OCR GCSE GATEWAY BIOLOGY A · J247

BIOLOGY



MARK SCHEME

B3.3 MAINTAINING INTERNAL ENVIRONMENTS

SCORE	PERCENTAGE
/190	%

STEMUP

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Question			Answer/Indicative content	Marks	Guidance
1			idea that it is a sign of the extent of the disease (1) temperatures far away from normal can be dangerous (1)	1 1	
			Total	**2**	
2			kidney (1) higher volume / less concentrated (1)	1 1	
			Total	**2**	
3		i	Tim's and Meena's genotypes Nn (1)	1	
		i	correct genotypes of offspring (NN, Nn, Nn, nn)	1	
		ii	baby may be nn (1)	1	
		ii	one in four chance of baby being affected (1)	1	
		ii	pancreas produces insulin (1)	1	
		ii	insulin controls blood glucose level (1)	1	
			Total	**6**	
4			C	1	
			Total	**1**	
5			A	1	
			Total	**1**	
6			B	1	
			Total	**1**	
7		i	Tim's and Lucy's genotypes Nn (1)	1	**allow** correctly completed punnet square
		i	correct genotypes of offspring (NN, Nn, Nn, nn) (1)	1	
		ii	baby may be nn (1)	1	
		ii	one in four chance of baby being affected (1)	1	
		ii	pancreas produces insulin (1)	1	

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Question			Answer/Indicative content	Marks	Guidance
		ii	insulin controls blood glucose level (1)	1	
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
8			[Level 3] Explains implications of all **three** conditions, at least one of them in detail **and** at least one **calculation** that indicates the number of people that may be involved. Quality of written communication does not impede communication of the science at this level. **(5–6 marks)** [Level 2] Explains implications of **two** conditions **and** at least one **calculation** that indicates the number or a **calculated** percentage of people that may be involved **or two** conditions at least one of them in detail. Quality of written communication partly impedes communication of the science at this level. **(3–4 marks)** [Level 1] Explains implications of at least **one** condition. 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 may include:** • plaque formation / fatty deposits in the coronary arteries can lead to reduced blood supply to heart muscle / lack of oxygen and or glucose to heart muscle / thrombosis • high blood pressure is linked to (an increased risk of) thrombosis / strokes / kidney damage • **allow** Type 2 diabetes causes kidney damage / blindness / poor circulation / ulcers **Indicative scientific points at level 1, 2 may include:** • too much cholesterol in the blood can form plaques in the walls of arteries **ignore** high blood cholesterol is linked to (an increased risk of) heart disease (low demand) • failure to respond to insulin is failure to control blood sugar levels / Type 2 diabetes • **ignore** failure to respond to insulin is diabetes (low demand) **Indicative scientific points at level 1 only:** • high blood pressure is linked to (an increased risk of) heart disease / heart attack • **allow** 1 mark for correct calculation only with no other explanations **example** of calculations • 30 000 people in Singapore have all three conditions (or similar calculation) • 330 000 have high blood pressure only • 68% have a single condition • 60% have at least one heart related / circulatory disease Use L1, L2, L3 annotations in scoris; do

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Question			Answer/Indicative content	Marks	Guidance
					not use ticks. Examiner's Comments There were some good descriptions of the effects of cholesterol and high blood pressure. A number of candidates simply repeated the data given in the pie chart without any type of numerical calculations. The distinction between type 1 and 2 diabetes was often confused and this often limited access to the higher marks.
			Total	6	
9			sweat **evaporates** (1) taking heat from the skin (1)	2	**allow** heat is lost from the body **allow** takes heat from the body **ignore** cools body down as in stem of question Examiner's Comments Most knew that it was the evaporation of sweat which caused the cooling effect. Other candidates did not mention that the evaporation of sweat needed heat from the body. A few candidates' responses suggested that the sweat, itself, cools the skin.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
10		i	brain / hypothalamus (1) (monitors) temperature of **blood** (1)	2	**ignore** body temperature (in question) **Examiner's Comments** Often candidates got the 'brain' mark but did not score on the idea of it monitoring the blood. Many responses just referred to body temperature.
		ii	**any two from:** (more) blood flows close to surface (1) (increased) heat loss (1) by radiation / conduction / convection (1)	2	**not** blood vessels move closer to surface **allow** any heat transfer but needs to be a loss from the body **Examiner's Comments** The most common reason why candidates did not score on the first marking point was because they described blood vessels as 'moving closer to the surface', this often negating earlier references to widening blood vessels. A number of the candidates who did not understand the process did gain a mark for the idea that heat was lost, although they often incorrectly linked it to sweating.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
11			heat stroke (1) dehydration (1)	2	**ignore** just 'stroke' **allow** hyperthermia **allow** insufficient water to remove toxins **allow** higher level answers e.g. damage to enzymes / stops enzymes working / denatures enzymes (1) **allow** preventing chemical reactions happening (1) **ignore** kills enzymes **ignore** burn or body becomes too hot or overheats **ignore** damage to any body part e.g.organ failure **Examiner's Comments** Half the candidates gained at least one mark, though few gained two. The mark was most commonly awarded for the idea that high body temperatures may cause death through dehydration, although a few did correctly explain the effect on enzymes. No credit was given for vague answers such as 'organ failure'.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
12			**Level 3 (5-6 marks)** Answer includes reference to heart disease AND diabetes. The link between **type 2** diabetes and failure to respond to insulin AND between high blood pressure / cholesterol and heart disease is made. At least one calculation indicates the number of people that might be involved. Quality of written communication does not impede communication of the science at this level. **Level 2 (3-4 marks)** Answer includes reference to heart disease OR diabetes. There is some attempt to link diabetes with failure to respond to insulin OR to link heart disease with high blood pressure / cholesterol Quality of written communication partly impedes communication of the science at this level. **Level 1 (1-2 marks)** Answer includes some reference to heart disease OR diabetes. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to C** **Relevant points include:** • high blood pressure is linked to an increase risk of heart disease • high blood cholesterol is linked to an increase risk of heart disease • failure to respond to insulin indicates type2 diabetes • too much cholesterol in the blood can form plaques in the walls or arteries • 30 000 people in Singapore have all three conditions (or similar calculation). **allow** higher level answers involving blood pressure and strokes / kidney damage and the consequences of plaque formation in the coronary arteries Level 3 - full answer but no/wrong calculation then max 5 marks **allow** level 1 (2 marks max) for correct calculation with no reference to heart disease/diabetes if refer only to heart attacks instead of heart disease then allow 1 mark (level 1) or 3 marks (level 2) Use L 1, L2, L3 annotations in scoris. Do not use ticks. **Examiner's Comments** This 6 mark extended answer question was targeted across low and standard demand. Accordingly, although two thirds of candidates gained some credit, very few went beyond 4, the most common mark. The question asked candidates to not only use the data provided but also their own biological knowledge and also to include calculations. Some candidates wrote at great length but only described what the pie chart showed, without adding anything

