



**GCE**

**Biology A**

**H420/01: Biological processes**

Advanced GCE

**Mark Scheme for June 2019**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

















Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

Annotation	Meaning
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
	Wavy underlined words must be present or similar-meaning words must be present in answer to score a mark.
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

## Marking Annotations

Annotation	Use
	Benefit of Doubt
	Contradiction
	Cross
	Error Carried Forward
	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
	Benefit of the doubt not given
	Tick
	Omission Mark
	Blank Page
	Level 1 answer in Level of Response question
	Level 2 answer in Level of Response question
	Level 3 answer in Level of Response question

## Subject-specific Marking Instructions

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question		Answer	Marks	Guidance
1		C ✓	1	
2		A ✓	1	
3		A ✓	1	
4		C ✓	1	
5		D ✓	1	
6		A ✓	1	
7		B ✓	1	
8		D ✓	1	
9		B ✓	1	
10		B ✓ ALLOW A	1	
11		D ✓	1	
12		C ✓ ALLOW A	1	
13		D ✓	1	
14		D ✓	1	
15		B ✓	1	
		<b>Total</b>	<b>15</b>	

Question			Answer	Marks	Guidance																		
16	(a)	(i)	<p><b>1</b> similar increase <b>and</b> decrease (in pressure) , between 0 to 0.15s / to 0.15s / to point X ✓</p> <p><b>2</b> steeper / faster, rise / fall , in ventricle (pressure) ✓</p> <p><b>3</b> bigger , increase / decrease , in ventricle (pressure) ✓</p> <p><b>4</b> <i>idea that</i> at approximately 0.15s atrial (pressure) has , (small) rise and fall / AW , but ventricular is increasing ✓</p> <p><b>5</b> <i>idea that</i> from approximately 0.3s ventricular pressure decreases but atrial pressure still increasing ✓</p> <p><b>6</b> from 0.5s no change in pressure(s) in both ✓</p> <p><b>7</b> comparative figures with units ✓</p>	4 max	<p><b>ALLOW</b> changes in pressure are the same , between 0 to 0.15s / to point X / to 0.15s</p> <p><b>ALLOW</b> ORA for atrium</p> <p><b>ALLOW</b> ORA for atrium</p> <p><b>NOTE: MPs 2 and/or 3</b> may be implied using comparative figures</p> <table border="1" data-bbox="1272 491 1749 703"> <thead> <tr> <th>Time (s)</th> <th>LA (kPa)</th> <th>LV (kPa)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0.2</td> <td>0.2</td> </tr> <tr> <td>0.08</td> <td>1.5</td> <td>1.0</td> </tr> <tr> <td>0.15</td> <td>0.2</td> <td>0.2</td> </tr> <tr> <td>0.30</td> <td>0.8</td> <td>16.0</td> </tr> <tr> <td>0.50</td> <td>0.2</td> <td>0.2</td> </tr> </tbody> </table> <p>For <b>MP7</b> units must be mentioned once Figures must show <b>change</b> in pressure in kPa</p> <p><b>ALLOW</b> +/- 0.5 throughout for pressure</p> <p>e.g. at 0.15s ventricle pressure goes from 0.2 kPa to 16kPa but atrial has 'blip' from 0.2 to 0.8 and back down = <b>MP4</b> and <b>MP7</b></p> <p>e.g. ventricular pressure has big increase from 0.2kPa to 16kPa but atrial only goes to 0.8kPa = <b>MP3</b> and <b>MP7</b></p>	Time (s)	LA (kPa)	LV (kPa)	0	0.2	0.2	0.08	1.5	1.0	0.15	0.2	0.2	0.30	0.8	16.0	0.50	0.2	0.2
Time (s)	LA (kPa)	LV (kPa)																					
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0.50	0.2	0.2																					
	(a)	(ii)	86 bpm ✓	1	<p><b>Unit must be given</b></p> <p><b>ALLOW</b> beats per minute</p>																		

