



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
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	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.
ECF	Error carried forward
AW	Alternative wording
ORA	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	
			Total	15	

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

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

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

	(b)	(i)		4	<table><tr><th>Volume of gibberellin applied ($10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}$)</th><th>Rate of increase of internodal length (mm day^{-1})</th></tr><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></table> IGNORE extrapolations Units must be given for both axes ALLOW solidus i.e. / for brackets () NOTE () or / should be seen at least once NOTE non-linear x axis data ALLOW one error in plotting ALLOW ECF if non-linear scale used DO NOT ALLOW ruled lines between points	Volume of gibberellin applied ($10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}$)	Rate of increase of internodal length (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 (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																										
			x (horizontal) axis labelled volume of gibberellin applied ($\times 10^{-3} \text{ cm}^3 \text{ kg}^{-1} \text{ day}^{-1}$) AND y (vertical) axis labelled rate of internodal length increase (mm day^{-1}) ✓ linear scale on both axes AND at least 50% of area covered ✓ line graph AND points plotted accurately to ± 1 small square ✓ suitable curved line of best fit drawn ✓																								

	(b)	(ii)	Any one 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	ALLOW sucrose / cellulose / vitamins IGNORE minerals / ions / fibre
	(c)	(ii)	Test tube	Observations	Conclusion	2	1 mark per correct column IGNORE monosaccharides DO NOT ALLOW precipitate IGNORE any qualifications / shades of colour
			1	(pale) purple / lilac / violet / mauve	Protein present		
			2	Yellow colour	reducing sugar (present)		
			3	Pale brown colour	no / very little , starch (present)		
			4	(turns) white / cloudy / milky OR (forms white) suspension / emulsion	Fat present		
			5	<u>pink</u>	Glucose content small (15 mg dl ⁻¹)		
			✓				

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

18	(a)*	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. Once the level is located, award the higher or lower mark. The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. In summary: • The science content determines the level. • The communication statement determines the mark within a level.						
		Level 3 (5–6 marks) Full and detailed comparison of the circulatory systems of a fish and mammal. <i>There is a well-developed comparison including a range of features. The information presented is relevant and clearly explained.</i> Level 2 (3–4 marks) Detailed comparison of the circulatory systems of a fish and mammal. <i>There is a reasonable attempt at comparison including a small range of features. The information presented is mostly relevant and clearly explained.</i> Level 1 (1–2 marks) 6 Indicative scientific points may include... <i>As this is a comparison BOTH fish and mammals must be mentioned</i> Similarities • Both are closed systems / blood in blood vessels • Both have a heart • Both carry oxygen using haemoglobin • Both have arteries / veins / capillaries Differences: <table><tr><th>Fish</th><th>Mammal</th></tr><tr><td>Single circulation / blood through heart once</td><td>Double circulation / blood through heart twice Pulmonary and systemic circulations</td></tr><tr><td>One atrium and 1 ventricle / 2 chambers (in heart) / no septum in heart</td><td>Two atria and 2 ventricles / 4 chambers (in heart) / heart has a septum</td></tr></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
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							

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

	(c)		carbon dioxide / CO_2 , forms , carbonic acid / H_2CO_3 OR carbonic acid / H_2CO_3 , dissociates into H^+ (and HCO_3^-) ✓ haemocyanin , acts as a buffer / associates with (excess) H^+ ✓ H^+ / low pH , causes change in (tertiary) structure of haemocyanin ✓	2 max	ALLOW hydrogen ions / H ions throughout for H^+ IGNORE cannot bind to oxygen / reduced affinity for oxygen IGNORE Bohr effect If 2 MPs awarded give max 1 if haemoglobin instead of haemocyanin written ALLOW equation e.g. $\text{CO}_2 (+ \text{H}_2\text{O}) \rightarrow \text{H}_2\text{CO}_3$ OR e.g. $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ (+ \text{HCO}_3^-)$ DO NOT ALLOW hydrogen / H atoms / molecules
			Total	10	

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

	(c)	(i)	(any number in range) 180 to 279 ✓✓✓	3	ALLOW ANY number between 180 and 279 for 3 marks IGNORE +/- <table><tr><th>Year</th><th>% containing testosterone</th><th>No of urine samples</th><th>Number of positive tests</th></tr><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></table> If incorrect response: ALLOW for 2 marks number testing positive in 1988 – number testing positive in 1991 e.g. 799 - 546 OR e.g. $(1.7 \div 100) \times 47000 - (0.65 \div 100) \times 84000$ ALLOW for 1 mark Calculation of number of samples testing positive in EITHER 1988 or 1991 e.g. $(1.7 \div 100) \times 47000$ OR e.g. 1.7% of 46000 ALLOW for % testosterone + / - 0.02% ALLOW for number of urine samples +/- 1000	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														
1988	1.7	46000	782														
1991	0.65	85000	553														

