

## Mark scheme - Excretion (The Liver)

Question			Answer/Indicative content	Marks	Guidance
1			A ✓	1	<b>Examiner's Comments</b> This question provided significant challenge to candidates. All three statements were correct thereby giving option <b>A</b> as the correct response.
			<b>Total</b>	<b>1</b>	
2			C ✓	1	<b>Examiner's Comments</b> This question proved challenging for some and required skills in applying knowledge to novel context to choose the most appropriate response.
			<b>Total</b>	<b>1</b>	
3	a		<b>A</b> hepatic vein as blood leaving liver (1) <b>B</b> hepatic artery as blood entering liver through narrow vessel (1) <b>C</b> hepatic portal vein as blood (from gut) entering liver through branched vessel (1)	3	
	b	i	mitochondrion	1	<b>ALLOW</b> mitochondria.
		ii	<i>either</i> facilitated diffusion (1) conversion of ornithine into citrulline creates concentration gradients <b>or</b> (molecules are not lipid soluble so) require protein channels to cross membrane (1) <b>or</b> active transport (1) ornithine and citrulline need to be moved into and out of <b>D</b> more quickly than would be met by diffusion (1)	2	
		iii	deamination / removal of NH <sub>2</sub> group from amino acid (1)	1	
		iv	ATP (1)	1	

	c	i	<p><i>two from</i> pH temperature substrate / hydrogen peroxide concentration (1)</p>	1	<p>Two answers required for 1 mark.</p> <p><b>DO NOT ALLOW</b> an answer that includes mass of liver / enzyme concentration.</p>
		ii	<p><i>pH</i> take pH reading / ensure hydrogen peroxide is same pH for all enzymes concentrations tested (1)</p> <p><i>temperature</i> use liver tissue and hydrogen peroxide at room temperature / same temperature for all enzyme concentrations tested (1)</p> <p><i>substrate concentration</i> use same concentration and volume of hydrogen peroxide for all enzyme concentrations tested (1)</p>	1	
		iii	<p><b>* Level 3 (5–6 marks)</b> Deduction includes coherent interpretation of the evidence, clearly linking all ideas to explain why and how activity is regulated.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Deduction includes clear use of some evidence to support conclusion but ideas may not be clearly linked for both how and why.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> A simple deduction about how or why based on a limited interpretation of the evidence.</p> <p><i>The information is basic and communicated in an unstructured</i></p>	6	<p><b>Relevant points include:</b></p> <p><i>Why</i></p> <ul style="list-style-type: none"> <li>large quantities of hydrogen peroxide and high turnover number of catalase would mean vigorous reaction and lots of oxygen produced very quickly.</li> </ul> <p><i>How</i></p> <ul style="list-style-type: none"> <li>isolation of catalase in peroxisomes</li> <li>released in small quantities</li> <li>cells can limit expression of catalase</li> <li>this effectively limits enzyme concentration and therefore reduces reaction rate</li> <li>cells have no control over temperature or substrate concentration so enzyme concentration is the only method of control.</li> </ul>

			<p><i>way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>		
			<b>Total</b>	<b>9</b>	
4		i	<p><b>D</b> pyruvate (1) <b>E</b> lactate (1)</p>	2	
		ii	is a hydrogen acceptor / removed hydrogen from reduced NAD	1	
		iii	<p><i>two from</i> for glycolysis to take place, NAD / <b>G</b>, is needed (1) there is a limited amount of NAD in the cell (1) formation of, NAD / <b>G</b>, allows, glycolysis to continue / some ATP to be formed (1)</p>	2	
		iv	liver <b>and</b> in the blood	1	Both required for 1 mark.
			<b>Total</b>	<b>6</b>	
5			<p>pyruvate ✓  Krebs ✓  liver ✓  link ✓  ATP ✓</p>	5	<b>ALLOW</b> citric acid / tricarboxylic acid / TCA
			<b>Total</b>	<b>5</b>	
6			<p>(large) gaps / holes, in tissue / between cells ✓  cell death ✓  <i>idea that</i> usual structure of liver tissue is not present ✓</p>	2 max	e.g. sinusoids not present, etc.
			<b>Total</b>	<b>2</b>	