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Question			Answer/Indicative content	Marks	Guidance
					extra, and were not awarded any marks. To gain level 1 (1 or 2 marks) candidates had to appreciate that the conditions could lead to heart disease or diabetes. For level 2 (3 or 4 marks) they had to correctly link heart disease or diabetes to the specific conditions tested for. To gain level 3 (5 or 6 marks), candidates should have stated that failure to respond to insulin is linked specifically to type 2 diabetes, as well as include at least one calculation using the data given, eg to state that 30 000 people had all three conditions. Very few attempted any calculations.
			Total	6	
13			to lose heat/ keep cool (1)	1	**allow** for temperature regulation **Examiner's Comments** Three quarters of candidates knew that sweating helps to lose heat or to cool the body down. No credit was given for the idea that it is a way of losing water.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
14		i	A = ureter (1) B = cortex (1)	2	**allow** phonetic spelling **not** urethra **Examiner's Comments** A third of candidates could name the ureter or cortex in the cross section of a kidney, and half of these could name both. Common errors were to name the cortex as the medulla, and the ureter as the urethra. Although misspelt words are usually credited if they are phonetically correct, if an answer was somewhere in between ureter and urethra, and could have been either, it was not given the mark.
		ii	to filter (the blood) (1)	1	**allow** molecules / substances are forced out (of blood) **allow** ultrafiltration **ignore** just remove waste **Examiner's Comments** Over a third of candidates correctly explained that the high blood pressure in the kidney is needed to filter the blood. It was not enough to simply say so that the kidney could work.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
15	a		percentage working decreases over time / ORA (1) less points / A grade will have a greater chance of still a working / lasting longer / ORA (1)	2	**ignore** just negative correlation **allow** correct comparison e.g. A and B last longer than C and D **allow** converse answers **ignore** actual data on its own **Examiner's Comments** There were two patterns to be described in the graph, but despite there being two marks many candidates only described one pattern. Candidates need to be as clear as possible in their answers. For example, a mark was gained for saying that the lower the point score, the longer a kidney would last. However a mark was not awarded if candidates referred to a lower grade, as it is not clear which letter is 'lower'. When asked to describe a pattern in a graph, candidates should include the variables in their answer and not say something like 'the lines go down'. Most candidates gained one mark, and a quarter gained two.
	b		7% (difference) (2) BUT Manjit grade B/79% and Georgina grade C/72% (1)	2	**allow** answers written by table **Examiner's Comments** Over half the candidates gained at least one mark by working out the percentage chance for each person, but only a third worked out the difference between these as being 7%. Although some incorrectly calculated the difference, there were many who did not attempt to work out the difference at all.
			Total	**4**	

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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>16</td><td>a</td><td></td><td>
<table>
<tr><th>part of the kidney</th><th>letter</th><th></th></tr>
<tr><td>cortex</td><td>E</td><td></td></tr>
<tr><td>medulla</td><td>D</td><td></td></tr>
<tr><td>renal artery</td><td>(A)</td><td></td></tr>
<tr><td>renal vein</td><td>B</td><td></td></tr>
<tr><td>ureter</td><td>C</td><td>(2)</td></tr>
</table>
</td><td>2</td><td>3 or 4 correct (2)
1 or 2 correct (1)

Examiner's Comments

Almost all candidates gained at least 1 mark for correctly identifying the parts of a kidney. The most common error was to confuse the cortex and medulla.</td></tr>
<tr><td></td><td>b</td><td></td><td>(Level 3)
Explains the role of ADH in controlling the amount of water removed in urine and how alcohol affects the action of ADH.
Quality of written communication does not impede communication of the science at this level.
(5–6 marks)
(Level2)
Explains the role of ADH in controlling the amount of water removed in urine.
Quality of written communication partly impedes communication of the science at this level.
(3–4 marks)
(Level 1)
Gives a simple description that the kidneys remove excess water.
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)</td><td>6</td><td>This question is targeted at grades up to A*

Indicative scientific points at level 3 includes level 2 points plus

• explains that alcohol causes even more water to be lost / even less reabsorbed.

ignore alcohol reduces ADH (in question)

Indicative scientific points at level 2 may include:

• ADH increases the amount of water reabsorbed / reduces amount lost in urine
• less ADH decreases the amount of water reabsorbed / increases amount lost in urine
• ADH increases permeability of kidney tubules so more water is reabsorbed back into the blood
• increased water in blood reduces the amount of ADH

Indicative scientific points at level 1 may include:

• kidneys remove excess water (to form dilute urine)
• kidneys reabsorb less water.