	(a)	(iii)	45 (%) ✓✓	2	<p><b>IGNORE</b> + or –  <b>ALLOW</b> for 1 max 44 or 46</p> <p>If answer incorrect or not given to 2 sig.figs:  <b>ALLOW</b> for 1 max  <math>5 \div 11 \times 100</math> <b>OR</b> 45.45 <b>OR</b> 45.5</p>
	(a)	(iv)	atrioventricular ✓	1	<p><b>ALLOW</b> bicuspid / mitral  <b>IGNORE</b> AV  <b>DO NOT ALLOW</b> tricuspid</p>
	(b)		<p>type / vigour / intensity / AW , of exercise ✓</p> <p>muscle mass / bone density / fitness / height /                      build / proportion of body fat / BMI ✓</p> <p>age ✓</p> <p>(environmental) temperature ✓                      brand / make / type , of smart watch ✓                      reference to , exercise / rest , before experiment ✓                      named , health / lifestyle , condition ✓</p>	3 max	<p><b>List Rule</b>                      If all <b>three</b> prompt lines used and more than one variable is on prompt line mark the <b>first</b> one on each line.                      If only <b>one</b> or <b>two</b> lines used but there is more than one variable listed mark the first three variables given.</p> <p><b>IGNORE</b> repeats / replicates / amount of exercise</p> <p><b>IGNORE</b> mass  <b>IGNORE</b> gender</p> <p><b>DO NOT ALLOW</b> body temperature  <b>ALLOW</b> same smart watch</p> <p>e.g. asthma                      e.g. smoking                      e.g. drugs / anabolic steroids  <b>IGNORE</b> diet / healthy unqualified / alcohol</p>
	(c)		mitochondria / mitochondrion	1	
			<b>Total</b>	<b>12</b>	



Question		Answer	Marks	Guidance
17	(a)	<p>1 (gibberellin is) a chemical messenger ✓</p> <p>2 produced in one part of plant but has effects in another part / AW ✓</p> <p>3 affects activity / AW , of target , cells / tissues ✓</p> <p>4 long-lasting / acts over long period of time ✓</p> <p>5 wide-spread effect ✓</p>	3 max	<p><b>IGNORE</b> functions of gibberellin</p> <p><b>ALLOW</b> cell-signalling molecule</p> <p>e.g. causes activity of target cells to be altered</p> <p>e.g. causes response in target cells</p>

	(b)	(i)	4	<table border="1" data-bbox="1272 201 1910 639"> <thead> <tr> <th>Volume of gibberellin applied (<math>10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}</math>)</th> <th>Rate of increase of internodal length (<math>\text{mm day}^{-1}</math>)</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>1</td></tr> <tr><td>0.2</td><td>1</td></tr> <tr><td>0.4</td><td>2</td></tr> <tr><td>0.6</td><td>4</td></tr> <tr><td>0.9</td><td>22</td></tr> <tr><td>1.2</td><td>47</td></tr> <tr><td>1.4</td><td>48</td></tr> <tr><td>1.8</td><td>49</td></tr> <tr><td>1.9</td><td>50</td></tr> <tr><td>2.0</td><td>50</td></tr> </tbody> </table> <p><b>IGNORE</b> extrapolations</p> <p>Units <b>must</b> be given for both axes  <b>ALLOW</b> solidus i.e. / for brackets ()  <b>NOTE</b> () or / should be seen at least once</p> <p><b>NOTE</b> non-linear x axis data</p> <p><b>ALLOW</b> one error in plotting  <b>ALLOW ECF</b> if non-linear scale used</p> <p><b>DO NOT ALLOW</b> ruled lines between points</p>	Volume of gibberellin applied ( $10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}$ )	Rate of increase of internodal length ( $\text{mm day}^{-1}$ )	0.0	1	0.2	1	0.4	2	0.6	4	0.9	22	1.2	47	1.4	48	1.8	49	1.9	50	2.0	50
Volume of gibberellin applied ( $10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}$ )	Rate of increase of internodal length ( $\text{mm day}^{-1}$ )																									
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2.0	50																									
<p>x (horizontal) axis labelled  <b>volume of gibberellin applied (<math>\times 10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}</math>)</b>  <b>AND</b>  y (vertical) axis labelled  <b>rate of internodal length increase (<math>\text{mm day}^{-1}</math>)</b> ✓</p> <p>linear scale on both axes  <b>AND</b>  at least 50% of area covered ✓</p> <p>line graph  <b>AND</b>  points plotted accurately to <math>\pm 1</math> small square ✓</p> <p>suitable curved line of best fit drawn ✓</p>																										