			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. Once the level is located, award the higher or lower mark. The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. In summary: • The science content determines the level. • The communication statement determines the mark within a level.		
	(c)	(ii)*	Level 3 (5–6 marks) 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. <i>There is a well-developed argument including a good range of evidence. The information presented is relevant and clearly explained.</i> Level 2 (3–4 marks) Detailed evaluation including reference to at least one factor that supports and one that does not support the statement. <i>There is a reasonable attempt at evaluation including a small range of evidence. The information presented is mostly relevant and clearly explained.</i>	6	Indicative scientific points may include... <i>Evidence in support of the statement:</i> • General trend : reduction in % samples with testosterone from start to end of test • From 1988 to 1991, % samples with testosterone decreased as test numbers increased • Increase in number of tests carried out over time • More testing shows , more awareness / scrutiny / acts as deterrent <i>Evidence against the statement:</i> • From 1986 to 1988 there was an increase in % tests with testosterone / number of positive tests • Correlation does not show causation • More tests but more athletes competing • After 1991 / in 1992 and 1993 there was an increase in % tests with testosterone / number of positive tests • Fewer samples with testosterone is not the same as less incidence of abuse

		Level 1 (1–2 marks) Evaluation is attempted including reference to a factor that supports or contradicts the statement, or refers to an issue of validity which affect the data. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence which may be unclear.</i> 0 marks No response or no response worthy of credit.		• No clear pattern / trend in positive samples • From 1986 to 1994 the number of positive tests increases Issues of validity with data: • Only a limited / short time was studied or only valid for the time studied • Other steroids used and not detected • Other drugs mask testosterone levels • Testosterone levels may vary naturally in the population (AW) • No details provided for the method used / modern technology may have improved the sensitivity of the test over time • No detail of a control group • Security of testing / cheating / corruption / bribery • Not turning up for testing / times of testing • Reference to significance of data • No statistical tests / SD bars / range bars • Could be same sport being tested or different sports • Could be same athletes repeatedly tested or different athletes
		Total	14	

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

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

Question			Answer		Marks	Guidance									
21	(a)	(i)	<table><tr><td>Hormone produced</td><td>Functions of hormone</td></tr><tr><td>adrenaline</td><td>TWO 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></table> ✓✓	Hormone produced	Functions of hormone	adrenaline	TWO 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	1 mark per correct column ALLOW adrenaline for noradrenaline in column one ALLOW for functions any two of the following: • increases heart rate • increases blood glucose concentration • increases blood flow to muscles • increases glycogenolysis • causes pupils to dilate • decreases blood flow to gut • increases blood pressure • dilation of bronchioles • increases air flow to alveoli • increases breathing rate
Hormone produced	Functions of hormone														
adrenaline	TWO 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														
	(a)	(ii)	B AND (adrenal) medulla ✓	1	BOTH required for one mark										
	(b)	(i)	Z THEN X ✓ Y ✓	2	Order MUST be Z, X then Y for two marks										

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

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

	(c)		D1 increasing temperature increases , O₂ concentration / rate of photosynthesis ✓ D2 at each temperature rate of , oxygen production / photosynthesis , is constant ✓ explanations E1 oxygen is a product of , photosynthesis / photolysis / light-dependent reactions ✓ E2 temperature acts as a <u>limiting factor</u> ✓ E3 no other (named) factor was limiting ✓ E4 increasing temperature increases , kinetic energy of molecules / rate of enzyme reactions ✓	3 max	ALLOW ORA for decreasing temperature 2 max for explanations ALLOW e.g. light intensity / CO₂ concentration ALLOW e.g. increases , ESC / EPC , formation e.g. increases number of successful collisions ALLOW KE for kinetic energy ALLOW ORA for decreasing temperature
	(d)	(i)	<i>accurate because:</i> does not require , photons / light <u>energy</u> ✓ <i>inaccurate because:</i> needs , ATP / reduced NADP , produced in light-dependent stage ✓	2	IGNORE can occur in the dark ALLOW variations of reduced NADP e.g.NADPH
	(d)	(ii)	ribulose <u>bis</u> phosphate carboxylase / RuBisCO ✓	1	ALLOW RUBISCO / rubisco
	(e)	(i)	(auxin causes) apical dominance ✓	1	

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

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