ignore drinking more water / beer increases volume of urine
ignore drinking more water / beer makes</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
					urine more dilute (in question) **allow** level 1, 2 marks max for drinking alcohol causing more dilute urine than drinking water (no mention of ADH) **Use L 1, L2, L3 annotations in scoris. Do not use ticks.** **Examiner's Comments** This was a challenging question with a very small minority gaining all 6 marks. No credit was given for repeating the statements given in the question that alcohol reduces ADH release, and that drinking either beer or water will make urine more dilute. Many candidates' answers were little more than these statements reworded. To gain credit, candidates had to give some explanation of the role of ADH, as well as explain why urine was more dilute after drinking beer than after drinking the same amount of water. Many candidates thought that drinking 2 litres of alcohol would lead to more concentrated urine than drinking 2 litres of water, explaining this as being because alcohol is more concentrated than water.
			Total	**8**	
17			small intestine (1) food has been digested by this point / is digested here (1) glucose from food is absorbed here / passes through the lining of small intestine (1)	3	**Examiner's Comments** Many candidates correctly identified the small intestine but few could correctly explain the increase, many just referring to the concentration of glucose in the intestine.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
18			[Level 3] Answer correctly calculates urine volume during the day before race. It also predicts one reason why one output may change during the race with a reason and link this to one change in input. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer correctly calculates urine volume during the day before race. It also predicts one change that may occur on the day of the race. OR Answer predicts one reason why one output may change during the race with a reason and link this to one change in input. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer correctly calculates urine volume during the day before race or predicts one change that may occur on the day of the race. 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 G to C Indicative scientific points may include: during day before race: • At rest Kaye is taking in 2500cm^3 • Therefore she must give out 2500 cm^3 • Her urine volume must be 1600 cm^3 during day of race: • during race she will sweat more / sweating will help to lose heat generated in race linked to: water will need to be replaced so likely to drink more or • during race she will sweat more / sweating will help to lose heat generated in race linked to: likely to pass less urine Other predictions include: • Respiration rate will increase during race • More water gain from respiration Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Many candidates could correctly calculate the volume of urine lost. They could also make a prediction for changes on the day of the race such as an increase in sweating. Only the better answers included

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Question			Answer/Indicative content	Marks	Guidance
					a linked explanation for changes on the day of the race.
			Total	6	
19			urea / water / salts (1)	1	**ignore** urine Examiner's Comments By far the most common error here was to confuse urea with urine.
			Total	1	
20			Type 1 **and** a correct reason Type 1 is insulin dependent / early onset / juvenile (1) Type 1 doesn't produce any / enough insulin (1) Type 2 can be controlled with diet only (1)	1	Type 2 / Type A / Type B = 0 **allow** Type 1 **has to be** controlled by injecting insulin / she **needs** insulin **ignore** she injects insulin (in the stem of the question) / she uses insulin **allow** pancreas doesn't work **allow** Type 2 is late onset / associated with obesity Jessica is neither / Type 2 not insulin dependent Examiner's Comments Candidates who correctly identified the type of diabetes usually went on to give the correct reason. There were a few that just repeated the stem of the question and were not credited.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
21			insulin dose would be less / decreases (1) because she would use up **blood** sugar / glucose (1)	2	 **ignore** sugar / glucose unless clearly linked to blood **Examiner's Comments** Most marks were gained from the 'less needed' marking point. Many candidates failed to gain credit because they did not say sugar in **blood** decreases.
			Total	**2**	
22			heat stroke (1) dehydration (1)	2	**ignore** just 'stroke' **allow** hyperthermia **allow** insufficient water to remove toxins **allow** higher level answers e.g. damage to enzymes / stops enzymes working / denatures enzymes (1) **allow** preventing chemical reactions happening (1) **ignore** kills enzymes **ignore** burn or body becomes too hot or overheats **ignore** damage to any body part e.g. organ failure **Examiner's Comments** Most candidates mentioned enzymes denaturing, but didn't put the relatively simpler answers of heat stroke and dehydration. Many high level answers explained enzymes' function.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
23			(calculation for Sanchez) (-) 6.3 (%) (1) Sanchez is very dehydrated and will have muscle spasms / cramps (1)	2	second marking is dependent on the first allow: (-) 6.25 (%) / (-) 6 (%) (1) allow: ecf for symptoms if calculation incorrect e.g. calculate (-) 4.2 then say moderately dehydrated and his muscles work less efficiently (1) ignore choice of who wins Examiner's Comments Many candidates found the percentage change calculation difficult one common error was to divide the difference by the mass after the race rather than at the start. Those that correctly calculated the percentage change often lost the second mark by not providing a full explanation as to why Sanchez was unlikely to win the race.
			Total	2	
24			(calculation for Sanchez) (-) 6.3 (%)(1) Sanchez is very dehydrated and Leroy is slightly dehydrated (1) Sanchez (less likely to complete the race as he) will have muscle spasms / cramps (1)	2	allow: (-) 6.25 (%) / (-) 6 (%) (1) allow: ecf for symptoms if calculation incorrect ignore choice of who wins Examiner's Comments Many candidates could correctly calculate the percentage for Sanchez and link it to the information in the table.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
25			increased salt (in diet) leads to higher blood pressure (1) high blood pressure leads to increased risk of developing heart disease / risk of stroke / blood vessels bursting (1)	2	**allow** positive correlation between salt in diet and blood pressure **ignore** high salt in urine causes high blood pressure **Examiner's Comments** The main issue for some candidates was the failure to differentiate between salt in the diet leading to higher blood pressure and the salt in the urine being an indicator of salt in the diet.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
26			**any two from:** too much / more urine is released (1) urine is **more** dilute (1) blood is too / more concentrated (1) increased thirst (1) less water **reabsorbed** (into blood) (1)	2	must be comparative **allow** urinate more often **allow** urine has a higher concentration of water **allow** blood has a lower concentration of water **allow** become dehydrated / need to drink more water **ignore** references to permeability of tubules (as in question) **Examiner's Comments** A minority of candidates gained marks in this question. No credit was given for simply taking the information from the table in part (i) and saying that a lack of ADH would decrease the permeability of kidney tubules, rather candidates had to describe the consequences of this. Commonly seen correct answers were that less water would be reabsorbed, more urine would be produced, urine would be more dilute, and that people would become dehydrated. Some candidates gave the reverse of these ideas; others gave contradictory answers such as less water reabsorption would make urine more concentrated.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
27		i	sweating (1)	1	**allow** evaporation / conduction / convection / radiation **Examiner's Comments** Many candidates misread the question and wrote about insulation, although a large minority did correctly explain that fur reduces sweating. Quite a few candidates left this blank.
		ii	cools them down / removes heat / so they do not overheat / saliva acts like sweat (1)	1	**allow** higher level responses referring to saliva evaporates **Examiner's Comments** Most candidates correctly explained that the saliva would cool cats down.
			Total	2	
28			A ✓	1 (AO 1.1)	Examiner's Comments Although some candidates identified diet and exercise, most candidates chose an option that included insulin. Candidates need to be careful to take note of emboldened words in the question.
			Total	1	
29			A ✓	1 (AO 1.1)	
			Total	1	

