

Markscheme

November 2021

Biology

On-screen examination

16 pages

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The following are the annotations available to use when marking responses.

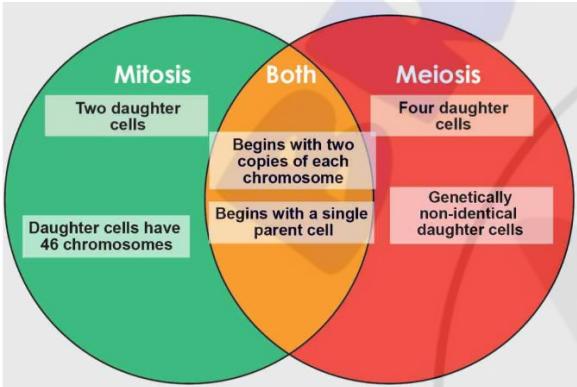
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	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
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	Dynamic annotation, it can be expanded to surround work
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Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

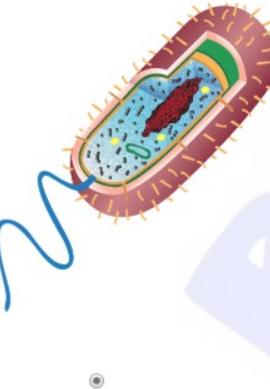
Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the "Total" column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word "**max**" in the Answer column. Further guidance may be given in the Notes column.
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- 11 If two related points are required to award a mark, this is indicated by "**and**" in the answer column.
- 12 Words in brackets () in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA (or reverse argument)* in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE (or words to that effect)* in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question	Answers		Notes	Total	Criterion
1	a	Mammal		1	A
	b	<p>Pollination (pollen needs to be transferred from one plant to another) for reproduction or (pollen needs to be transferred from one plant to another) to increase variation</p> <p>Seed dispersal (seeds are transported away from parent plant for) better chance to survive or increased chance to grow or decreased competition</p>	<i>Do not accept a description of pollen moving alone</i>	2	A
	c	palm tree or eucalyptus or mango tree or grass	<i>Do not accept tree alone</i>	1	A
	d	<p>Advantage (flying fox) eats moth larvae (which would destroy the mango crop) or (flying foxes) act as pollinators</p> <p>Disadvantage the flying foxes eat mango (so profit is decreased)</p>	<i>Accept references to seed dispersal</i>	2	A

2	a	<p>Any two from [max 2]</p> <ul style="list-style-type: none"> • growth • repair or replacement • (sexual) reproduction or to produce gametes • (asexual) reproduction 	Allow reproduction alone for one mark	2	A
	b	 <p>one correctly placed in mitosis and both and meiosis or mitosis or "both" or meiosis fully correct all correctly placed</p>		2	A
	c	<p>every individual has different genetic material every sex cell / gamete is unique genetic material from two parents is combined</p> <p>A further point, for example [max 1]</p> <ul style="list-style-type: none"> • every sex cell / gamete has an equal chance of being fertilized • the offspring express traits from both parents or an individual is unique from both parents 	<p>Allow reference to characteristics or traits</p> <p>Allow reference to sperm and egg</p>	4	A

3	a	nervous system cardio-vascular system or muscular system		2	A
	b	the nervous system detects or communicates (the reduction in temperature) causing vasoconstriction / blood vessels narrow or blood is diverted away from extremities (thereby) reducing heat loss Or the nervous system detects or communicates (the reduction in temperature) causing hairs to rise (thereby) reducing heat loss Or the nervous system detects or communicates (the reduction in temperature) causing shivering / involuntary muscle contractions produce heat or increased cellular respiration (in the muscles)	ORA	3	A
	c	enzymes have an optimum temperature too cold and reactions do not occur fast enough too hot and enzymes change shape and no longer function Correct use of a term from the list: active site; denature; catalyze; lock and key; substrate	<i>Do not accept die</i> WTTE	5	A D

4	a			1	A
	b	A		1	C
	c	<p>Qualitative data, for example [max 1]</p> <ul style="list-style-type: none">• colour• form• elevation• margin <p>Quantitative data, for example [max 1]</p> <ul style="list-style-type: none">• number of colonies• measurement of size or diameter or radius	<i>Allow named examples</i>	2	C
	d	<p>An RQ linking different disinfecting agents</p> <p>With an implied DV for example [max 1]</p> <ul style="list-style-type: none">• zone of no growth• growth of bacteria• presence / absence of bacteria		2	B

	e	<p>IV: type of disinfectant</p> <p>DV: diameter of zone of inhibition or clear zone around disk</p> <p>Any two reasonable CV, for example [max 2]</p> <ul style="list-style-type: none"> • species of bacteria on the plate • size of disk • time of immersion of disk • concentration of the disinfectant • time period of bacterial growth 	<p><i>Do not accept growth, DV must be measurable</i></p>	4	B																		
	f	<p>Any reasonable suggestion relating to sterility of disk or water, for example [max 1]</p> <ul style="list-style-type: none"> • it shows that the effect is not caused by the disk or water • zone is caused by disinfectant (not disk, water, movement of liquid) • it is a negative control • to measure how effective water is as a disinfectant 		1	B																		
	g	<table border="1"> <thead> <tr> <th>Liquid</th> <th>Diameter of zone of no growth on plate 1 / mm</th> <th>Diameter of zone of no growth on plate 2 / mm</th> </tr> </thead> <tbody> <tr> <td>bleach</td> <td>22</td> <td>24</td> </tr> <tr> <td>ethanol</td> <td>9</td> <td>7</td> </tr> <tr> <td>hydrogen peroxide</td> <td>27</td> <td>13</td> </tr> <tr> <td>iodine</td> <td>17</td> <td>15</td> </tr> <tr> <td>water</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <p>two measurements correct to ± 1 mm</p> <p>all measurements correct to ± 1 mm</p>	Liquid	Diameter of zone of no growth on plate 1 / mm	Diameter of zone of no growth on plate 2 / mm	bleach	22	24	ethanol	9	7	hydrogen peroxide	27	13	iodine	17	15	water	0	0		2	C
Liquid	Diameter of zone of no growth on plate 1 / mm	Diameter of zone of no growth on plate 2 / mm																					
bleach	22	24																					
ethanol	9	7																					
hydrogen peroxide	27	13																					
iodine	17	15																					
water	0	0																					

	h	<p>Any reasonable strength, for example [max 1]</p> <ul style="list-style-type: none">• a range of disinfectants produced results that can be compared• a control (water) was used• reference to reliability of data linked to a named control variable <p>Any reasonable weakness, for example [max 1]</p> <ul style="list-style-type: none">• only two trials• results cannot be verified with only two data points• cannot identify outliers• data for hydrogen peroxide was not reproducible <p>Two additional statements from either list</p>	<p>ORA accept either but not both</p>	4	C
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5	a	<p>Stage 2 bacteria sensitive to an antibiotic are killed by it or only resistant individuals survive</p> <p>Stage 5 no bacteria are killed (as all are resistant) or population of resistant bacteria increases (as antibiotic has no effect)</p>	<i>Do not accept references to immunity</i>	2	A										
	b	<table border="1"> <tr><td>2010</td><td>6.0</td></tr> <tr><td>2011</td><td>5.0</td></tr> <tr><td>2012</td><td>6.5</td></tr> <tr><td>2013</td><td>8.1</td></tr> <tr><td>2014</td><td>8.9</td></tr> </table> <p>two data points plotted correctly ± 0.1 for percentages</p> <p>all data points plotted correctly ± 0.1 for percentages</p>	2010	6.0	2011	5.0	2012	6.5	2013	8.1	2014	8.9		2	C
2010	6.0														
2011	5.0														
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	c	<p>Trimethoprim ▾</p> <p>it has the zone which is largest and clear(est)</p> <p>An attempt at a scientific explanation, for example [max 1]</p> <ul style="list-style-type: none"> there are no resistant bacteria so the zone is clear (trimethoprim) is effective at a lower concentration (than the other antibiotics) 		3	C										
	d	<p>the light absorbed increases as population of bacteria increases or positive relationship</p> <p>proportional or linear relationship</p>	<i>Award two marks for directly proportional</i>	2	C										

	e	<p>Two points from each stage [max 2]</p> <p>Stage 1</p> <ul style="list-style-type: none">• slow growth• plentiful resources• few bacteria to reproduce <p>Stage 2</p> <ul style="list-style-type: none">• rapid or steady population growth• plentiful resources• many bacteria to reproduce <p>Stage 3</p> <ul style="list-style-type: none">• no (net) population growth• (because) as many bacteria are dying as are reproducing• limiting factors are present	<p><i>Ignore names of stages</i></p> <p><i>Do not accept bacteria stop reproducing</i></p>	6	C
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6		1	2	3	4		
V (Identification of IV and DV)	Some variables are referred to that are connected to the problem but these may not be explicitly identified	concentration of salt solution identified as IV or % absorption identified as DV	concentration of salt solution identified as IV and % absorption identified as DV				
CV (Control variables)	one control variable is identified	two control variables are identified					
H (Hypothesis)	Formulates a hypothesis connected to the variables but not explicitly linked to IV or their DV	Formulate a testable hypothesis correctly linked to the IV and their DV (no explanation)	Formulate a testable hypothesis correctly linked to the IV and their DV with reference to osmosis or dehydration				
M (Manipulation of variables/ description of method)	Attempt at a method but detail is insufficient for manipulation of variables	Partial method is described with detail sufficient for CV and IV or CV and their DV	Partial method is described with detail sufficient for IV and their DV and one CV	Method is described with detail sufficient for IV and their DV and two CV			
D (Collection of data)	Plans to repeat at least three trials for a single concentration or measures for at least five different concentrations	Plans to repeat at least three trials and measures for at least five different concentrations	Plans to repeat at least three trials and measures for at least five different concentrations and range includes 0% concentration				
S (Safety)	A general comment relating to safety	A safety comment relating specifically to the safe handling or disposal of bacteria					