7	i	<p>3157 <math>\mu\text{m}^3</math> / 3.157 <math>\times 10^3</math> <math>\mu\text{m}^3</math></p> <p><b>OR</b></p> <p>3155 <math>\mu\text{m}^3</math> / 3.155 <math>\times 10^3</math> <math>\mu\text{m}^3</math> (3.14 used for value of <math>\pi</math>)</p> <p><b>OR</b></p> <p>3158 <math>\mu\text{m}^3</math> / 3.158 <math>\times 10^3</math> <math>\mu\text{m}^3</math> (22/7 used for value of <math>\pi</math>)</p> <p><b>OR</b></p> <p>3.157 / 3.155 / 3.158, <math>\times 10^{-15}</math> <math>\text{m}^3</math> (answer using SI units)</p> <p style="text-align: right;">✓✓✓</p>	<p><b>ALLOW for two marks</b> correctly calculated value not given to 4SF e.g. 3156.55 <math>\mu\text{m}^3</math></p> <p>3157.82 <math>\mu\text{m}^3</math> (22/7 used) 3154.95 <math>\mu\text{m}^3</math> (3.14 used)</p> <p><b>OR</b> correctly calculated value without units e.g. 3157 / 3.157</p> <p><b>OR</b> correctly calculated value with inappropriate units</p> <p>e.g. 3.157 <math>\times 10^{-6}</math> <math>\text{mm}^3</math></p> <p>3.157 <math>\times 10^{-9}</math> <math>\text{cm}^3</math></p> <p><b>If two or three marks were not awarded for the correct answer or calculated value:</b> for <b>one mark</b> look for evidence of use of the formula:</p> <p><math>(4/3) \times \pi \times r^3</math></p> <p><b>Examiner's Comments</b> The necessity to use <math>\pi</math> in the equation for <b>Q17(b)(i)</b> generated three different versions of the correct answer in order to encompass all the various values of <math>\pi</math> e.g. 3.14 or 22/7. Candidates could gain credit for a variety of responses and many variations that included errors could still gain one or two marks if Examiners could clearly see how candidates had arrived at their response e.g. one mark was awarded for candidates that had used the correct equation for calculating the volume of a sphere. The most common error was using the wrong value for the radius, having confused it with the diameter or simply not knowing the formula for a sphere. The equation for calculating area of a</p>
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					circle rather than volume of a sphere was another common error. Some candidates mistakenly squared the value of the radius or mis-keyed the correct values into the formula and it is recommended that centres encourage candidates to repeat calculations to check for such errors, provided time allows.
		ii	<p>(transmission) electron (microscope) ✓</p> <p><b>AND ONE</b> of the following:</p> <p>2D image ✓</p> <p>internal details visible ✓</p> <p>(named) organelles / ultrastructures , visible ✓</p> <p>high <u>magnification</u> ✓</p> <p>high <u>resolution</u> ✓</p>	<b>2 max</b>	<p><b>ALLOW TEM</b> <b>DO NOT ALLOW</b> scanning electron microscope / SEM</p> <p><b>IGNORE</b> black and white / colour</p> <p>e.g. mitochondria <b>IGNORE</b> nucleus (as visible under a light microscope)</p> <p><b>Examiner's Comments</b></p> <p>For candidates who recognised that an electron microscope was necessary to produce the image of the Kupffer cell, <b>Q17(b)(ii)</b> posed few problems and both marks were often achieved. Some candidates suggested a scanning electron microscope rather than transmission which was not credited but error carried forward was used for the second mark of this question to avoid candidates losing both marks. Error carried forward was also used where candidates had incorrectly stated a light microscope but marks were only gained for the mark points in the mark scheme and not for incorrect statements such as '<i>no organelles can be seen</i>' or '<i>has low resolution</i>'.</p>
			<b>Total</b>	<b>5</b>	
8			Phloem = B <b>AND</b>	<b>3</b>	