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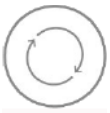
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Question			Answer/Indicative content	Marks	Guidance
30	a	i	cortex✓	1 (AO 1.1)	Examiner's Comments The question assessed recall AO1.1 for structure of the kidney. Few candidates could identify the cortex, although some did mix it up with the medulla. Most referred to just the kidney or membrane. Many candidates put no answer.
		ii	urine✓	1 (AO 1.1)	Examiner's Comments This tested recall, AO1.1, of the function of the ureter. Some candidates were able to identify urine as the liquid flowing through the ureter. However, common incorrect responses were water, blood and urea.
		iii	arrow on diagram points downwards from kidney in same line as ureter✓	1 (AO 2.1)	ALLOW arrow pointing downwards even if not on ureter Examiner's Comments Candidates could apply their knowledge of direction of flow of urine. The flow in the ureter was well understood by most candidates. There were some candidates however, that had the flow back into, and in some cases, around the kidney.
	b	i	Bowman's capsule✓	1 (AO 1.1)	Examiner's Comments The majority of candidates found this recall AO1.1 question very challenging.. A small number of candidates correctly identified the Bowman's capsule. Some candidates put glomerulus, presumably using one of the labels as a memory prompt, but many no responses were seen.

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Question			Answer/Indicative content	Marks	Guidance
		ii	glucose present in filtrate but not in urine / more sodium chloride in filtrate than urine / urea/others levels much higher in urine ✓ glucose/sodium chloride must be reabsorbed✓ urea/others excreted in urine✓	3 (AO 2.2) (AO 2 x 3.2b)	ALLOW urea/others removed from body Examiner's Comments This question assessed both AO2 and AO3 assessment objectives. This is key to how successful candidates were in their response. Candidates often limited themselves to only one mark due to just stating what happened to the different substances in the filtrate or collecting duct as evidenced in the pie charts. The question required candidates to make conclusions based on the evidence and only a few higher ability candidates linked these changes to reabsorption and excretion.  This highlights a lack of awareness in candidates for what is required from a question asking them to draw conclusions from data. Many just described the data.
	c	i	Patient A = 2900 & Patient B = 2700 ✓	1 (AO 2.2)	Mark answer line first but if nothing on answer line check table for correct answer Examiner's Comments Mathematical skills were assessed in this question. Most candidates got the correct calculations. Occasionally the correct calculations were seen in the table but then candidates wrote 900 and 700 on the answer line and did not gain the mark.

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Question			Answer/Indicative content	Marks	Guidance
		ii	(Patient A) total output of patient A is 2900/exceeds total input / patient B input matches output✓ patient A is losing too much water (from the kidneys)✓	2 (AO 2.1) (AO 3.2a)	No marks if Patient B identified **ALLOW** input output is imbalanced in patient A **ALLOW** patient A loses more water than normal <u>Examiner's Comments</u> The question required analysis and evaluation to provide a successful response. Most candidates selected Patient A and many then went on to gain at least 1 mark. This was usually for input less than output. Some also then explained that this would lead to water imbalance. Occasionally, candidates would not gain marks even though they had selected the correct patient because they compared the water output to Patient B. Exemplar 2 They are losing more water in the form of urine than patient B because Patient A total output is 2900 where as patient B total output is 2700. [2] In this case the candidate implies that they have decided Patient A needs treatment but haven't said it specifically. This would not prevent the candidate gaining marks but their explanation is comparing water output to Patient B which is incorrect. The correct explanation needs candidates to compare the input and output for each patient separately. This highlights the need for candidates to gain a greater understanding that homeostasis is about maintenance of an individual's internal environment and data should be considered within that same individual and not across others as well.
			Total	10	

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Question			Answer/Indicative content	Marks	Guidance
31			D ✓	1 (AO 2.1)	
			Total	1	
32			C ✓	1 (AO 2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
33	a	i	loop of Henlé✓	1 (AO 1.1)	<u>Examiner's Comments</u> The name of this part of the tubule was correctly recalled by many of the higher ability candidates.
		ii	collecting duct✓	1 (AO 1.1)	ALLOW DCT IGNORE collection duct <u>Examiner's Comments</u> Fewer candidates could answer correctly in part ii), often stating the glomerulus as their answer.
	b		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Explains more than one body response to different temperature <u>and</u> osmotic challenges. **AND** applies knowledge and understanding to identify a drink requirement both pre-race <u>and</u> post-race **AND** analyses information and ideas to explain which sports drink is best for pre-race <u>and</u> for post-race. *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)** Explains a body response to different temperature <u>or</u> to osmotic challenges **AND** applies knowledge and understanding to identify a drink requirement for pre-race <u>or</u> for post-race. **AND** analyses information and ideas to explain which sports drink is best for pre-race <u>or</u> for post-race.	6 (AO 2 × 1.1) (AO 2 × 2.1) (AO 2 × 3.2a)	**AO1.1 Demonstrate knowledge and understanding of scientific ideas of responses of body to different temperature and osmotic challenges.** • exercise causes loss of water through sweating • will use up much of the sugar for energy/respiration/exercise • exercise causes loss of salts through sweating **AO2.1 Apply knowledge and understanding of scientific ideas to identify drink requirements pre-race and post-race** • pre-race drink needs to provide the body with sugar needed for exercise • post-race drink will need to replace salts lost / replace sugars used up **AO3.2b Analyse information and ideas to make judgements about which sports drink is best for pre-race and post-race.** • hypertonic is best for pre-race as it contains the highest levels of sugars / is taken 60 minutes before race as takes time to be absorbed / absorbed slowly so it's effects last for the race • isotonic drink after the race will not change / dilute / increase the