	(b)	(ii)	Any <b>one</b> from seed germination flowering in long-day plants cellular , transcription / translation prevents leaf abscission aids stomatal opening promotes fruit development promotes , activity of amylase / hydrolysis of starch ✓			1 max	
	(c)	(i)	non-reducing , sugars / disaccharides ✓			1	<b>ALLOW</b> sucrose / cellulose / vitamins <b>IGNORE</b> minerals / ions / fibre
	(c)	(ii)	<b>Test tube</b>	<b>Observations</b>	<b>Conclusion</b>	2	<b>1 mark per correct column</b>
			1	(pale) purple / lilac / violet / mauve	Protein present		
			2	Yellow colour	reducing sugar (present)		<b>IGNORE</b> monosaccharides
			3	Pale brown colour	no / very little , starch (present)		
			4	(turns) white / cloudy / milky <b>OR</b> (forms white) suspension / emulsion	Fat present		<b>DO NOT ALLOW</b> precipitate
			5	<u>pink</u>	Glucose content small (15 mg dl <sup>-1</sup> )		<b>IGNORE</b> any qualifications / shades of colour
				✓	✓		

	(c)	(iii)	(result using colorimeter will be) <u>quantitative</u> <b>OR</b> not subjective / less affected by human error / no bias ✓	1	<b>IGNORE</b> accurate / valid <b>ALLOW</b> is objective
			<b>Total</b>	<b>12</b>	

<p>18</p>	<p>(a)*</p>	<p>Using a ‘best-fit’ approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.</p> <p>Once the level is located, award the higher or lower mark.</p> <p><b>The higher mark</b> should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.</p> <p><b>The lower mark</b> should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.</p> <p><b>In summary:</b></p> <ul style="list-style-type: none"> <li>• <b>The science content determines the level.</b></li> <li>• <b>The communication statement determines the mark within a level.</b></li> </ul>							
		<p><b>Level 3 (5–6 marks)</b> Full and detailed comparison of the circulatory systems of a fish and mammal.</p> <p><i>There is a well-developed comparison including a range of features. The information presented is relevant and clearly explained.</i></p> <p><b>Level 2 (3–4 marks)</b> Detailed comparison of the circulatory systems of a fish and mammal.</p> <p><i>There is a reasonable attempt at comparison including a small range of features. The information presented is mostly relevant and clearly explained.</i></p> <p><b>Level 1 (1–2 marks)</b></p>	<p><b>6</b></p> <p><b>Indicative scientific points may include...</b> <i>As this is a comparison BOTH fish and mammals must be mentioned</i></p> <p><i>Similarities</i></p> <ul style="list-style-type: none"> <li>• Both are closed systems / blood in blood vessels</li> <li>• Both have a heart</li> <li>• Both carry oxygen using haemoglobin</li> <li>• Both have arteries / veins / capillaries</li> </ul> <p><i>Differences:</i></p> <table border="1" data-bbox="1370 1034 1989 1359"> <thead> <tr> <th data-bbox="1370 1034 1653 1082">Fish</th> <th data-bbox="1653 1034 1989 1082">Mammal</th> </tr> </thead> <tbody> <tr> <td data-bbox="1370 1082 1653 1225">Single circulation / blood through heart once</td> <td data-bbox="1653 1082 1989 1225">Double circulation / blood through heart twice Pulmonary and systemic circulations</td> </tr> <tr> <td data-bbox="1370 1225 1653 1359">One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart</td> <td data-bbox="1653 1225 1989 1359">Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum</td> </tr> </tbody> </table>	Fish	Mammal	Single circulation / blood through heart once	Double circulation / blood through heart twice Pulmonary and systemic circulations	One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart	Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum
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One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart	Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum								