17

B

7	a	(coronary) <u>artery</u> narrows or is obstructed less (oxygenated) blood reaches the heart muscle / tissue or making blood flow more difficult the heart (muscle) is unable to respire sufficiently or cannot beat	WTTE	3	D
	b	inflating the balloon increases the diameter of the artery or squashes the plaque or keeps artery open allowing more blood to flow or making it easier for the blood to flow heart does not need to pump as hard (to supply the same volume of blood)	WTTE	3	D
	c	prevents or slows the pathway or reactions (that produce cholesterol) from occurring (because) statin molecule blocks the enzyme's <u>active site</u>	<i>Do not accept "affects the active site"</i>	2	D
	d	Angioplasty Advantages, for example [max 1] <ul style="list-style-type: none"> effective over a long time / one-time procedure short recovery time from surgery Disadvantages, for example [max 1] <ul style="list-style-type: none"> possible risk of complication (heart attack) / infection during surgery risk of a clot developing near the stent / thrombosis scar after surgical procedure does not lower cholesterol levels Statins Advantages, for example [max 1] <ul style="list-style-type: none"> reduce the amount of (LDL) cholesterol increase the amount of HDL cholesterol prevents other diseases Disadvantages, for example [max 1] <ul style="list-style-type: none"> must be taken regularly / long term possible side effects e.g. headache, nausea, reduction in vitamin D/hormones effect is not instant – takes time to work. 	<i>Allow generic advantages / disadvantages such as cost, waiting times, doesn't change behaviour/address underlying causes, links to genetics etc</i> <i>Take care to ensure each point is only awarded once</i> <i>Accept "bad" for LDL cholesterol and "good" for HDL cholesterol</i>	4	D

8		1	2	3	4		
	impact on quality of life	A reduced quality of life is implied	A statement of one impact on quality of life	Statements of more than one impact on quality of life	Statements of more than one impact on quality of life with further support for at least one impact		
	economic	An advantage or disadvantage is implied	A statement of an advantage and a disadvantage or a statement of an advantage or a disadvantage that is justified clearly linked to economic factor	A statement of an advantage and a disadvantage and justification for one of these clearly linked to economic factor	A statement of an advantage and a disadvantage and justification for both clearly linked to economic factor		
	Individual	A statement of an individual's responsibility is implied	A statement of an individual's responsibility with justification Or Two statements of an individual's responsibility	More than one statement of an individual's responsibility with justification			
	Society	A statement of a responsibility of society is implied	A statement of a responsibility of society with justification Or Two statements of a responsibility of society	More than one statement of a responsibility of society with justification			
	Conclusion	A conclusion is given					



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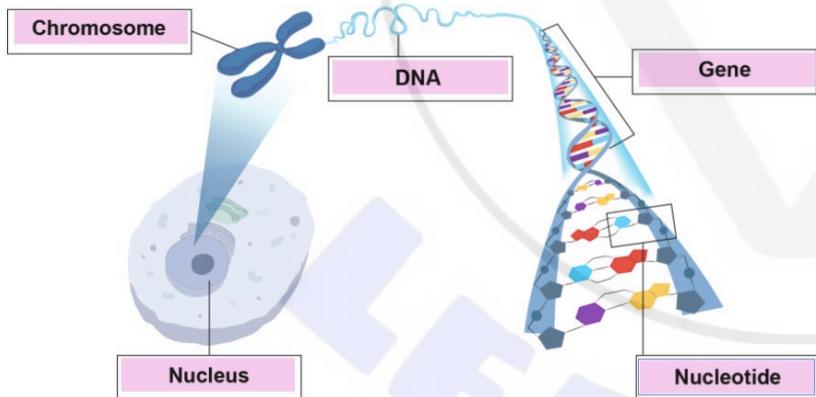
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	Bacteria cells	Animal cells																	
Mitochondria		present																	
Cell wall	present																		
Cell membrane	present	present																	
Nucleus		present																	
b	<p>Accept any two reasonable advantages of the 3D model, for example [2 max]:</p> <ul style="list-style-type: none"> • closer to reality • easier to visualise • can see what is moving • gives more detail about organelles • can study relationship between organelles in space 	Accept structure in place of organelle <i>Do not accept clearer</i>	2	A															
c	 <p>First mark for two correct Second mark for all correct</p>	Allow position of Gene and DNA to be reversed	2	A															

	d dd	<i>Do not accept d</i>	1	A															
e	<table border="1"> <thead> <tr> <th colspan="2"></th> <th colspan="2">Father's alleles</th> </tr> <tr> <th colspan="2"></th> <th>D</th> <th>d</th> </tr> </thead> <tbody> <tr> <th rowspan="2">Mother's alleles</th> <th>d</th> <td>Dd</td> <td>dd</td> </tr> <tr> <th>d</th> <td>Dd</td> <td>dd</td> </tr> </tbody> </table> <p>All cells of table correct 50 % or 1:1 or 1/2</p>			Father's alleles				D	d	Mother's alleles	d	Dd	dd	d	Dd	dd	<i>ECF from part d</i> <i>Allow a completed grid showing only one copy of the mother's alleles</i> <i>Accept 2:2 or 2/4</i>	2	A
		Father's alleles																	
		D	d																
Mother's alleles	d	Dd	dd																
	d	Dd	dd																
f	<p>Variation results in a range of characteristics or An example of a characteristic showing variation</p> <p>Individual with favourable characteristic is likely to survive or Survival of the fittest</p> <p>Survivors are more likely to reproduce</p> <p>Characteristics are passed on or Offspring has favourable characteristics</p> <p>Species becomes better adapted to its environment or Favourable characteristics become more common in the species</p>	ORA	5	A															

2	a	<p>Producer: grasses or (oak) tree</p> <p>Omnivore: (black) bear</p> <p>Primary consumer: deer or rabbit or squirrel or (black) bear</p>	<p>Do not accept plant</p>	3	A
	b	<p>Identification of change resulting from the housing development, for example, [1 max]:</p> <ul style="list-style-type: none">• more food is available• the foxes' habitat has been destroyed• trash is not a suitable food source <p>Correctly linked impact on fox population, [1 max]:</p> <ul style="list-style-type: none">• (so) the population of foxes increases• (so) the population of foxes decreases	<p><i>Only award the second mark if the first is given</i></p> <p>Do not allow extinction.</p>	2	A
	c	<p>(Foxes) eat more rabbits or squirrels and (so) the number of rabbits or squirrels decreases</p> <p>(so) more grass or acorns (available for deer) or less competition for grass or acorns</p> <p>(so) the deer population would increase</p> <p>or</p> <p>Foxes have an alternative food source or consume less prey and (so) the number of rabbits or squirrels increases</p> <p>(so) less grass or acorns (available for deer) or more competition for grass or acorns</p> <p>(so) the deer population would decrease</p>	<p><i>Only award the third mark if the first or second marks are awarded</i></p>	3	A

3	a	Plant B		1	C
	b	<p>Accept any reasonable suggestion, for example [1 max]:</p> <ul style="list-style-type: none"> • plant B was a native plant • better hiding places • more leaves or branches to hide • better camouflage 		1	C
	c	<p>Accept any similarity from the list [1 max]:</p> <ul style="list-style-type: none"> • both have provided hiding places for prey • both were better than no plants <p>Accept any difference from the list [1 max]:</p> <ul style="list-style-type: none"> • native plants give higher survival rates (than non-native) • there is a greater range between the two native plants 	ORA	2	C
	d	<p>To show the effect of plants on results or It is a control (experiment)</p>	WTTE <i>Do not accept reference to control variables</i>	1	C

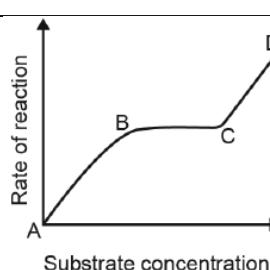
4	a	<p>Accept reactants and products in either order</p>	1	A	
	b	<p>IV: distance of light source from plant</p> <p>DV: volume of gas produced or number of bubbles (in a fixed time)</p> <p>Any two reasonable control variables, for example [2 max]:</p> <ul style="list-style-type: none"> • temperature of the water • same plant or length of plant or number of leaves used for each trial • same light bulb or lamp • same concentration of CO₂ in water 	<p>ORA, WTTE Accept light intensity</p> <p><i>Do not accept rate of photosynthesis as this cannot be measured directly.</i> Accept oxygen, do not accept carbon dioxide or air</p>	4	B
	c	<p>the rate of photosynthesis decreases ▾</p> <p>(because) light intensity decreases or (because) the temperature decreases</p> <p>A correct explanation linked to photosynthesis, for example [1 max]:</p> <ul style="list-style-type: none"> • less light is absorbed by chlorophyll • less light is converted to chemical energy (oxygen, glucose) • there is less kinetic energy • there are fewer successful collisions 	<p>No ORA for second marking point</p> <p>Accept energy as an alternative to light. ORA for third marking point. Award separately</p>	3	B

5	a	(temperature controlled) water bath	<i>Accept a description of a water bath using standard lab equipment Do not accept thermostat or thermometer alone</i>	1	B
	b	Increase the number of different temperatures (IV) tested		1	C
	c	To (collect enough data to) calculate an average To reduce (the impact of) experimental error or increase accuracy of results or identify outliers	<i>Accept mean Do not accept references to precision Accuracy must refer to the data, not the method</i>	2	B
	d	Use a measuring cylinder to measure volume (rather than just counting bubbles) or Count bubbles for a longer time or Multiple students count bubbles and calculate an average	<i>Do not accept answers related to filming as this equipment was not provided</i>	1	C
	e	6.(00) Any two from the list below [2 max]: <ul style="list-style-type: none"> • include unit for temperature • need consistent presentation of significant figures for average data • improve heading for average column • add a title to the table • plot the results as a (line or scatter) graph 	<i>Do not accept improvements to the method Do not accept bar graph</i>	3	C
	f	Trial 1 for temperature 40°C	<i>Accept 6</i>	1	C
	g	Accept any reasonable suggestion, for example [1 max]: <ul style="list-style-type: none"> • calculate the average omitting the outlier • re-do the trial 	<i>WTTE Do not accept repeat the whole experiment</i>	1	C
	h	Hypothesis is valid up to 39°C Partially valid or not valid and above 39 °C	<i>Accept any value in the range 38 - 40°C</i>	2	C
	i	<u>Enzymes</u> (involved in photosynthesis) (enzymes) denature or (so) the substrate no longer fits in the active site or enzyme can no longer catalyse the reaction (so) less <u>photosynthesis</u> is happening (above 39°C)	<i>WTTE</i>	3	C