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Question			Answer/Indicative content	Marks	Guidance
			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 knowledge and understanding of <u>one</u> body response to different temperature and osmotic challenges OR applies knowledge and understanding to identify a drink requirement either pre-race <u>or</u> post-race. OR analyses information and ideas to explain which sports drink is best for either pre-race <u>or</u> for post-race *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.*		concentration of the blood / will match the concentration of body fluids <u>Examiner's Comments</u> This is the Level of Response question on this paper. For a level three answer, examiners were looking for an explanation of why the water, salt and sugar levels would change during the race. This should then be coupled with the function of the drinks before and after the race. An explanation for the timing and choice of the drinks should also be included. Exemplar 4 shows a level 2 answer, which does not explain the choice of the isotonic drink after the race. Exemplar 4 The race causes him to sweat which releases water and salt, leaving him with less whilst running his body would have respired using glucose stores that decrease his sugar levels. The HYpertonic drink contains more sugars which provide him with more energy, it is also absorbed over a longer time which will help him through the 10k long race. after the race he drinks an Isotonic drink which regulates his sugar levels to the optimum. This is done over a quicker period of time as he will not be using as much energy needing [6]

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Question			Answer/Indicative content	Marks	Guidance
	c		**Any four from:** glucose (in filtrate but) not in urine so must be reabsorbed✓ sodium chloride lower in urine so reabsorbed✓ urea (much) higher in urine so not reabsorbed✓ others higher in urine so not reabsorbed✓ waste products higher in urine so not reabsorbed but useful substances reabsorbed✓	4 (AO 3.2b)	IGNORE unqualified responses e.g. glucose is reabsorbed If no other mark awarded ALLOW some substances reabsorbed but others are not Examiner's Comments This question differentiated quite well. Some candidates used data from the two pie charts to back up their answers, whereas less successful candidates answered in general terms.
			Total	12	

Question			Answer/Indicative content	Marks	Guidance
34			(Diagram B) because vasodilation ✓ (blood vessels) release **more** heat / energy (to environment) ✓ sweat being released to <u>evaporate</u>	3 (AO 1.1) (AO 2 × 2.1)	**if A chosen award no marks** **ALLOW** blood vessels/arterioles have widened / dilated idea of more heat released must be linked to blood vessels **IGNORE** cools down more **ALLOW** sweat not evaporated due to humidity preventing evaporation <u>Examiner's Comments</u> This was a well answered question, with many candidates gaining three marks. The lack of reference to sweat evaporating to cool the skin down was the most common omission.
			Total	3	
35			A	1 (AO 2.1)	
			Total	1	
36			D	1 (AO 2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
37	a	i	insulin ✓	1 (AO 1.1)	Examiner's Comments This AO1.1 question was answered correctly by many candidates, but a number of candidates did not respond.
		ii	Any two from: secreted / released from glands/endocrine cells ✓ travel in blood(stream) ✓ affect target organs / cells ✓	2 (AO 1.1)	ALLOW named gland ALLOW hormones bind to specific receptors Examiner's Comments Another AO1.1 question that proved challenging for many. Where candidates did provide responses, many wrote about examples of what hormones can do but not how. There was a big focus on hormones affecting either puberty or fight/flight responses, but these did not gain any marks as they only wrote in their responses 'hormones make you emotional' or 'adrenaline gets you ready for action' and had not identified where they were produced, or how they got to different parts of the body.

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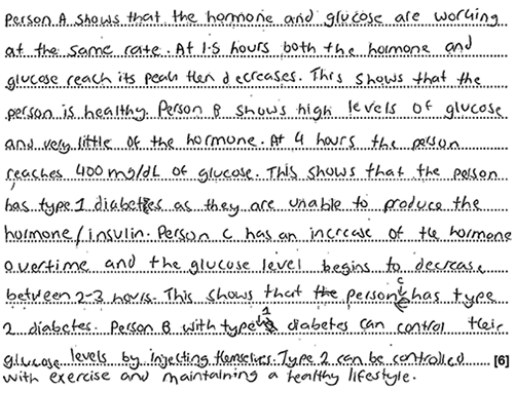
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Question			Answer/Indicative content	Marks	Guidance
		iii	*Please refer to the marking instructions of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Correctly compares differences in insulin and glucose levels and identifies each person with evidence from the graphs. **AND** Describes the treatment for Type 1 **and** Type 2 diabetes. *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)** Correctly identifies at least one of the people who are diabetic/healthy **AND** Describes the treatment for Type 1 **or** Type 2 diabetes. **OR** Correctly compares differences in insulin and glucose levels in at least one person. **AND** Describes the treatment for Type 1 **or** Type 2 diabetes. *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)** Correctly identifies at least one of the people who are diabetic/healthy. **OR** Correctly compares differences in insulin and glucose levels in at least one person. **OR** Describes the treatment for Type 1 **or** Type 2 diabetes. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6 (AO 2x 1.1) (AO 2x 2.1) (AO 2x 3.2a)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to describe how diabetes is controlled** • Type 1 diabetes needs insulin injections • Type 2 diabetes needs a carefully managed diet/avoid high sugar intake/regular exercise/take diabetic medication/pills **AO2.1 Applies knowledge and understanding of scientific ideas in describing the differences in the glucose and insulin levels** • In person A the insulin levels increase and return the glucose levels to normal • In person B insulin levels remain low and glucose levels are very high and not reduced • In person C insulin is produced (but slowly) and glucose levels are slow to be reduced/do not return to normal • Persons B and C have higher resting glucose levels **AO3.2a Analyse information and ideas to make judgements and draw conclusions about the type of diabetes each person has** • Person A is healthy • Person B and C have diabetes • Person B has Type 1 diabetes • Person C has Type 2 diabetes Examiner's Comments This question covering AO1, AO2 and AO3 discriminated well. Most candidates gained at least L1, by identifying at least one person or describing a treatment. Many got L2, by identifying and describing the patterns on the graphs and identifying the treatments/people. Relatively few