		<p>Some correct comparison of the circulatory systems of a fish and mammal.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited explanations which may be unclear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>		<table border="1"> <tr> <td data-bbox="1370 165 1655 336">Blood passes through 2 sets of capillaries (before returning to heart)</td> <td data-bbox="1655 165 1986 336">Blood passes through 1 set of capillaries (before returning to heart)</td> </tr> <tr> <td data-bbox="1370 336 1655 448">Blood pressure is lower (to organs)</td> <td data-bbox="1655 336 1986 448">Blood maintained at higher pressure</td> </tr> <tr> <td data-bbox="1370 448 1655 619"></td> <td data-bbox="1655 448 1986 619">2 circulations with different pressures / can have high pressure in systemic circulation</td> </tr> <tr> <td data-bbox="1370 619 1655 756">Less efficient at transporting / supplying oxygen to tissues</td> <td data-bbox="1655 619 1986 756">More efficient at transporting / supplying oxygen to tissues</td> </tr> <tr> <td data-bbox="1370 756 1655 952">(Fulfils needs) as fish are 'cold blooded' / have a low oxygen demand / low metabolic rate</td> <td data-bbox="1655 756 1986 952">(Fulfils needs) as mammals need to maintain a constant body temperature / have a high oxygen demand / high metabolic rate</td> </tr> </table>	Blood passes through 2 sets of capillaries (before returning to heart)	Blood passes through 1 set of capillaries (before returning to heart)	Blood pressure is lower (to organs)	Blood maintained at higher pressure		2 circulations with different pressures / can have high pressure in systemic circulation	Less efficient at transporting / supplying oxygen to tissues	More efficient at transporting / supplying oxygen to tissues	(Fulfils needs) as fish are 'cold blooded' / have a low oxygen demand / low metabolic rate	(Fulfils needs) as mammals need to maintain a constant body temperature / have a high oxygen demand / high metabolic rate
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(b)		<p>secreted into / travels in , blood ✓ binds to receptors on (skin) cell (surface) ✓</p> <p>detail of response inside cell(s) ✓</p>	2 max	<p><b>ALLOW</b> transport medium / AW for blood <b>ALLOW</b> specific binding sites for receptors</p> <p>e.g. activates G protein e.g. causes formation of a secondary messenger e.g. enzyme / phosphorylation , cascade</p>										

	(c)	<p>carbon dioxide / <math>\text{CO}_2</math> , forms , carbonic acid / <math>\text{H}_2\text{CO}_3</math>  <b>OR</b>  carbonic acid / <math>\text{H}_2\text{CO}_3</math> , dissociates  into <math>\text{H}^+</math> (and <math>\text{HCO}_3^-</math>) ✓</p> <p>haemocyanin , acts as a buffer /  associates with (excess) <math>\text{H}^+</math> ✓</p> <p><math>\text{H}^+</math> / low pH , causes change in (tertiary)  structure of haemocyanin ✓</p>	2 max	<p><b>ALLOW</b> hydrogen ions / H ions throughout for <math>\text{H}^+</math>  <b>IGNORE</b> cannot bind to oxygen / reduced affinity  for oxygen  <b>IGNORE</b> Bohr effect  <b>If 2 MPs awarded give max 1</b> if haemoglobin  instead of haemocyanin written</p> <p><b>ALLOW</b> equation  e.g. <math>\text{CO}_2 (+ \text{H}_2\text{O}) \rightarrow \text{H}_2\text{CO}_3</math>  <b>OR</b>  e.g. <math>\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ (+ \text{HCO}_3^-)</math>  <b>DO NOT ALLOW</b> hydrogen / H atoms / molecules</p>
		<b>Total</b>	<b>10</b>	