		1	2	3	4		
6	V (Variables)	IV as length or a measurable DV or one CV is identified	IV as length and a measurable DV and one CV is identified	IV as length and a measurable DV and two CV are identified			
	H (Hypothesis)	Formulates a hypothesis connected to a relevant variable	Formulates a testable hypothesis correctly linked to (stated) DV (no explanation)	Formulate a testable hypothesis correctly linked to (stated) DV with correct scientific explanation	Formulate a testable hypothesis correctly linked to (stated) DV with correct scientific explanation and including correct use of term chlorophyll or chloroplast		
	E (Equipment)	Equipment to measure (stated) DV or manipulate IV or monitor one CV	Equipment to measure the (stated) DV and equipment to manipulate the IV or monitor one CV				
	M (Method)	Attempt at a method but detail is insufficient to collect relevant data	Detail of method is incomplete but some relevant data could be collected	Detail of method is sufficient to follow and similar data could be collected	Detail of method is sufficient to repeat the experiment		
	D (Data)	Plans to repeat at least three trials or to collect data for at least five increments	Plans to repeat at least three trials and collect data for at least five stated increments				

15

B

7	a	<input type="button" value="Substrate"/> <input type="button" value="Enzyme"/> <input type="button" value="Enzyme"/> <input type="button" value="Product"/> <p>One enzyme labelled correctly All correct</p>	<i>Ignore any errors in other enzyme for the first mark</i>	2	A
	b	<p>First two marks: A and B As the (substrate) concentration increases and the rate increases or There is a positive correlation between (substrate) concentration and rate</p> <p>More substrate available for enzymes to act on or A greater number of successful collisions between enzyme and substrate</p> <p>Second two marks: B and C As the substrate (concentration) increases and the rate is unchanged or constant</p> <p>(as) all the active sites are occupied or (as) the (concentration of) enzyme is limiting</p>	WTTE	4	C
	c			1	C

8	a	Arteries have more elastic fibres (in their walls) Arteries have thicker <u>walls</u> or are (more) muscular	Accept arteries are more elastic	2	A
	b	<p>Any two reasonable advantages, for example [2 max]:</p> <ul style="list-style-type: none"> • weight loss • improved mood or mental health • increased fitness • reduced risk of developing other medical issues, eg, heart disease. <p>Any two reasonable disadvantages, for example [2 max]:</p> <ul style="list-style-type: none"> • may lead to injuries or muscle ache or soreness • may lead to complications for people in risk groups • hard to keep up or long-term effect only 	<i>Do not accept responses not related to health. Accept only one medical issue.</i>	4	D
	c	<p>(medication causes) blood vessels to stop contracting or relax</p> <p>(so) the blood vessel (lumen) increases in diameter or volume or</p> <p>(so) the same volume of blood flows through a larger space</p> <p>A correct use of one of the terms [1 max]: volume, vasodilation, dilate, lumen.</p>	Accept arteries or veins	3	D

9		1	2	3	4	11	D
		1. Individual (impact of prescribing medication)	States an impact on an individual's lifestyle	States one impact with justification or two impacts	States a positive and negative impact with justification of one		
		2. Society (Positive and negative impacts)	States an impact on society	States an impact with justification or two impacts	States a positive and negative impact with justification of one	States a positive and negative impact with justification of both	
		3. A (Concluding appraisal)	Attempts a concluding appraisal	Gives a concluding appraisal with opinion that includes relevant detail or different lines of argument.	Gives a concluding appraisal with opinion that includes relevant detail and different lines of argument		

10	a	<p>The pill increases melatonin levels or Melatonin levels must be high to go to sleep (when stressed) melatonin levels need to be higher (than normal) because cortisol levels are higher (than normal) or To balance or compensate for increase in cortisol (caused by stress)</p>	<p><i>Do not accept the pill promotes melatonin production</i></p> <p><i>Do not accept melatonin causes cortisol to decrease</i></p>	2	D
	b	<p>Accept any reasonable benefit, for example [1 max]:</p> <ul style="list-style-type: none"> • easy to keep • rats are mammals so similar to humans • easy to control external variables that might impact sleep <p>Accept any reasonable limitation, for example [1 max]:</p> <ul style="list-style-type: none"> • different physiology • side effects may not be measurable • rats exist in a controlled laboratory environment (unlike humans) <p>Any two reasonable ethical considerations, for example [2 max]:</p> <ul style="list-style-type: none"> • reference to exposure to stress • side effects are unknown • they cannot give consent • reference to breeding rats only for use in experiments <p>A concluding appraisal</p> <p>A justification of the appraisal</p>		6	D

Markscheme

November 2022

Biology

On-screen examination

13 pages

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Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Horizontal wavy line that can be expanded
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses. Do not deduct marks for spelling errors.
- 2 Follow the markscheme provided and award only whole marks.
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- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (*or reverse argument*) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (*or words to that effect*) in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
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- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question	Answers	Notes	Total	Crit
1	a Sea urchin or small fish or large crab		1	A
	b Producers carry out photosynthesis or producers can convert/capture light energy Into sugar or chemical energy or food for a consumer	<i>Accept references to autotrophs for mp1</i> <i>WTTE Accept nutrition</i>	2	A
	c Accept any reasonable suggestion, for example [max 1] <ul style="list-style-type: none">• Conservation zones or creation of national parks• Captive breeding program• Reintroduction into the wild	<i>The role of humans in the action must be clear</i>	1	A
	d Number of sea urchins has decreased (as) more are being eaten by the sea otters There are fewer sea urchins to eat kelp (so) the number of kelp (plants) has increased	<i>Accept reference to prey with respect to sea urchins and otters eating them</i>	4	A

2	a	Carbohydrates or fats or sugars or named example	"Protein" alongside a correct answer is a CON do not award a mark	1	A
	b	Amino acids		1	A
	c	A The optimum pH is acidic or 1.9	No ecf. First mark must be correct for second to be awarded	2	A
	d	Diffusion (passively) moved from an area of high concentration to an area of lower concentration or Active transport (actively) moved from an area of low concentration to an area of higher concentration	Accept facilitated or passive diffusion	2	A
	e	Accept any feature, [max 2] <ul style="list-style-type: none"> • no nucleus • haemoglobin • biconcave disc or curved shape • small and flexible Accept any correctly linked explanation, [max 2] <ul style="list-style-type: none"> • to create more space • binds to oxygen (to transport around the body) • maximize surface area (to volume ratio) • can pass through <u>capillaries</u> 	<i>Do not accept arteries or veins</i>	4	A

3	a	<table border="1"><tr><td>Sex hormone</td><td>Site of production</td></tr><tr><td>testosterone</td><td>testes</td></tr><tr><td>progesterone</td><td>ovaries</td></tr></table> <p>Correct row or correct column All correct</p>	Sex hormone	Site of production	testosterone	testes	progesterone	ovaries	2	A
Sex hormone	Site of production									
testosterone	testes									
progesterone	ovaries									
b	<p>A Venn diagram illustrating sexual development changes. It features three overlapping circles: a green circle on the left labeled 'Males', a red circle on the right labeled 'Females', and an orange circle in the center labeled 'Both'. The 'Males' circle contains 'Sperm production starts' and 'Facial hair grows'. The 'Females' circle contains 'Hips widen', 'Development of breast tissue', and 'Menstruation starts'. The central 'Both' circle contains 'Sex organs grow and develop' and 'Pubic hair grows'.</p> <p>One zone correct All correct</p>	2	A							
c	<p>Two sex cells will come together (in fertilization) To produce offspring with 46 chromosomes</p>	2	A							
d	<p>Female (genotype) is XX and male is XY Sperm can pass on either X or Y (chromosome) Egg always passes on X</p>	3	A							

4	a	<p>all correct</p>	1	A
	b	<p>IV: Temperature</p> <p>DV: O₂ concentration or amount of O₂</p> <p>Accept any two control variables, for example [max 2]</p> <ul style="list-style-type: none"> • CO₂ concentration • Length of plant stem • Type of plant • Light level 	4	B
	c	<p>If: The temperature increases</p> <p>Then: oxygen concentration will increase</p> <p>Because: (the rate of) <u>photosynthesis</u> increases</p>	3	B
	d	<p>260.666...</p> <p>261</p>	2	C
	e	<p>Add units for temperature to the table</p>	1	C
	f	<p>Results do not support the prediction from 20(°C) to 40(°C)</p> <p>Results support the prediction as temperature rises above 40(°C)</p> <p>or</p> <p>There is insufficient data to draw a conclusion</p> <p>At least five increments or temperatures are needed to show a reliable trend</p>	2	C

5	a	<p>Accept any two reasonable CV, for example [max 2]</p> <ul style="list-style-type: none"> • One CV associated with plant eg stem length or type of plant or number of leaves • light level/intensity was not controlled • Initial O₂ concentration 		2	C
	b	<p>To control the temperature or temperature is a control variable</p> <p>This is the optimum temperature for the reaction or the reaction will take place quickly</p>	WTTE	2	B
	c	<p>Accept any reasonable suggestion, for example [max 2]</p> <ul style="list-style-type: none"> • more trials/repeats • more increments of IV or intermediate values of IV • there is no control experiment (with CO₂=0% or atmospheric CO₂ level) <p>Accept any correctly linked justification, for example [max 2]</p> <ul style="list-style-type: none"> • more reliable data or allows identification of outliers or can calculate an average or more accurate results • more values give a clearer pattern • cannot establish a baseline 	WTTE	4	C
	d	<p>As the concentration of CO₂ increases the rate of photosynthesis increases (below 0.10%)</p> <p>The line plateaus (above 0.10% CO₂)</p> <p>Value of 0.10% correctly referenced</p> <p>Because CO₂ is limiting (below 0.10%)</p> <p>Other limiting factors are involved (above 0.10%)</p>		5	C
	e	Increase the temperature or light intensity		1	C