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Question			Answer/Indicative content	Marks	Guidance
			0 marks *No response or no response worthy of credit.*		candidates got up to L3, as there was often a mistake in identifying which person was healthy, Type 1 or Type 2. Many thought the third graph was the healthy person due to the correlation in pattern. Exemplar 2  Person A shows that the hormone and glucose are working at the same rate. At 1.5 hours both the hormone and glucose reach its peak then decreases. This shows that the person is healthy. Person B shows high levels of glucose and very little of the hormone. At 4 hours the person reaches 400 mg/dL of glucose. This shows that the person has type 1 diabetes as they are unable to produce the hormone / insulin. Person C has an increase of the hormone overtime and the glucose level begins to decrease between 2-3 hours. This shows that the person has type 2 diabetes. Person B with type 1 diabetes can control their glucose levels by injecting themselves. Type 2 can be controlled with exercise and maintaining a healthy lifestyle. [6] Here, the candidate has identified all people, with good evidence from graph for each. Treatments have been given for both types, but Type 1 does not specify what to inject. So L3 5 marks as treatment for type 1 lacked full communication but there was sufficient communication of Type 2 with exercise & healthy lifestyle being identified.
	b		kidney ✓	1 (AO 1.1)	<u>Examiner's Comments</u> Candidates in the main were able to identify the kidney in this AO1.1 question. However, examples were seen where the liver, bladder and pancreas had been identified.

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Question			Answer/Indicative content	Marks	Guidance
	c		**Any two from:** drugs shape is same as substrate ✓ blocks the active site ✓ denature the enzyme ✓ change (shape of) active site ✓	2 (AO 2.1)	**ALLOW** drug is competitive/non-competitive inhibitor **ALLOW** competes with enzyme for active site **NOT** kill the enzyme **ALLOW** drug deforms enzyme/active site **ALLOW** substrate doesn't fit the active site/not complimentary **ALLOW** key doesn't fit the lock Examiner's Comments This AO2.1 question was answered well by higher ability candidates. Most candidates realised the enzyme could denature. Some went further to describe what this meant in terms of the shape of the enzyme.
			Total	12	
38			D	1 (AO 1.1)	
			Total	1	
39			C	1 (AO 2.1)	
			Total	1	

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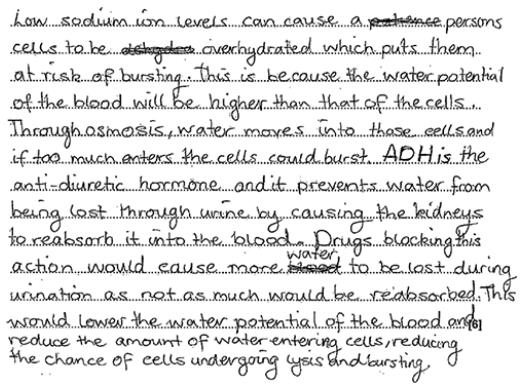
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Question			Answer/Indicative content	Marks	Guidance
40			Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation of how low levels of Na^+ affects the blood and how this can affect cells. **AND** Explains the effect of blocking ADH and suggests how this can correct the condition. *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)** Explains how low levels of Na^+ affects the blood or how this can affect cells **AND** explains the effect of blocking ADH or suggests how this can correct the condition **OR** Explains how low levels of Na^+ affects the blood and how this can affect cells. **OR** Explains the effect of blocking ADH and suggests how this can correct the condition. *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)** Describes how low levels of Na+ affects water potentials. **OR** Describes the effect of blocking ADH. *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.*	6 (AO 3 x 1.1 3 x 2.1)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to explain how low levels of Na^+ affects the blood** • blood is hypotonic / less concentrated / higher water potential **AO2.1 Applies knowledge and understanding of scientific ideas to explain how low levels of Na^+ affects cells** • water enters cells by osmosis / as cells are more concentrated / lower water potential than the blood • cell membrane becomes overstretched / lysis may happen / cells will burst **AO1.1 Demonstrates knowledge and understanding of scientific ideas to explain the effect of blocking ADH** • blocking ADH makes the kidney tubule less permeable/less water reabsorbed • blocking ADH increases the volume of water lost from the body/present in urine / urine becomes more dilute **AO2.1 Applies knowledge and understanding of scientific ideas to suggest how blocking ADH can correct the condition** • blood concentration is increased / water potential lowered / water would move out of cell / water will not move into cells • eventually blood and cells are isotonic/same concentration/same water potential/same sodium ion concentration Examiner's Comments A number of candidates did not commit themselves as to whether the body cells would lose or take up water and explained both possibilities. Incorrect references to turgidity were also seen. There was also confusion regarding the role of ADH, with a

