more white blood cells to destroy the pathogen/produce antibodies ✓ **OR** weakened immune system/cancer/cancer treatment reducing white blood cell number so less white blood cells to defend against pathogens/produce antibodies	2 (AO2 x 2.1)	**IGNORE** fighting(off) pathogens
		ii	Area = 10 × 10 = 100(mm^2) Volume = 100 × 0.001 = 0.1 (mm^3) ✓	1 (AO2.2)	
		iii	No (no mark) 1000 ÷ 0.1 OR 1000 x 10 ✓ number of white blood cells/mm^3 is 10 x 10^3 / 1.0 x 10^4 / 10000 ✓ within the range of 6.0 – 16.0 x 10^3 ✓	3 (AO2 x 2.2) (AO3.2b)	**ALLOW** ECF from (ii) **ALLOW** number of white blood cells /mm^3 = 10 000 **ALLOW** within the normal white blood cell range/ 6000 – 16000

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Question			Answer/Indicative content	Marks	Guidance
	c		(Fanconi anaemia) (no mark) (3 x 10^6 is a) low red blood cell count ✓ must be Fanconi anaemia because: caused by recessive allele ✓ obtained from heterozygous/carrier parents who don't have a blood disorder ✓ OR cannot be D-B anaemia because: neither parents have a blood disorder ✓ it is caused by a dominant allele ✓	3 (AO3x3.2 b)	if incorrect disorder then no marks IGNORE low numbers of all cells
			Total	11	

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Question			Answer/Indicative content	Marks	Guidance
75			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Demonstrates a knowledge of the importance of the blood supply to the heart. **AND** Applies knowledge to explain why a failure of this blood supply can lead to heart disease. **AND** Analyses the information to explain the link between a lack of LDL protein and heart disease. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Demonstrates a knowledge of the importance of the blood supply to the heart. **AND** Applies knowledge to explain why a failure of this blood supply can lead to heart disease. **OR** Demonstrates a knowledge of the importance of the blood supply to the heart. **AND** Analyses the information to explain the link between a lack of LDL protein and heart disease. **OR** Applies knowledge to explain why a failure of this blood supply can lead to heart disease. **AND** Analyses the information to explain the link between a lack of LDL protein and heart	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)	**AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle.** • blood in the coronary artery supplies heart muscle • oxygen / glucose is supplied to the muscle • this is needed for the muscle to contract/for respiration **AO2.1 Apply knowledge and understanding of the requirements of the heart muscle** • without oxygen / glucose the heart muscle cannot respire • energy from respiration is needed for the muscle to contract **AO3.1a Analyse information and ideas to interpret the effects of lack of LDL receptor protein.** • without LDL receptor protein there will be more cholesterol in the blood / cholesterol levels will be too high to be removed/broken down • increased build up of cholesterol in the coronary artery will increase the risk of heart disease / decrease blood flow to the heart muscle

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Question			Answer/Indicative content	Marks	Guidance
			disease. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Demonstrates a knowledge of the importance of the blood supply to the heart. **OR** Applies knowledge to explain why a failure of this blood supply can lead to heart disease. **OR** Analyses the information to explain the link between a lack of LDL protein and heart disease. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit*		
			Total	6	
76			**Any two from:** (small pieces means) there will be a larger surface area of dead plants ✓ therefore, decomposers will be able to reproduce faster / feed faster ✓ therefore, decomposers will be able to respire faster ✓	2 (AO 2 × 2.2)	Examiner's Comments In this AO2 question, few candidates linked size to area and a number incorrectly thought large pieces had large surface area. Very few candidates were able to link the size to rates of respiration or reproduction.
			Total	2	

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