6			1 mark	2 marks	3 marks	4 marks	15	B
		Variables	IV as light intensity or a measurable DV or one CV is identified	IV as light intensity and a measurable DV and one CV is identified	IV as light intensity and a measurable DV and two CV are identified			
		Hypothesis	Formulates a hypothesis connected to a relevant variable	Formulates a testable hypothesis correctly linked to a (stated) DV (no explanation)	Formulates a testable hypothesis correctly linked to a (stated) DV with correct scientific explanation			
		Equipment (included in method)	Some relevant equipment is referenced	Equipment to measure (stated) DV and manipulate IV	Equipment to measure (stated) DV and manipulate IV and monitor at least one CV			
		Method	Attempt at a method but detail is insufficient to collect relevant data	Detail of the method is incomplete but some relevant data could be collected	Detail of method is sufficient to follow and similar data could be collected	Detail of method is sufficient to repeat the experiment		
		Data	Plans to repeat at least three trials or to collect data for at least five increments	Plans to repeat at least three trials and to collect data for at least five increments				

7	a	Plant W		1	C
	b	Boric acid does not have an impact on the pest species attacking those plants or Not all plants are affected by pests	<i>Allow reference to plant X only</i>	1	C
	c	To control all other variables		1	C
	d	Plant W – 4% Plant Y – 6%		2	C
	e	The farmer should use 6% Because, 6% is the lowest concentration which gives maximum yield of both plants	WTTE	2	C

8	a	<p>Similarity: Accept any reasonable trend, for example [max 1]</p> <ul style="list-style-type: none"> Number of new cases increases and then decreases with age in both males and females <p>Difference: Accept any reasonable trend, for example [max 1]</p> <ul style="list-style-type: none"> Males increase until 74 (peak) while females increase until 69 (peak) Female cases higher than males 0 – 59 and 85+ / male cases higher than females 60 - 84 		2	D
	b	<p>(Greater) exposure to (named) risk factor(s) over time</p> <p>Accept a correctly linked justification [max 1]</p> <ul style="list-style-type: none"> Greater chance of mutations occurring (and) more mutations can accumulate over time 		2	D
	c	<p>Accept any reasonable positive impact, for example [2 max]</p> <ul style="list-style-type: none"> Good for mental health / SAD Vitamin D production / Calcium absorption and strong bones / Rickets Able to do sports outside <p>Accept any reasonable negative impact, for example [2 max]</p> <ul style="list-style-type: none"> Increased risk of (skin) cancer Cataracts Sunburn <p>A brief concluding statement</p> <p>A statement giving advice linked to minimizing health concerns</p>		6	D

9		1 mark	2 marks	3 marks	4 marks	14	D
		Medical	One statement of a medical benefit or One statement of a medical benefit with further development	Two statements of a medical benefit or One statement of a medical benefit with further development	Two statements of a medical benefit, one with further development	Two statements of a medical benefit, both with further development	
		Economic	One statement of an economic consideration or One statement of an economic consideration with further development	Two statements of an economic consideration or One statement of an economic consideration with further development	Two statements of an economic consideration, one with further development	Two statements of an economic consideration, both with further development	
		Ethical	One statement of an ethical consideration or One statement of an ethical consideration with further development	Two statements of an ethical consideration or One statement of an ethical consideration with further development	Two statements of an ethical consideration, one with further development	Two statements of an ethical consideration, both with further development	
		Conclusion	A simple conclusion is stated	A conclusion is stated with further development			

Markscheme

May 2022

Biology

On-screen examination

15 pages

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Question	Answers	Notes	Total	Crit
1 a	<p>1. Does the cell have a nucleus?</p> <pre> graph TD A[1. Does the cell have a nucleus?] -- YES --> B[2. Does the cell have a large central vacuole?] A -- NO --> C[Bacterial cell] B -- YES --> D[Plant cell] B -- NO --> E[Animal cell] </pre> <p>all correct</p>		1	A
	<p>b Accept any reasonable suggestion, for example [max 1]</p> <ul style="list-style-type: none"> • does it have chloroplasts? • does it have a cell wall? 	<p><i>Do not accept references to colour, shape or vacuole</i></p>	1	A
	c Mitochondrion	<i>Accept mitochondria</i>	1	A
	<p>d Controls what enters or exits the cell or Separates the cell from the outside</p>	<p>WTTE</p> <p><i>Do not accept references to protection. Do not accept any reference to cell wall – this is a CON</i></p>	1	A
	<p>e Tissues are made out of cells Cells in a tissue are similar (and) work together (to perform a shared function) or Different tissues perform different functions</p>	<p>WTTE, Accept named examples of cells and tissues</p>	3	A

2	a	<p>System 1: Nervous system</p> <p>System 2: Reproductive system</p>		2	A
	b	Metabolism		1	A
	c	<p>Breaks into smaller pieces or Easier to swallow</p> <p>To increase the surface area (so) chemical digestion is faster or (to) allow enzymes to work faster</p>	WTTE <i>Do not accept easier</i>	3	A
	d	Sugars or a named sugar	Accept disaccharide or monosaccharide	1	A
	e	<p>Accept any two correct features [max 2]</p> <ul style="list-style-type: none"> • folds or villi or micro villi or finger-like projection or long length • good blood supply • walls of villi or small intestine are one cell thick or semi permeable • lacteal <p>Accept any two correct explanations [max 2]</p> <ul style="list-style-type: none"> • large surface area for absorption • to carry nutrients to cell or maintains concentration gradient • short diffusion distance or efficient transfer of nutrients • absorbs / transports fatty acids and glycerol 		4	A

3	a	<p>Accept any reasonable natural source, for example [max 1]</p> <ul style="list-style-type: none">• decaying or dead plants or animals• animal waste• soil or dirt	WTTE, do not accept named nutrients	1	A
	b	<p>Direct sources: accept any reasonable answer, for example [max 1]</p> <ul style="list-style-type: none">• fish farm• sewage treatment plants• industrial plants <p>Indirect sources: accept any reasonable answer, for example [max 1]</p> <ul style="list-style-type: none">• residential runoff• runoff from farms• runoff from industrial plants• runoff from sewage plant	WTTE	2	A
	c	<p>Nutrients reaching water source from named source</p> <p>Providing the algae with increased nutrients</p> <p>(so) the algae reproduce more</p>	<p>Accept examples of nutrients</p> <p>WTTE</p> <p>WTTE Do not accept grow. Do not accept algal bloom. Do not award the third mark unless the second is awarded. Do not accept increase in the population of algae</p>	3	A
	d	<p>Algal bloom blocks out sunlight</p> <p>Aquatic plants die due to lack of (sunlight for) <u>photosynthesis</u></p> <p>Organic material broken down by bacteria causes oxygen in water to be depleted</p> <p>Oxygen depletion leads to death of aquatic organisms</p>	<p>WTTE</p> <p>Accept named organisms</p>	4	A

4	a	The colour of the solution or food colouring (added to water)		1	B
	b	Volume (of water in beaker) Final and initial volumes Time (over which change occurred) or duration of experiment	<i>Accept quantity / amount / cm³ of water</i> <i>Accept decrease in volume (of water) or change in volume (of water)</i>	3	B
	c	Accept any two reasonable control variables, for example [max 2] <ul style="list-style-type: none"> • temperature of the environment • temperature of the water • species of plant • wind / air movement • dimensions of plant stem • surface area of plant leaves • light intensity / distance of light (from plant) 	<i>WTTE</i> <i>Do not accept quantity / amount of light</i>	2	B
	d	Accept any two improvements from the list [max 2] <ul style="list-style-type: none"> • stem was identified • solution identified as water • specified the numbers of dyes used / greater than 5 dyes used Accept any two correctly linked justifications from the list [max 2] <ul style="list-style-type: none"> • different parts of the plant may be affected differently • shows this is controlled, enables repetition of the experiment • gives information about how the IV is manipulated 	<i>Do not accept group two posed a question</i>	4	C
	e	Two significant figures used instead of one (so) smaller rounding errors or the measurements are more precise Inclusion of a control (control) enables a comparison to be made with no dye or normal water	<i>WTTE</i> <i>Ignore "accurate"</i> <i>WTTE</i>	4	C

	<p>f <i>Accept any suggestion from the list [max 1]</i></p> <ul style="list-style-type: none">• it is not clear if they followed the same method• too many variables were not explicitly controlled or monitored.• differences in the precision of data recorded• the two groups had different research questions	<p><i>Do not accept the inclusion of control as not following the same method.</i> <i>Accept number of decimal places, do not accept accuracy</i></p>	1	C
	<p>g Water cannot evaporate directly from the beaker Change in volume is due to transpiration or Evaporation does not affect the volume of water lost</p>		2	C

5		1	2	3	4		
	1.V (Variables)	Some variables are referred to that are connected to the problem, but these are not explicitly identified	IV or DV (allow rate here for max 2) and one CV is identified	IV and Measurable DV and one CV is identified	IV and Measurable DV and two CV are identified		
	2.H (Hypothesis)	Formulates a hypothesis connected to the variables but not explicitly linked to the DV with no explanation	Formulates a hypothesis correctly linked to the DV with no explanation	Formulates a hypothesis correctly linked to the DV with correct scientific reasoning			
	3.M (Manipulation / method)	Attempt at a method but detail is insufficient to collect relevant data	Detail of method is incomplete but some relevant data could be collected	Detail of method is sufficient to follow and similar data could be collected	Detail of method is sufficient to repeat the experiment		
	4.D (Data)	Plans to conduct at least three trials or measures for at least five different conditions of IV	Plans to conduct at least three trials and measures for at least five stated conditions of IV	Plans to conduct at least three trials and measures for at least five stated conditions of IV and includes a control condition			
	5. J (Justification)	Plans to calculate average or rate	Justification of calculation of average or rate				
	6.S (Safety)	A relevant safety consideration linked specifically to a stated hazard					