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Question			Answer/Indicative content	Marks	Guidance
					number of candidates stating that it makes the body pass out more water. Exemplar 4 shows a clear, correct Level 3 answer. Exemplar 4  low sodium ion levels can cause a ~~patience~~ persons cells to be ~~dehydrated~~ overhydrated which puts them at risk of bursting. this is because the water potential of the blood will be higher than that of the cells. Through osmosis, water moves into those cells and if too much enters the cells could burst. ADH is the anti-diuretic hormone and it prevents water from being lost through urine by causing the kidneys to reabsorb it into the blood. Drugs blocking this action would cause more ~~blood~~ water to be lost during urination as not as much would be reabsorbed. This would lower the water potential of the blood and reduce the amount of water entering cells, reducing the chance of cells undergoing lysis and bursting. [6]
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
41	a		glucagon ✓	1 (AO 1.1)	
	b	i	(person) **C** ✓	1 (AO 3.2a)	<u>Examiner's Comments</u> A significant number of candidates thought that candidate A had type 2 diabetes. Others confused type 1 with type 2 and so chose option B.
		ii	insulin is produced/released / insulin level is high ✓ idea that ability to control glucose levels is reduced ✓	2 (AO 2.1)	mark independently of (d)(i) **ALLOW** idea that body is resistant to insulin <u>Examiner's Comments</u> Confusion between type 1 and type 2 diabetes was seen in a number of the candidates' responses. Some however explained type 2 diabetes clearly and concisely and so scored both marks. This is shown in exemplar 5. **Exemplar 5** Insulin is being produced due to the high levels of glucose however because the person is resistant to insulin glucose levels don't rapidly decrease when insulin peaks [2]

Question			Answer/Indicative content	Marks	Guidance
	c		embryonic stem cells are able to differentiate into any cell / totipotent / adult stem cells are limited / pluripotent ✓ **therefore insulin producing cells** are easier to develop from embryonic stem cells/adult stem cells are not ✓	2 (AO 1.1) (AO 2.1)	**IGNORE** adult stem cells are already specialised **ALLOW** difficult to locate adult stem cells **IGNORE** embryonic stem cells can repair all parts Examiner's Comments The majority of candidates correctly explained the totipotent nature of embryonic stem cells but few candidates went on to explain the consequences of this in replacing pancreatic cells. Exemplar 6 shows an example of a common answer that only scores the first marking point. Exemplar 6 embryonic stem cells can specialise to become any type of cell whereas adult stem cells can only specialise to become a cell from their own tissue [2]
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
42		i	**Any two from:** idea it affects enzymes (action/structure) ✓ high temperature causes active site to change shape / active site denatures ✓ stops them working ✓	2 (AO1.1)	**ALLOW** enzymes are heat sensitive/denature **ALLOW** enzymes cannot bind to substrate molecules **IGNORE** cells denature **ALLOW** enzymes no longer catalyse reaction

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Question			Answer/Indicative content	Marks	Guidance
		ii	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 knowledge of homeostasis. **AND** Applies knowledge of a skin mechanism for maintaining body temperature in different environments. **AND** Analyses information to comment on the effect of exposing skin. *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 knowledge of homeostasis **and** applies knowledge of a skin mechanism for maintaining body temperature in different environments. **OR** Demonstrates knowledge of homeostasis **and** analyses information to comment on the effect of exposing the skin. **OR** Applies knowledge of a skin mechanism for maintaining body temperature in different environments **and** analyses information to comment on the effect of exposing skin. *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 knowledge of homeostasis. **OR** Applies knowledge of a skin mechanism for maintaining body temperature in different environments. **OR** Analyses information to comment on the effect of exposing skin.	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)	**AO1.1 Demonstrate knowledge and understanding of skin and homeostasis** • need to keep constant internal temperature, despite the different external temperatures • person A needs to lose heat to the environment / person B needs to reduce heat lost to the environment • person A gains heat from the environment / person B loses heat to the environment • person A will be in danger of overheating / person B will be in danger of becoming too cold. **AO2.1 Apply knowledge and understanding of the mechanisms in skin for maintaining body temperature in different environments** • cold environment reduces sweating /decreases blood flow to the skin (vasoconstriction) / shivering / body hairs rise • warm environment increases sweating / increases blood flow to the skin (vasodilation) / body hairs on skin lie flat **AO3.1a Analyse information and ideas to interpret the effect of exposing / covering skin in different environments** • person A body less covered/more exposed skin in warmer conditions increases heat loss/allows sweat to evaporate • person B body covered/less exposed skin in colder conditions reduces heat loss/stops sweat evaporating

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Question			Answer/Indicative content	Marks	Guidance
			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	8	
43			cells absorb water ✓ by osmosis ✓ red blood cells/cytoplasm swells / increased pressure in the cell/on the cell membrane / <u>cell membrane</u> ruptures/bursts ✓	3 (AO3 x 1.1)	IGNORE references to water potential IGNORE just cell bursts
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
44	a	i	The higher the BMI then the higher the mass of urea (in urine) / ORA ✓	1 (AO2.1)	**ALLOW** positive correlation **IGNORE** they are directly proportional **IGNORE** linear relationship
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.0016 (g/cm^3) award 2 marks** 1.6 ÷ 1000 ✓ = 0.0016 (g/cm^3) ✓	2 (AO2.2)	**ALLOW** 1.6 x 10^{-3}
		iii	idea that there is a greater increase in mass of urea as BMI increases in Fig 22.2/second graph ✓ idea that first graph/22.1 has stronger correlation / more points closer to line of best fit / less spread of data ✓	2 (AO2 x 3.2b)	**ALLOW** larger mass of urea per BMI gained **ALLOW** line is steeper/higher gradient in Fig22.2 **IGNORE** higher BMI for greater mass of urea **ALLOW** second graph does not follow the line of best fit so closely
	b		<table><tr><td>Bowman's capsule</td><td>1</td></tr><tr><td>Collecting duct</td><td>5</td></tr><tr><td>Proximal convoluted tubule</td><td>2</td></tr><tr><td>Loop of Henlé</td><td>3</td></tr><tr><td>Second coiled region</td><td>4</td></tr></table>✓✓✓	3 (AO3 x 1.1)	5 before 2 ✓ 2 before 3 ✓ 3 before 4 ✓
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
45		i	Yes (no marks) cooler than black/grey skin **OR** Yes (no marks) lighter skin is cooler **OR** No (no marks) zebra skin was similar temperature to the other barrels **OR** No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓	1 (AO3.2a)	argument must support decision
		ii	paint the barrels different colours rather than using the skins / use the same type of skin painted different colours **OR** idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓	1 (AO3.3a)	**ALLOW** use painted towels to cover barrels **ALLOW** for same type of skin e.g. hair-free skin
			Total	**2**	
46			A ✓	1 (AO2.1)	
			Total	**1**	
47			cells absorb water ✓ by osmosis ✓ (red blood) cells/cytoplasm swells / increased pressure in the cell/on the cell membrane / <u>cell membrane</u> ruptures/bursts ✓	3 (AO3 x 1.1)	**IGNORE** references to water potential **IGNORE** just cell bursts
			Total	**3**	