Question		Answer	Marks	Guidance
19	(a)	<p>have , thin wall / valves , so will , distend / bulge ✓</p> <p>large lumen / wide , as contains , large volume of / slow-moving , blood ✓</p> <p>found closer to the , surface / skin , than arteries ✓</p>	3	<b>ALLOW</b> ORA e.g. arteries are found further away from surface than veins
	(b)	<p>1 (skin has) large surface area for absorption ✓</p> <p>2 (skin has) <u>many</u> / network of , capillaries ✓</p> <p>3 (steroids are) lipid-soluble / non-polar ✓</p> <p>4 (so) can cross phospholipid bilayer ✓</p> <p>5 muscles are close to the skin (surface) so short diffusion , pathway / distance ✓</p>	2 max	<b>ALLOW</b> can cross , cell surface / plasma , membranes



	<b>(c)</b>	<b>(i)</b>	(any number in range) 180 to 279 ✓✓✓	<b>3</b>	<p><b>ALLOW ANY number between 180 and 279 for 3 marks</b>  <b>IGNORE +/-</b></p> <table border="1" data-bbox="1272 344 1904 504"> <thead> <tr> <th>Year</th> <th>% containing testosterone</th> <th>No of urine samples</th> <th>Number of positive tests</th> </tr> </thead> <tbody> <tr> <td>1988</td> <td>1.7</td> <td>46000</td> <td>782</td> </tr> <tr> <td>1991</td> <td>0.65</td> <td>85000</td> <td>553</td> </tr> </tbody> </table> <p><b>If incorrect response:</b></p> <p><b>ALLOW for 2 marks</b>  number testing positive in 1988 – number testing positive in 1991  e.g. 799 - 546  <b>OR</b>  e.g. <math>(1.7 \div 100) \times 47000 - (0.65 \div 100) \times 84000</math></p> <p><b>ALLOW for 1 mark</b>  Calculation of number of samples testing positive in EITHER 1988 or 1991  e.g. <math>(1.7 \div 100) \times 47000</math>  <b>OR</b>  e.g. 1.7% of 46000</p> <p><b>ALLOW</b> for % testosterone + / - 0.02%  <b>ALLOW</b> for number of urine samples +/- 1000</p>	Year	% containing testosterone	No of urine samples	Number of positive tests	1988	1.7	46000	782	1991	0.65	85000	553
Year	% containing testosterone	No of urine samples	Number of positive tests														
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		<p>Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.</p> <p>Once the level is located, award the higher or lower mark.</p> <p><b>The higher mark</b> should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.</p> <p><b>The lower mark</b> should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.</p> <p><b>In summary:</b></p> <ul style="list-style-type: none"> <li>• <b>The science content determines the level.</b></li> <li>• <b>The communication statement determines the mark within a level.</b></li> </ul>		
(c)	(ii)*	<p><b>Level 3 (5–6 marks)</b> Full and detailed evaluation including reference to factors that both support and contradict the statement, as well as reference to the issues of validity which affect the data.</p> <p><i>There is a well-developed argument including a good range of evidence. The information presented is relevant and clearly explained.</i></p> <p><b>Level 2 (3–4 marks)</b> Detailed evaluation including reference to at least one factor that supports and one that does not support the statement.</p> <p><i>There is a reasonable attempt at evaluation including a small range of evidence. The information presented is mostly relevant and clearly explained.</i></p>	6	<p>Indicative scientific points may include...</p> <p><b><i>Evidence in support of the statement:</i></b></p> <ul style="list-style-type: none"> <li>• General trend : reduction in % samples with testosterone from start to end of test</li> <li>• From 1988 to 1991, % samples with testosterone decreased as test numbers increased</li> <li>• Increase in number of tests carried out over time</li> <li>• More testing shows , more awareness / scrutiny / acts as deterrent</li> </ul> <p><b><i>Evidence against the statement:</i></b></p> <ul style="list-style-type: none"> <li>• From 1986 to 1988 there was an increase in % tests with testosterone / number of positive tests</li> <li>• Correlation does not show causation</li> <li>• More tests but more athletes competing</li> <li>• After 1991 / in 1992 and 1993 there was an increase in % tests with testosterone / number of positive tests</li> <li>• Fewer samples with testosterone is not the same as less incidence of abuse</li> </ul>

