Mark scheme – The Challenges of Size (H)

Question			Answer/Indicative content	Marks	Guidance
1			C ✓	1 (AO1.1)	
			Total	**1**	
2			A ✓	1 (AO1.1)	
			Total	**1**	
3			C ✓	1 (AO1.1)	
			Total	**1**	
4			D ✓	**1 (AO 2.2)**	
			Total	**1**	
5			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**	
6			A ✓	**1 (AO 1.1)**	
			Total	**1**	
7			C ✓	**1 (AO 1.2)**	
			Total	**1**	
8			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	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

			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 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.		• 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

			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**	
9	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
	c		(Fanconi anaemia) (no mark) (3 x 10^6 is a) low red blood cell count ✓ must be Fanconi anaemia because:	3 (AO3x3.2b)	**if incorrect disorder then no marks** **IGNORE** low numbers of all cells

			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 ✓		
			Total	**11**	
10	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** $\pi \times 0.5^2 \times 72$ ✓ = 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 ✓	2 (AO2 x 1.2)	

			the range of values is 71 to 75 / range is 4 mm / 2mm is half the range ✓		**ALLOW** adding or subtracting 2 from 73 covers all the readings this is the mean ± half the range = 2 marks
			Total	**15**	
11	a		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
	b	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
			Total	**7**	
12	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.
	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**	
13	a		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** 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.
	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.
		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** 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		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.
			Total	**9**	
14			**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**	
15	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.
	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 **Examiner's Comments** 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 evendence of this as ~~water~~ and sucrose is trying to travel for the root hair cells below the ringed area, but can't pass beyond. [3]
			Total	**9**	