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<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>48</td><td>a</td><td>i</td><td>The higher the BMI then the higher the mass of urea (in urine) / ORA ✓</td><td>1
(AO2.1)</td><td>ALLOW positive correlation
IGNORE they are directly proportional
IGNORE linear relationship</td></tr>
<tr><td></td><td></td><td>ii</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.0016 (g/cm^3) award 2 marks

1.6 ÷ 1000 ✓

= 0.0016 (g/cm^3) ✓</td><td>2
(AO2.2)</td><td>

ALLOW 1.6 x 10^{-3}</td></tr>
<tr><td></td><td></td><td>iii</td><td>idea that there is a greater increase in mass of urea as BMI increases in Fig 17.2/second graph ✓

idea that first graph/17.1 has stronger correlation / more points closer to line of best fit / less spread of data ✓</td><td>2
(AO2 x 3.2b)</td><td>ALLOW larger mass of urea per BMI gained
ALLOW line is steeper/higher gradient in Fig17.2
IGNORE higher BMI for greater mass of urea

ALLOW second graph does not follow the line of best fit so closely</td></tr>
<tr><td></td><td>b</td><td></td><td><table><tr><td>Bowman’s capsule</td><td>1</td></tr><tr><td>Collecting duct</td><td>5</td></tr><tr><td>Proximal convoluted tubule</td><td>2</td></tr><tr><td>Loop of Henlé</td><td>3</td></tr><tr><td>Second coiled region</td><td>4</td></tr></table>✓✓✓</td><td>3
(AO3 x 1.1)</td><td>5 before 2 ✓
2 before 3 ✓
3 before 4 ✓</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
49		i	polymers ✓ monomers ✓	2 (AO2 x 1.1)	
		ii	(**A** has) less ADH released/present ORA ✓ so less/no reabsorption of water / permeability of collecting duct is lower/has not changed ✓	2 (AO2 x 2.1)	**ALLOW** ADH release is inhibited in A / lack of ADH production in **A** **IGNORE** less movement of water out of the tubule (must state reabsorption)
		iii	**Any two from:** (low) water potential/(decreased) water levels are detected by hypothalamus ✓ will cause the release of ADH/ increased ADH levels ✓ increased permeability of collecting duct/kidney tubules / increased reabsorption of water (into blood) / decreased urine production / urine will become more concentrated ✓	2 (AO2 x 2.1)	**IGNORE** brain
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
50	a	i	Yes (no marks) cooler than black/grey skin **OR** Yes (no marks) lighter skin is cooler **OR** No (no marks) zebra skin was similar temperature to the other barrels **OR** No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓	1 (AO3.2a)	argument must support decision
		ii	paint the barrels different colours rather than using the skins / use the same type of skin painted different colours **OR** idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓	1 (AO3.3a)	**ALLOW** use painted towels to cover barrels **ALLOW** for same type of skin e.g. hair-free skin
	b	i	**Any two from:** zebras with stripes attracts less/fewer insects / ORA✓ narrower stripes attract less insects / ORA ✓ stripe width for least number of insects/optimum protection is about 8cm / stripe width for most number of insects is about 25cm ✓	2 (AO2x3.1a)	**ALLOW** insect bites for insects **IGNORE** length of stripe **ALLOW** width range between 5-10cm for least number of insects / most number of insects is 22-27cm
		ii	stripe width of 8cm because it is the lowest point on the graph/fewest number of insects ✓	1 (AO3.2a)	**ALLOW** width tolerance between 7-9cm and least number of insects (on tape)

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Question			Answer/Indicative content	Marks	Guidance
		iii	**Any three from:** stripes developed as a mutation / variation for skin stripes ✓ (animals with stripes) less likely to be bitten by insects / more healthy / spread less pathogens / ORA ✓ (striped animals) more likely to survive ✓ (striped animals) more likely to reproduce ✓ pass on allele/gene for stripes / ORA ✓ process occurs over many generations ✓	3 (AO3 x 2.1)	**ALLOW** some more striped than others **ALLOW** offspring produced / breed together **IGNORE** selective breeding **ALLOW** pass on advantageous gene **IGNORE** trait is passed on / genes are passed on **IGNORE** over time
			Total	**8**	
51		i	use Benedicts (reagent) ✓ heat / boil ✓ no change in colour / stays blue / does not go red ✓	3 (AO3 x 1.2)	
		ii	Yes (no mark) blood sugar levels will be controlled/not rise ✓ idea of a sugar replacement ✓	2 (AO1 x 3.2a) (AO1 x 2.1)	If No chosen = 0 marks **IGNORE** blood sugar levels will decrease **ALLOW** less sugar eaten
			Total	**5**	

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