17

B

6	a	<p>Accept one point from the first list [max 1]</p> <ul style="list-style-type: none"> • too difficult / time-consuming to sample all leaves on a plant • to increase the accuracy of results • to allow the calculation of averages <p>Accept one point from the second list [max 1]</p> <ul style="list-style-type: none"> • to ensure the sample represents the whole plant • to avoid (sampling) bias • to avoid intentionally selecting certain leaves 		2	C																					
	b	<p>Accept any reasonable response, for example [max 1]</p> <ul style="list-style-type: none"> • the leaf might not be representative • the leaf might be damaged or dead or diseased 	WTTE	1	C																					
	c	<p>Table Object</p> <table border="1"> <thead> <tr> <th>Maize leaf sample</th> <th>Number of stomata</th> </tr> </thead> <tbody> <tr><td>1</td><td>7</td></tr> <tr><td>2</td><td>9</td></tr> <tr><td>3</td><td>8</td></tr> <tr><td>4</td><td>8</td></tr> <tr><td>5</td><td>10</td></tr> <tr><td>6</td><td>5</td></tr> <tr><td>7</td><td>10</td></tr> <tr><td>8</td><td>6</td></tr> <tr><td>9</td><td>8</td></tr> <tr><td>10</td><td>9</td></tr> </tbody> </table> <p>9</p>	Maize leaf sample	Number of stomata	1	7	2	9	3	8	4	8	5	10	6	5	7	10	8	6	9	8	10	9		1
Maize leaf sample	Number of stomata																									
1	7																									
2	9																									
3	8																									
4	8																									
5	10																									
6	5																									
7	10																									
8	6																									
9	8																									
10	9																									
d	<p>Any correctly calculated average eg $80/10 = 8$</p> <p>Stomatal density is calculated: 88.88(...) or 88.89</p> <p>Correctly rounded to 89 (mm^{-2})</p>	<p><i>ECF from part c</i></p> <p><i>Award one mark max if average value is not used and correct working for stomatal density is shown ECF from 1st marking point. Award two marks max for 88.88</i></p> <p><i>Award three marks if only 89 is seen. ECF from 1st marking point</i></p>	3	C																						

	e	Qualitative		1	C
	f	Accept any reasonable suggestion, for example [max 1] <ul style="list-style-type: none">• pondweed grows underwater• transpiration does not take place• gases diffuse through the epidermis (and not stomata)	WTTE Do not accept it is an aquatic plant	1	C
	g	<p>Sunflowers have stomata on both sides</p> <p>Water lilies have stomata on one side or the top only</p> <p>A further three explanatory points [max 3]</p> <ul style="list-style-type: none">• (because) transpiration happens in both sunflowers and water lilies• no stomata on the surface in contact with water• gas exchange occurs between stomata and air or not between stomata and water• high stomatal density on the top of water lily leaves or water lilies have a greater stomatal density than sunflowers• water lilies do not need to limit water loss or sunflowers do need to limit water loss		5	C

7	a	The interconnected food chains in an ecosystem		1	D
	b	<p>Enzymes break the <u>bonds</u> (between the building blocks)</p> <p>Enzymes speed up the break down of plastics</p> <p>Any further mark from the list [max 1]</p> <ul style="list-style-type: none"> • (by) lowering activation energy • specific enzymes will break down specific plastics <p>Terminology mark</p> <p>a correct use of one of the terms: catalyse, catalyst, active site, substrate, product, induced fit, lock-and-key, catabolic</p>	WTTE	4	D
	c	<p>1. 2. 3. 4. </p> <p>Populations produce more offspring than the environment can support, so there is competition.</p> <p>Individuals in a population have different characteristics from one another.</p> <p>Individuals with characteristics adapted to the environment survive longer.</p> <p>Characteristics of individuals who reproduce become more common in the population.</p> <p>One of boxes 2, 3 or 4 correctly placed</p> <p>Boxes 2, 3 and 4 all correctly placed</p>		2	D

8	a		1	2	3	4	13	D
		Properties and uses	A statement of one physical property or use	A statement of two physical properties or a statement of one physical property and statement of why this property is useful	A statement of at least two physical properties and statement of why each of these two properties are useful			
		Environmental consequences	One environmental consequence is stated	Any two different consequences are stated or a common consequence is stated with further discussion	A consequence with further discussion is given for one method and a different consequence for the second method is stated or A common consequence is stated but with further discussion specific to each method	A different consequence with further discussion is given for each method		
		Economic impacts	One impact is stated	Any two different impacts are stated or a common impact is stated with further discussion	An impact with further discussion is given for one method and a different impact for the second method is stated or A common impact is stated but with further discussion specific to each method	A different impact with further discussion is given for each method		
		Concluding appraisal	Gives a concluding opinion about how best to recycle plastics	Gives a concluding appraisal with opinion that includes specific detail or a comparison of methods				

	b	<p>Accept any reasonable suggestion, for example [max 2]</p> <ul style="list-style-type: none">• government actions (taxes, policy changes)• education (raise awareness of impact of pollution)• behavioural changes (choose alternatives, clean-up, reuse) <p>Accept any correctly linked justification [max 2]</p> <ul style="list-style-type: none">• incentives would reward or penalize behaviours• knowing the impact of pollution• recognizing how personal responsibility leads to change	4	D
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Markscheme

November 2023

Biology

On-screen examination



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	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Horizontal wavy line that can be expanded
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses. Do not deduct marks for spelling errors.
- 2 Follow the markscheme provided and award only whole marks.
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Question	Answers	Notes	Total	Crit
1	a Nucleus		1	A
	b A paired with T C paired with G		2	A
	c Alleles are different forms of the same gene.		1	A
	d 	Accept Aa or aA as heterozygous notation	1	A
	e 50%	Accept 0.5 or 1/2	1	A
	f Large surface area Accept any further point, for example [max 1] <ul style="list-style-type: none">• Short diffusion distance or 1 cell thick• Good blood supply or capillary network• They are moist		2	A
	g Accept any reasonable suggestion of a symptom, for example [max 1] <ul style="list-style-type: none">• Tiredness or shortness of breath• Cough• Low blood oxygen• Increased lung infections		1	A
	h Accept any reasonable benefit, for example [max 1] <ul style="list-style-type: none">• Can cure untreatable diseases• Less medication is needed Accept any ethical consideration, for example [max 1] <ul style="list-style-type: none">• Don't know the long-term effects• Can be used to make cosmetic rather than medical changes• Regulations may be different in different countries.	Accept correctly named disease WTTE	2	A

3	a	Reproduction	<i>Do not accept any other characteristic of life</i>	1	A
	b	Sugar + oxygen → carbon dioxide + water + energy Reactants and products correct		1	A
	c	Independent variable: duration/time of exposure to UV Dependent variable: CO ₂ concentration Accept any two reasonable control variables, for example [max 2] <ul style="list-style-type: none">• temperature• concentration of sugar• type of sugar• concentration of yeast	<i>Accept ppm of CO₂, do not accept rate (of respiration)</i>	4	B
	d	If: reference to increasing exposure time Then: the amount of CO ₂ produced decreases or the rate of CO ₂ production decreases or the rate of respiration decreases Because: link to UV affecting enzyme or DNA or structure of the enzyme	ORA	3	B
	e	To control the <u>temperature</u>		1	B
	f	Accept any two weaknesses, for example [max 2] <ul style="list-style-type: none">• Not enough increments• Not enough trials• Lack of (named) control variables• Inaccurate measuring equipment Accept any two correctly linked justifications, for example [max 2] <ul style="list-style-type: none">• (enough increments needed) to observe a reliable trend• more trials yield more accurate data or reduce the effect of random errors or not enough data to calculate a valid average• (Lack of control variables) data are not reliable or not a fair test or different sugars respire at different rates• Imprecise data		4	C
	g	To ensure the results are due to UV exposure or It is a control experiment	<i>Accept to allow comparisons between UV exposure and no UV exposure</i>	1	B

4	a	To increase the trials per exposure time Reduce random error or increase accuracy or calculate average		2	C
	b	Average concentration: 1301 Rate: 433.6666 Presentation with no dp: 434	Accept any dp for 2 nd mark	3	C
	c	<p>Data points (0, 783) and (45, 250) plotted correctly Line of best fit: X: Time of UV exposure / min Y: Rate of CO₂ production / ppm min⁻¹</p>	<i>Ignore data point at 30 mins</i> <i>Units must be included in marking points 3 and 4</i>	4	C
	d	550±5 (ppm min ⁻¹)	ECF from part c – check the trend line in part c if necessary	1	C
	e	Accept any two reasonable suggestions, for example [max 2] <ul style="list-style-type: none"> • Sugar is a limiting factor • Yeast is dead (from ethanol poisoning) • No respiration is happening 	<i>Do not accept lack of oxygen</i> <i>Accept two different ways for killing yeast for 2 marks</i> <i>Accept two valid explanations in one box</i>	2	C

	f Accept any two points from the following list [max 2] <ul style="list-style-type: none"> • A section of DNA • That leads to a heritable characteristic • That codes for a protein 	WTTE	2	A
	g As exposure time (to UV) increases, the number of changes in DNA increases	<i>Accept positive correlation</i>	1	C
	h Cellular respiration is less for longer exposure Longer exposure time (to UV) causes more changes in DNA of enzymes Accept a further point from the list [max 1] <ul style="list-style-type: none"> • Change in enzyme active site • Can no longer bind to substrate • Enzyme is denatured 	<i>Accept mutations for changes</i>	3	C
	i Accept two reasonable suggestions, for example [max 2] <ul style="list-style-type: none"> • Yeast was killed after 60 mins • As UV killed yeast, it may also kill other microorganisms • (but) No evidence that other microorganisms are killed • May not be practical to use this method outside the lab • There is not sufficient detail about control variables/method 		2	C

5		1	2	3	4		
	Variables	Some variables implied	IV or DV and one CV identified explicitly	IV and DV and one CV identified explicitly	IV and DV and two CV identified explicitly		
	Hypothesis	simple RQ	A prediction linking IV to DV	A hypothesis linking IV to DV with attempt at a scientific explanation			
	Equipment	Equipment to control the IV or measure the DV	Equipment to control the IV and measure the DV	Equipment to control the IV and measure the DV and monitor at least one CV			
	Method	Partial method is described with detail sufficient for IV and DV only	Method is described with detail sufficient for manipulating IV, monitoring DV and controlling one CV	Method is complete and includes sufficient detail to replicate conditions of IV, DV and two CV			
	Manipulation of IV / sufficient data	Ref to different increments or trials	At least five increments or three trials	At least five increments and three trials	At least five increments and three trials and plans to calculate mean		
	Justification of range	Temperature range is explicitly stated as being appropriate based on safety considerations or the active range of yeast	Temperature range is explicitly stated as being appropriate based on safety considerations and the active range of yeast				