		<p><b>Level 1 (1–2 marks)</b>                  Evaluation is attempted including reference to a factor that supports <b>or</b> contradicts the statement, <b>or</b> refers to an issue of validity which affect the data.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence which may be unclear.</i></p> <p><b>0 marks</b>                  No response or no response worthy of credit.</p>		<ul style="list-style-type: none"> <li>• No clear pattern / trend in positive samples</li> <li>• From 1986 to 1994 the number of positive tests increases</li> </ul> <p><b>Issues of validity with data:</b></p> <ul style="list-style-type: none"> <li>• Only a limited / short time was studied or only valid for the time studied</li> <li>• Other steroids used and not detected</li> <li>• Other drugs mask testosterone levels</li> <li>• Testosterone levels may vary naturally in the population (AW)</li> <li>• No details provided for the method used / modern technology may have improved the sensitivity of the test over time</li> <li>• No detail of a control group</li> <li>• Security of testing / cheating / corruption / bribery</li> <li>• Not turning up for testing / times of testing</li> <li>• Reference to significance of data</li> <li>• No statistical tests / SD bars / range bars</li> <li>• Could be same sport being tested or different sports</li> <li>• Could be same athletes repeatedly tested or different athletes</li> </ul>
		<b>Total</b>	<b>14</b>	

Question			Answer	Marks	Guidance
20	(a)	(i)	<p>1 contains non-protein groups ✓</p> <p>2 has <u>prosthetic</u> group ✓</p> <p>3 (prosthetic group) is , iron / Fe , ion ✓</p> <p>4 (prosthetic group) is attached by , covalent bonds / ionic interactions / hydrogen bonds ✓</p>	3 max	<p><b>ALLOW</b> ions / molecules for groups</p> <p><b>ALLOW</b> non-polypeptide for non-protein</p> <p><b>ALLOW</b> Fe<sup>2+</sup> / Fe<sup>3+</sup> for iron ion</p> <p><b>e.g. has non-protein prosthetic group = 2 marks</b></p>
	(a)	(ii)	<p>1 proteins / contain polypeptide chain(s) ✓</p> <p>2 contain , cysteine / sulphur (atoms) ✓</p> <p>3 have prosthetic group(s) / are conjugated (proteins) ✓</p> <p>4 contain iron ions ✓</p>	2 max	<p><b>Mark as continuous prose</b></p> <p><b>IGNORE</b> subunit</p> <p><b>IGNORE</b> ref to structure / amino acids / bonds</p> <p><b>ALLOW two</b> marks for conjugated protein</p>
	(a)	(iii)	<p>1 haemoglobin , is a <u>larger</u> molecule / has <u>greater</u> molecular mass / has more amino acids ✓</p> <p>2 haemoglobin has , quaternary structure / more than one polypeptide chain ✓</p> <p>3 haemoglobin has , more than one / four , prosthetic groups / iron ions ✓</p> <p>4 haemoglobin contains haem (groups) ✓</p>	2 max	<p><b>Mark as continuous prose</b></p> <p><b>ALLOW ORA</b> for rubredoxin</p> <p><b>ALLOW</b> longer polypeptide chain(s)</p> <p><b>IGNORE</b> subunit</p> <p><b>ALLOW</b> rubredoxin , does not have quaternary structure / <u>only</u> has one polypeptide chain</p> <p><b>ALLOW</b> haemoglobin has , four / two alpha and two beta , polypeptide chains</p> <p><b>DO NOT ALLOW</b> haemoglobin has , one / two / three , polypeptide chains</p> <p><b>ALLOW</b> rubredoxin <u>only</u> has one prosthetic group</p> <p><b>ALLOW ORA</b> for rubredoxin</p> <p><b>ALLOW</b> haemoglobin doesn't contain sulphur in its , prosthetic group / haem</p>