		<p>contains sucrose / non-reducing sugar ✓</p> <p>non-reducing sugar / sucrose, hydrolysed / broken down, to monosaccharides ✓</p> <p>Liver = A</p> <p><b>AND</b></p> <p>does not contain starch / gives negative result for iodine test ✓</p>		<p><b>ALLOW</b> non-reducing sugars broken down to, reducing sugars / named monosaccharide</p> <p><b>ALLOW</b> 'colour after iodine added was yellow'</p> <p><b><u>Examiner's Comments</u></b></p> <p>Many candidates identified tissue B as phloem since it contained sucrose, or a non-reducing sugar, which would result in a red precipitate with Benedict's reagent after treatment with hydrochloric acid. Fewer mentioned that this treatment would hydrolyse sucrose into its monosaccharide constituents. Some candidates lost the mark for stating that sucrose is a reducing sugar.</p> <p>Most candidates correctly identified tissue A as liver due to the fact that it contained no starch resulting in a negative result for the iodine test. Lower ability candidates identified C as the liver stating that it would contain both glycogen and reducing sugars such as glucose, but ignoring the fact that tissue C also contained starch.</p>
		<b>Total</b>	<b>3</b>	
9		<p><b>W</b> liver / hepatic ✓</p> <p><b>X</b> pancreas / pancreatic ✓</p> <p><b>Y</b> skeletal / striated , <u>muscle</u> ✓</p>	3	<p><b>IGNORE</b> cells</p> <p><b>ALLOW</b> Islet of Langerhans / acini</p> <p><b><u>Examiner's Comments</u></b></p> <p>Generally this question was well-answered and it was clear that many candidates had seen images of tissues similar to those shown in Fig. 23.1. Credit could not be given for 'skeletal' or 'muscle' (tissue) for <b>Y</b> which were commonly seen incorrect</p>

					responses. 'Skeletal' could also apply to other types of tissue found in the skeleton e.g. bone, and 'muscle' could also apply to other types of muscle tissue e.g. smooth muscle.
			<b>Total</b>	<b>3</b>	
10			(bilirubin is a) metabolic waste product / described ✓ as produced, from haem / during (red blood cell) breakdown ✓ (bilirubin) removed / AW, from the body ✓	2 (AO1.2) (AO2.5)	<p><b>ALLOW</b> (bilirubin) removed into the digestive system</p> <p><b>Examiner's Comments</b></p> <p>In question <b>(a)(i)</b> Candidates generally struggled to score marks. They wrote around the marking points without describing the key ideas (e.g. they didn't mention the placenta, they didn't convey the idea of oxygen transferring between the two forms of haemoglobin, they stated oxygen is needed for fetal growth but did not mention respiration).</p> <p>Few candidates were able to plot the graph to the required accuracy for <b>(a)(ii)</b>. Many took the instruction to 'sketch' the curve as meaning that precision was not required, and so drew curves of a similar shape to those of adult and fetal haemoglobin already shown, ignoring the details of the curve set out in the question stem.</p> <p>In <b>(c)</b>, many candidates seemed to understand the concept of excretion, but struggled to translate this into an explanation of this specific example, and so did not gain full marks.</p>
			<b>Total</b>	<b>2</b>	
11			C	1 (AO1.1)	
			<b>Total</b>	<b>1</b>	
12		i	<b>N</b> = central vein / <u>intra</u> lobular blood vessel ✓	2 (AO2.1) AO2.1)	<b>ALLOW</b> branch of hepatic vein

			<b>O</b> = hepatocyte / liver cell ✓		
		ii	thin / flat, cells ✓ short diffusion distance ✓ <b>OR</b> fenestrated / AW ✓ increases permeability ✓	max 2 (AO2.1)	<b>DO NOT ALLOW</b> thin cell wall
			<b>Total</b>	<b>4</b>	