19 B

6	a	Vaccination or killing of infected bats	<i>Do not accept use of fences Accept fewer bats</i>	1	D
	b	Starting with a producer and three organisms linked in the web Plants – insects – frog – eagle or Plants – insects – woodpecker – eagle		2	A
	c	A correct or use any of the terms: predator, prey, energy, trophic level, population, consumer Accept any two reasonable consequences, for example [max 2] <ul style="list-style-type: none"> • Cougar population decreases • Squirrel population increases • Frog population increases • Eagle would increase • Deer population would decrease • Cougars become infected with rabies Accept any correctly linked justification, for example [max 2] <ul style="list-style-type: none"> • Fewer raccoons to eat • Squirrels are not being eaten by raccoons • Frogs are not being eaten by raccoons • More squirrels and frogs resulting in more food for eagle • Cougars would eat deer to replace lost raccoons in their food supply • Scratched or bitten by raccoons 		5	D

7	a		1	2	3	4	14	D
		1.Oral vaccines	An advantage or a disadvantage of oral vaccines is implied	An advantage and a disadvantage of oral vaccines is stated	An advantage and a disadvantage of oral vaccines with one of these justified	An advantage and a disadvantage of oral vaccines with both justified		
		2.Contraceptive	A suggestion related to population control	A suggestion correctly linked to population control with justification				
		3.Ethics	Any reasonable statement relating to ethics	More than one reasonable statement relating to ethics Or Any reasonable statement relating to ethics with further justification	More than one reasonable statement relating to ethics with at least one further justified			
		4.Collaboration	A statement of an economic or political consideration	More than one statement of an economic or political consideration	More than one statement of an economic or political consideration with further development of one statement	More than one statement of an economic or political consideration with further development of more than one statement		
		5.Conclusion	A concluding statement is given					
	b	<p>Accept any reasonable advantage, for example [max 1]</p> <ul style="list-style-type: none"> • Can be included in regular vaccination schedule • Correct dose is guaranteed • Develop immunity against the disease <p>Accept any reasonable disadvantage, for example [max 1]</p> <ul style="list-style-type: none"> • Not all people can be vaccinated • Supply issues in remote areas • Doesn't cure the disease or dogs will still suffer from the disease • May cause side effects 				<i>Do not accept idea that the vaccine may cause harm</i>	2	D

Markscheme

May 2023

Biology

On-screen examination

14 pages

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Markscheme instructions

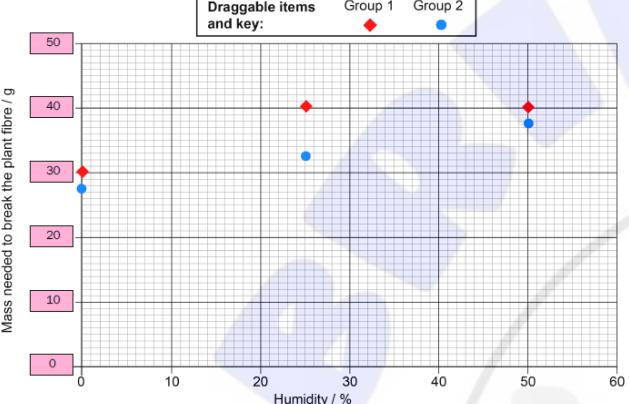
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Question	Answers		Notes	Total	Crit.
1	a	Knee	Accept ankle or knuckle	1	A
	b	Bicep		1	A
	c	Accept any two from the list, [max 2] <ul style="list-style-type: none"> • one muscle contracts while the other extends • X (Bicep) contracts or shortens and to flex or bend the arm • Y (Tricep) contracts or shortens and to extend or straighten the arm 		2	A
	d	Accept any reasonable similarity, for example [max 1] <ul style="list-style-type: none"> • produce energy or ATP • use glucose Accept any reasonable difference, for example [max 1] <ul style="list-style-type: none"> • aerobic requires oxygen / anaerobic does not • waste products are different (water and CO₂ or lactic acid) • anaerobic releases less energy 	<i>Do not accept ethanol</i>	2	A
	e	Protection: Accept any reasonable function, for example [max 1] <ul style="list-style-type: none"> • protect the organs • (hard) bones of the skeleton reduce the risk of injury on impact Blood cell production: Accept any reasonable function, for example [max 1] <ul style="list-style-type: none"> • (long) bones contain bone marrow • (long) bones produce stem cells 	Accept named examples Accept named examples <i>Do not accept mineral storage</i>	2	A

2	a	<i>Accept any two reasonable benefits, for example [max 2]</i> <ul style="list-style-type: none"> • slows ripening • prevents microbe growth or keeps food safe to eat for longer • reduces waste or extends shelf-life 	<i>WTTE</i>	2	A
	b	(This temperature range) reduces or stops microorganism activity or reproduction Does not freeze (at this temperature range) <i>One correct justification, [max 1]</i> <ul style="list-style-type: none"> • slows deterioration of food • prevents ice damage or freezer burn or changes in appearance 	<i>Do not accept "kills"</i> <i>WTTE</i>	3	A
	c	(Bacteria has) decreased in volume or shrunk or shrivelled Water has left or (bacteria is) dehydrated By osmosis	<i>Do not accept references to salt moving</i> <i>Accept a correct description of osmosis if not named</i>	3	A

3	a	Speed up reactions or biological catalyst Build up molecules or break down molecules	Accept specific examples	2	A							
	b	<p>Table Object</p> <table border="1"> <thead> <tr> <th>Genotype</th> <th>Lactose tolerant</th> </tr> </thead> <tbody> <tr> <td>TT</td> <td>Yes</td> </tr> <tr> <td>Tt</td> <td>Yes</td> </tr> <tr> <td>tt</td> <td>No</td> </tr> </tbody> </table> <p>All correct</p>	Genotype	Lactose tolerant	TT	Yes	Tt	Yes	tt	No	<i>A selection must be made in all boxes</i>	1
Genotype	Lactose tolerant											
TT	Yes											
Tt	Yes											
tt	No											
c	The (observable) characteristics of an organism (resulting from the expression of genes)	<i>Incorrect use of "gene" is a CON, award 0</i>	1	A								
d	<p>Similarity, [max 1]</p> <ul style="list-style-type: none"> highest levels directly after birth both decrease (after birth) <p>Justification, [max 1]</p> <ul style="list-style-type: none"> maternal milk is primary food source decrease as transition to other food sources <p>Difference, [max 1]</p> <ul style="list-style-type: none"> production is much higher in pigs pigs level off later than rats production decreases at a faster rate or earlier in pigs <p>Justification, [max 1]</p> <ul style="list-style-type: none"> consume more lactose or pigs are bigger than rats rats transition to other foods earlier than pigs pigs and rats mature at different rates 		4	A								
e	The higher the % lactose tolerance, the higher the milk consumption	<i>ORA Do not accept linear or proportional</i>	1	A								
f	<p>Accept any reasonable suggestion, for example [max 1]</p> <ul style="list-style-type: none"> data not available for all countries correlation does not guarantee causation people choose not to drink milk for reasons other than lactose intolerance data is from one year or one source only 		1	A								

4	a	How does the humidity affect the mass needed to break the fibre?		1	B
	b	<i>Independent variable:</i> humidity <i>Dependent variable:</i> mass and needed to break the fibre	<i>Do not accept strength</i>	2	B
	c	Accept any two reasonable control variables, for example [max 2] • diameter of fibre • storage or room temperature • length of fibre • age of plant • storage time • type of plant	<i>Do not accept increments of mass</i> <i>Accept length of time masses are hung on fibres</i> <i>Do not accept use the same fibre</i>	2	B
	d	The DV is only affected by the IV	WTTE	1	B
	e	Greater range of data Better for identifying a pattern or Repeats Can repeat to give an average, identify anomalous data	WTTE	2	C

f	 <p>Mass needed to break the plant fibre / g</p> <p>Humidity / %</p> <p>Draggable items and key: Group 1 Group 2</p>	<p>Equal increments on Y axis scale</p> <p>Three points plotted correctly</p> <p>All six points plotted correctly</p> <p>Data points matching the key</p>	<p>Ignore the key for mp 2</p> <p>Ignore the key for mp 3</p> <p>Only award mp 4 if at least three points are correctly plotted</p>	4	C
g	<p>Group 1: increases and then plateaus</p> <p>Group 2: Increases and linear</p>	WTTE	2	C	
	<p>Natural variation in fibre strength or fibres come from a different plant</p> <p>Less precise equipment gave less valid outcome</p>				

5	a	95 (micrometres) ± 5	Ignore incorrect units	1	c
	b	Candidate's value from part (a) – 80 $\left(\frac{\text{Difference}}{80} \right) \times 100$ Evidence of calculation rounded to nearest %	ECF from part (a) Award third marking point for any correctly rounded percentage if calculation is seen	3	c
	c	Any two increases in size from the list, [max 2] <ul style="list-style-type: none"> • cells or vacuoles • cell walls • gaps or lamella Water enters the fibres or cells by osmosis or diffusion (as humidity increases) larger difference between cell and environment or (as humidity increases) more rapid entry of water (into the cell)		4	c
	d	Accept any reasonable suggestion, for example [max 1] <ul style="list-style-type: none"> • (change in) mass • length in other planes or 3 dimensions • measure the increase of the labelled parts of the diagram Accept any correctly linked justification, for example [max 1] <ul style="list-style-type: none"> • to calculate the % water absorbed • to calculate (increase in) volume (rather than length) • to see if all parts increased at the same rate or find out where the water had gone 		2	c

6	a	<p>Accept any CV from the list, [max 1]</p> <ul style="list-style-type: none"> • volume of NaOH • fibres immersed in same chemical or NaOH • initial fibre length or diameter • type of fibre (agave) 		1	B
	b	<p>So the method could be repeated or Compared with other processes or Because time in the solution might affect the results or Time (in solution) is a control variable</p>	WTTE	1	C
	c	<p>Accept any three points from the following, [max 3]</p> <ul style="list-style-type: none"> • identify the alkali (as NaOH) • include a reference to direction of change of IV • include a possible range of IV concentrations • specify fibres are agave • specify what will be measured 	<p><i>Accept aspects of a re-written hypothesis</i> <i>Do not accept include adding scientific justification as an improvement</i></p>	3	B
	d	<p>First marking point: Hypothesis is valid or partially valid and as the extension increases from 0-2 or 5% (NaOH)</p> <p>Second marking point linked to hypothesis being invalid:</p> <ul style="list-style-type: none"> • between 2 or 5 – 10% the extension decreases • above 10% as there is no clear increase or decrease despite the change in concentration 	<p>WTTE</p> <p><i>Accept reference to a plateau, do not accept constant</i></p>	2	C