	(b)	(i)	264 / 263.932 / 263.93 / 263.9 (nm <sup>3</sup> ) ✓✓✓	3	<p><b>ALLOW 2 max</b> for the following if answer is incorrect</p> <p><b>1 mark</b> for 9.04 x 10<sup>-4</sup> x 4500</p> <p><b>1 mark</b> for 268 - 4.068</p>
	(b)	(ii)	<p>hydrophobic regions / R groups , on inside (of molecule / protein)</p> <p><b>AND</b></p> <p>hydrophilic regions / R groups , on outside (of molecule / protein) ✓</p>	1	<p><b>BOTH required for one mark</b></p> <p><b>ALLOW e.g.</b> hydrophobic regions point inwards and hydrophilic regions face outwards</p> <p><b>DO NOT ALLOW</b> hydrophobic tails / hydrophilic heads</p>
			<b>Total</b>	<b>11</b>	

Question			Answer	Marks	Guidance												
21	(a)	(i)	<table border="1"> <thead> <tr> <th>Hormone produced</th> <th>Functions of hormone</th> </tr> </thead> <tbody> <tr> <td>adrenaline</td> <td><b>TWO</b> functions from list in guidance</td> </tr> <tr> <td>noradrenaline</td> <td>increases heart rate, increases blood pressure, widens pupils.</td> </tr> <tr> <td>androgens</td> <td>help regulate sexual characteristics and cell growth.</td> </tr> <tr> <td>glucocorticoids / cortisol / corticosterone</td> <td>regulation of metabolism</td> </tr> <tr> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>	Hormone produced	Functions of hormone	adrenaline	<b>TWO</b> functions from list in guidance	noradrenaline	increases heart rate, increases blood pressure, widens pupils.	androgens	help regulate sexual characteristics and cell growth.	glucocorticoids / cortisol / corticosterone	regulation of metabolism	✓	✓	2	<p><b>1 mark per correct column</b></p> <p><b>ALLOW</b> adrenaline for noradrenaline in column one</p> <p><b>ALLOW</b> for functions any <b>two</b> of the following:</p> <ul style="list-style-type: none"> <li>• increases heart rate</li> <li>• increases blood glucose concentration</li> <li>• increases blood flow to muscles</li> <li>• increases glycogenolysis</li> <li>• causes pupils to dilate</li> <li>• decreases blood flow to gut</li> <li>• increases blood pressure</li> <li>• dilation of bronchioles</li> <li>• increases air flow to alveoli</li> <li>• increases breathing rate</li> </ul>
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✓	✓																
	(a)	(ii)	B <b>AND</b> (adrenal) medulla ✓	1	<b>BOTH</b> required for one mark												
	(b)	(i)	Z <b>THEN</b> X ✓  Y ✓	2	<b>Order MUST</b> be Z, X then Y for two marks												

	<b>(b)</b>	<b>(ii)</b>	large single peaks present ✓ small wavy line between peaks with at least three waves between any two peaks ✓	<b>2</b>	<b>0 marks</b> if just a wavy line drawn with no peaks
	<b>(b)</b>	<b>(iii)</b>	increased stroke volume / AW ✓ increased volume of ventricle (chamber) ✓  increased , thickness / strength , of heart <u>muscle</u> ✓	<b>2</b>	<b>ALLOW</b> myocardium for muscle
			<b>Total</b>	<b>9</b>	