7			1 mark	2 marks	3 marks	4 marks	15	B
		RQ	A simple RQ	RQ linked to % fibre and length				
V	IV as fibre % or DV as length or one CV is identified	IV as fibre % and DV as length and one CV is identified	IV as fibre % and DV as length and two CV are identified					
E	Equipment for basic set up or equipment to measure length (stretch)	Equipment for basic set up and equipment to measure length (stretch)						
M	Attempt at a method but detail is insufficient to collect relevant data	Detail of method is incomplete but some relevant data could be collected	Detail of method is sufficient to follow and similar data could be collected	Detail of method is sufficient to repeat the experiment				
D	Plans to repeat at least three trials or to collect data for at least five fibre %	Plans to repeat at least three trials and collect data for at least five stated fibre %	Plans to repeat at least three trials and collect data for at least five stated fibre % and including 0% and 20% fibre					
S	A relevant comment about safety e.g. taking care with heavy masses, breaking ropes							

8	a	Transpiration	<i>Accept references to plant reproduction</i>	1	A
	b	Fewer bees will mean there is less pollination of the flowers This may reduce the population of plants (which will) result in less food being available (for consumers) Link to how biodiversity is reduced		4	D
	c	Individual: Action Correctly linked justification Difficulty linked to action Government: Action Correctly linked justification Difficulty linked to action Simple conclusion Further justification of conclusion drawing on both individual and government		8	D

		1 mark	2 marks	3 marks	4 marks		
9	Environmental	States one environmental aspect for green roofs or one for solar panels	States one environmental aspect for green roofs and one for solar panels or states two environmental aspects for green roofs or solar panels	States one environmental aspect for green roofs and one for solar panels and with further justification of one aspect	States one environmental aspect for green roofs and one for solar panels and with further justification for both aspects	13	D
	Economic	States one economic aspect for green roofs or one for solar panels	States one economic aspect for green roofs and one for solar panels or states two economic aspects for green roofs or solar panels	States one economic aspect for green roofs and one for solar panels and with further justification of one aspect	States one economic aspect for green roofs and one for solar panels and with further justification for both aspects		
	Biosolar	Solar panels work more efficiently or more efficient use of space	Solar panels work more efficiently when cooled by plants or more efficient use of space by combining two purposes				
	Location	States a reasonable factor	States a reasonable factor with justification				
	Conclusion	Gives a concluding statement					

Markscheme

November 2017

Biology

On-screen examination

17 pages

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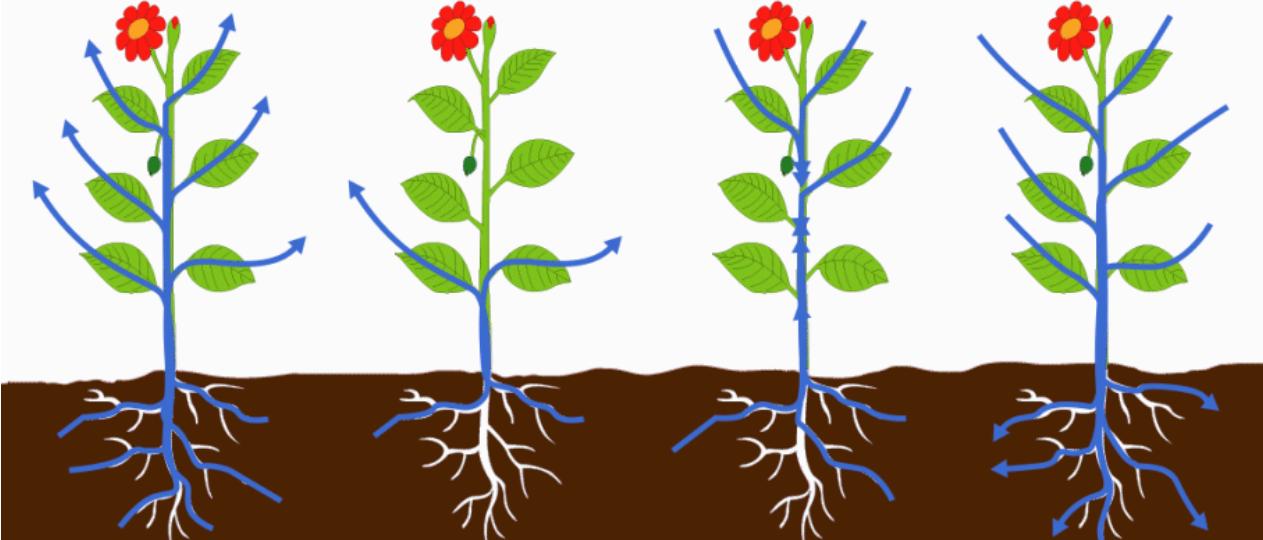
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The following are the annotations available to use when marking responses.

Annotation	Explanation	Shortcut	Annotation	Explanation	Shortcut
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.	Alt+1		No benefit of the doubt	Alt+4
	Arithmetic error			No explanation given	
	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6		No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question			Award 1, 2, 3, 4 marks. For use in holistically marked questions only	

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
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Question	Answers	Notes	Total	Criterion
1 a	<p>correct animation selected: Diagram A</p>  <p> <input checked="" type="radio"/> Diagram A <input type="radio"/> Diagram B <input type="radio"/> Diagram C <input type="radio"/> Diagram D </p>		1	A
b	<u>cell wall</u>		1	A
c	<p>Any reasonable suggestion for example:</p> <ul style="list-style-type: none"> • the plant will no longer be able to stand upright • the plant will wilt or go floppy. 	WTTE	1	A

d	<p><i>Either</i></p> <p>the leaves are curled <i>or</i> the stomata are sunken <i>or</i> there are hairs surrounding the stomata</p> <p>this allows transpired water to become trapped in enclosed spaces</p> <p>humidity increases</p> <p>so <u>evaporation</u> <i>or</i> <u>transpiration</u> is reduced in humid / moist conditions</p> <p><i>or</i></p> <p>leaf has a waxy cuticle</p> <p>leaf surface is impermeable to water</p> <p>this reduces area of leaf where water can be lost</p> <p>prevents <u>evaporation</u> <i>or</i> <u>transpiration</u> through that surface</p>		4	A
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2	a	<p>Any two from:</p> <ul style="list-style-type: none"> • light / sunlight • water • heat / high temperature • nutrients • pheromones 		2	A
	b	<p>positive tropism shown by stem growing upwards so that the leaves are exposed to light negative tropism shown by roots growing downward so that roots can absorb water/nutrients or a stable root structure is formed</p>		4	A
	c	<p>Any three reasonable suggestions (3 max), for example:</p> <ul style="list-style-type: none"> • (touch causes leaves to close) so leaves cannot be eaten • gives wilted, unappealing appearance • predators are confused as food disappears • (hence) improved chance of survival with more photosynthetic tissue. 		3	A
	d	<p>the stalk or plant will bend or move toward the light only if the <u>tip</u> is exposed to the light</p>	WTTE ORA	3	C
	e	<p>on the shaded side, the mica blocked the substance moving down from the tip (and therefore) the plant did not bend when the mica was on the lit side, the bending was not affected (so) the plant grew toward the light</p>		4	C

3	a	<table border="1"> <thead> <tr> <th>Function</th><th>Organelle</th></tr> </thead> <tbody> <tr> <td>The part of the cell containing DNA and responsible for control of growth and function</td><td>Nucleus</td></tr> <tr> <td>Packaging of molecules like proteins, movement of lipids and the creation of lysosomes</td><td>Golgi apparatus</td></tr> <tr> <td>Conversion of energy in food molecules to energy</td><td>Mitochondria</td></tr> </tbody> </table>	Function	Organelle	The part of the cell containing DNA and responsible for control of growth and function	Nucleus	Packaging of molecules like proteins, movement of lipids and the creation of lysosomes	Golgi apparatus	Conversion of energy in food molecules to energy	Mitochondria		3	A
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b	<p>Accept any reasonable function, for example:</p> <ul style="list-style-type: none"> • a specific instruction for a specific trait/protein • contains the genetic code for a cell activity • contains the genetic code for a particular characteristic. 	Do not accept “DNA has genetic information” alone.		1	A								
c	<p>A similarity, for example:</p> <ul style="list-style-type: none"> • both select for desired trait • both rely on the principles of heredity • both aim to alter the genetic code. <p>A difference, for example:</p> <ul style="list-style-type: none"> • genetic engineering can introduce a new trait whereas selective breeding uses an existing trait • genetic engineering needs one generation to introduce the trait, selective breeding needs more generations • genetic engineering is much faster than selective breeding to gain the desired trait • genetic engineering is an artificial process whereas selective breeding is natural. <p>Any further two points from either list (2 max)</p>			4	D								
d	<p>Any two reasonable suggestions, for example:</p> <ul style="list-style-type: none"> • reduction in the gene pool/variation • trait desired by humans might have a negative effect on the species • low variation reduces the ability to survive changes in the environment. 			2	A								

4	a	diffusion		1	A
	b	Sign C: harmful sign 		1	A
	c	Any two reasonable precautions, for example (2 max): <ul style="list-style-type: none">• use gloves• use safety glasses.		2	B
	d	(does the) concentration of iodine (solution affect the) time taken for iodine to diffuse across a <u>semi-permeable membrane</u> correct use of word <u>concentration</u>	<i>WTTE accept references to rate</i>	3	D
	e	A correct prediction linking the two variables, for example: if the concentration of the iodine solution increases then the rate of diffusion will increase.		1	B
	f	Identification of independent, dependent and control variables (2 max): one correct all correct Description for how to manipulate each variable identified above (4 max)	<i>ECF for correct description of manipulation of an incorrectly identified variable except for rate of diffusion of water</i>	6	B
	g	at least three trials average data can be calculated or anomalous data can be identified or allows for statistical analysis		2	B

	h	a table with at least three trials a table with at least three rows (for concentrations) labels including units		3	C
	i	Any reasonable weakness, for example: <ul style="list-style-type: none">• determining when the bag was completely changed could be subjective• the concentration of the solutions was not changed in equal increments.	WTTE	1	C