Question		Answer	Marks	Guidance
22	(a)	<p><b>A</b> RuBP / ribulose <u>bis</u>phosphate ✓  <b>B</b> triose phosphate / TP ✓  <b>C</b> fatty acid(s) ✓  <b>D</b> amino acid(s) ✓</p>	4	<p><b>Mark first response on each line</b>  <b>IGNORE</b> biphosphate</p> <p><b>IGNORE</b> named fatty acids / triglycerides / fats  <b>IGNORE</b> named amino acids  <b>ALLOW</b> polypeptide / protein</p>
	(b)	(i)	3	<p><i>independent variable</i>  temperature ✓</p> <p><i>dependent variable</i>  <u>concentration</u> of oxygen ✓</p> <p><i>control variable</i></p> <p>species / type of pondweed  <b>OR</b>  <u>mass</u> of pondweed  <b>OR</b>  light intensity / distance of light source from beaker  <b>OR</b>  time in water bath / equilibration time / time intervals  <b>OR</b>  volume of (distilled) water  <b>OR</b>  <u>mass</u> of NaHCO<sub>3</sub> ✓</p> <p><b>NOTE: 1 max for control variable</b>  <b>IGNORE</b> quoted figures  <b>ALLOW</b> <i>P. pusillus</i> for pondweed</p> <p><b>ALLOW</b> wavelength of light</p>
	(b)	(ii)	1 max	<p><b>IGNORE</b> reference to equipment</p> <p>pH ✓  concentration of CO<sub>2</sub> ✓</p> <p>age of pondweed ✓  size / surface area / number , of leaves ✓</p> <p><b>ALLOW</b> <i>P. pusillus</i> for pondweed</p>



	(c)		<p><b>descriptions</b></p> <p><b>D1</b> increasing temperature increases , O<sub>2</sub> concentration / rate of photosynthesis ✓</p> <p><b>D2</b> at each temperature rate of , oxygen production / photosynthesis , is constant ✓</p> <p><b>explanations</b></p> <p><b>E1</b> oxygen is a product of , photosynthesis / photolysis / light-dependent reactions ✓</p> <p><b>E2</b> temperature acts as a <u>limiting factor</u> ✓</p> <p><b>E3</b> no other (named) factor was limiting ✓</p> <p><b>E4</b> increasing temperature increases , kinetic energy of molecules / rate of enzyme reactions ✓</p>	3 max	<p><b>ALLOW</b> ORA for decreasing temperature</p> <p><b>2 max for explanations</b></p> <p><b>ALLOW</b> e.g. light intensity / CO<sub>2</sub> concentration</p> <p><b>ALLOW</b> e.g. increases , ESC / EPC , formation e.g. increases number of successful collisions</p> <p><b>ALLOW</b> KE for kinetic energy</p> <p><b>ALLOW</b> ORA for decreasing temperature</p>
	(d)	(i)	<p><i>accurate because:</i> does not require , photons / light energy ✓</p> <p><i>inaccurate because:</i> needs , ATP / reduced NADP , produced in light-dependent stage ✓</p>	2	<p><b>IGNORE</b> can occur in the dark</p> <p><b>ALLOW</b> variations of reduced NADP e.g.NADPH</p>
	(d)	(ii)	ribulose <u>bis</u> phosphate carboxylase / RuBisCO ✓	1	<b>ALLOW</b> RUBISCO / rubisco
	(e)	(i)	(auxin causes) apical dominance ✓	1	

	(e)	(ii)	<p>rooting , powder / solutions ✓  micropropagation / tissue culture ✓  weed killers / herbicides ✓  production of seedless fruit ✓  preventing abscission ✓  promotes fruit ripening ✓</p>	2 max	<p><b>List Rule</b>  If <b>both</b> prompt lines used and more than one response is on prompt line mark the <b>first</b> one on each line.  If only <b>one</b> line used but there is more than one response listed mark the first two given.</p> <p><b>ALLOW</b> rooting hormone  <b>IGNORE</b> to take cuttings</p> <p><b>ALLOW</b> parthenocarpy  <b>ALLOW</b> prevents leaf / fruit , drop</p>
			<b>Total</b>	<b>17</b>	

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