5	a	whether temperature affects the rate of movement across a membrane		1	B																												
	b	measurement is made for a fixed time period change in mass over a fixed time period used to determine rate g min^{-1} or g s^{-1}	Accept g / min or g/s	3	B																												
	c	0.10(1) correctly stated as 0.10 with correct sig figs	Accept incorrect precision for first mark																														
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d	increments evenly spaced y axis scale appropriate to give good visual differentiation of data trend two points plotted all points plotted correctly	ECF from part c Ignore point (5,0) if plotted		4	C																												

	e	<p>both graphs show similar trend until 35°C</p> <p>both graphs increase at a similar rate or rate of increase slows at a similar rate</p> <p>the university graph shows a plateau or reaches a constant value above 35°C</p> <p>the student graph has no data above 35°C</p>		4	C
	f	<p>as temperature increases (kinetic) energy increases</p> <p>particles move more quickly</p> <p>so the rate of movement across the membrane increases</p> <p>term <u>kinetic energy</u> used correctly</p> <p>or</p> <p>at a temperature above 35°C (the movement of water is) equilibrium is reached (for this system)</p> <p>so the rate of (net) movement becomes constant</p> <p>because particles are moving in both directions at the same rate</p> <p>term <u>equilibrium</u> or <u>osmotic pressure</u> used</p>		4	C
	g	<p>valid because the trends match (below 35°C)</p> <p>or</p> <p>valid because the data / results were similar</p> <p>or</p> <p>not valid because there are no measurements above 35°C</p>	<p><i>Accept any other correctly used terminology associated with osmosis e.g. isotonic etc.</i></p>	1	C

	h	<p>Any reasonable extension – change to the independent variable, for example:</p> <ul style="list-style-type: none">• increase the temperature range• investigate a different solute. <p>Any reasonable improvement, for example:</p> <ul style="list-style-type: none">• fill in the missing increments• increase the duration of each trial to check if equilibrium is reached after 10 mins.	Accept one extension and one improvement given in either box.	2	C
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6	a	Necessary equipment: balance or ruler, potato, beaker, thermometer, flask of distilled water, knife, ice, kettle, paper towels, goggles Three items: potato, thermometer, water A further three items from the necessary equipment list		2	B																												
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7	a	<p>Carbohydrate: quick energy release</p> <p>Fat: long term energy storage and insulation</p> <p>Minerals and vitamins: supports metabolism</p> <p>Protein: body structures and cell functions</p> <p>one pair correctly matched</p> <p>two pairs correctly matched</p> <p>all pairs correctly matched</p>		3	A
	b	goat			
				1	C

c		1	2	3	4	D
	Impacts	States an impact of intensive farming	States an impact of intensive farming and states the effect	states more than one impact of intensive farming, states the effects and uses science to explain the effect of one of the impacts	states more than one impact of intensive farming and their effects and gives detailed scientific explanations	
	Strengths and limitations of <i>in vitro</i> production	States a strength or a limitation of <i>in vitro</i> production	States a strength and a limitation of <i>in vitro</i> production	states a strength and a limitation of <i>in vitro</i> production supported by scientific reasoning	states a strength and a limitation of <i>in vitro</i> production supported by detailed scientific reasoning	
	Environmental	an environmental consideration for farming or <i>in vitro</i>	an environmental consideration for farming and <i>in vitro</i> or an environmental consideration for farming or <i>in vitro and</i> scientific reasoning	an environmental consideration for farming and <i>in vitro</i> supported by scientific reasoning		
	Ethical	an ethical issue for farming or <i>in vitro</i>	an ethical issue for farming and <i>in vitro</i> or an ethical consideration for farming or <i>in vitro and</i> scientific reasoning	an ethical issue for farming and <i>in vitro</i> supported by scientific reasoning		
	Appraisal	A brief concluding appraisal	A concluding appraisal linking all factors discussed			

16

8						9	D
Advantages and disadvantages	1	an advantage or a disadvantage linked to bio-printing	2	an advantage or a disadvantage correctly linked to bio-printing	3	an advantage and a disadvantage correctly linked to bio-printing	4
	Evaluative statement	Evaluative statement	Evaluative statement is justified	Evaluative statement is justified with scientific reasoning			
	Concluding appraisal	A brief concluding appraisal	A concluding appraisal linking all factors discussed				

Markscheme

November 2018

Biology

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Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
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Question	Answers	Notes	Total	Criterion
1 a	<p>Any two correct for each mark:</p> <p>Rice: carbohydrates</p> <p>Olive oil: fats</p> <p>Milk: fat or protein</p> <p>Fish: protein</p>		2	A
b	needed for growth or repair or structure or enzymes		1	A
c	50 (g) grams / g		2	A D
d	(yes) because it contains all of the nutrient groups in the table all of the daily vitamin C is included calcium is low so should be supplemented (so) you would need to know what else was eaten during the day		4	A
e	<p>Any two points from the list:</p> <ul style="list-style-type: none"> • an unbalanced diet can lead to a high energy intake or low energy usage if activity levels are low • energy intake is higher than energy used • genetic factors or low metabolic rate 		2	A

2	a	an organism or virus that causes a disease or an infection	<i>WTTE</i>	1	A
	b	Any two from (2 max): <ul style="list-style-type: none"> • movement • respiration • response to stimulus • growth • reproduction • excretion • digestion or nutrition 	<i>WTTE</i>	2	A
	c	drinking water supply chains or sewage facilities are broken Any additional reasonable point, for example: <ul style="list-style-type: none"> • people do not have access to bottled or clean water • people do not have access to antibiotics/cures/medical care 		2	D
	d	Skin: physical barrier or pH or oils or sweat White blood cells: destroy/deactivate/eat pathogen or produce antibodies (in the bloodstream)		2	A
	e	Basic explanation: you do not get the (symptoms of) disease or subsequent infection will lead to quicker response Additional points: vaccine is a weakened/inactive form of the pathogen or parts of the pathogen vaccine triggers the specific white blood cells/lymphocytes immune system or white blood cells/lymphocytes produce specific antibodies memory cells are present or the selection of specific white blood cells/lymphocytes has already been done		5	A

3	a	nervous		1	A
	b	<p>Any reasonable ethical consideration, for example:</p> <ul style="list-style-type: none"> the environment should be similar to the leeches' normal habitat moderate environmental conditions handled with care 		1	B
	c	<p>Independent variable: light level/intensity</p> <p>Control variables (two max), for example:</p> <ul style="list-style-type: none"> temperature movement around leeches where the leeches start in the decision chamber 		3	B
	d	<p>leeches will prefer the dark side or leeches will move away from the light (so) more leeches will be on the dark side (after 10 minutes) ORA link to observed behaviour (in the stream)</p>	Second mark is for a measurable prediction	3	B
	e	<p>Any reasonable point relating to sufficient data, for example:</p> <ul style="list-style-type: none"> a minimum of three trials is needed for sufficient data repetition improves accuracy 		1	B
	f	<p>Any two limitations, for example:</p> <ul style="list-style-type: none"> it is not the same as the natural environment (so natural behaviour is not tested) they were not given time for acclimation a group of 10 might be an unnatural situation a statement of any uncontrolled factor that should have been controlled 		2	C
	g	<p>Any reasonable improvement for this experiment, for example:</p> <ul style="list-style-type: none"> a wider range of light levels better control of the control variables time for acclimation <p>A correctly linked justification</p>		2	C

	h	<p>Any different independent variable, for example</p> <ul style="list-style-type: none">• temperature• movement of water• starting position of leeches	<p><i>Accept suggestions of different levels of light intensity only if this is not given in part (g)</i></p>	1	C
--	---	--	---	---	---

4	a	animal		1	A
	b	<p>reactions are slower at low temperatures or crickets are not active at low temperature</p> <p>reach an optimal temperature or warm temperatures are close to the temperature of their natural habitat</p> <p>enzymes do not function at a temperature that is too hot or above a certain temperature, metabolism will not work properly (and they stop chirping)</p>		3	B B B
	c	<p>(First table selected - no mark)</p> <p>Justification: mean should be calculated for each temperature or it is inappropriate to calculate the mean for each cricket at different temperatures</p>		1	C
	d	<p>x-axis: temperature °C included in x axis label</p> <p>y-axis: chirps per minute</p>		3	C
	e	<p>the data in the graph support the middle part of the prediction or the rate increases over the temperature range studied</p> <p>the method gave insufficient data to test the chirp rate at higher temperatures (so the method is not valid) or there were insufficient temperatures investigated</p>		2	C

5		1	2	3	4		
	Identification of variables	Some variables are referred to that are connected to the problem but these may not be explicitly identified	Independent or dependent variable and one control variable are identified	Independent variable and dependent variable and one control variable are identified	Independent, dependent and at least two control variables are identified		
	Hypothesis	Formulates a hypothesis connected to the variables but not explicitly linked to the variables	Formulate a testable hypothesis correctly linked to the variables (no explanation)	Formulate a testable hypothesis correctly linked to the variables with correct scientific explanation			
	Manipulation of variables/ description of method	Attempt at a method but detail is insufficient for another student to follow	Partial method is described but detail is insufficient for another student to follow	Method is described and could easily be followed by another student	Complete method is described and could be replicated by another student		
	Collection of data	Plans to repeat at least three trials with five woodlice or measures for four different conditions	Plans to repeat at least three trials with five woodlice and measures for four different conditions				
	Ethical	Any relevant comment relating to ethics	Any relevant and detailed comment relating to ethics				

15 B

6	a	decrease because there is more competition for plant material or food		1	C
	b	increase because there are fewer owls eating the woodlice <i>or</i> decrease because there is more predation from rats <i>or</i> no change linking fewer owls with more rats correct use of a term from the list: predator, prey, predation, trophic levels, consumer		2	D
	c	add units to axes		1	C
	d	First mark: population of both rats and woodlice goes up and down or increases and decreases (over time) Any two additional points from the list below (2 max): <ul style="list-style-type: none"> • maximum population is the same number for each species (over time) • maximum population for woodlice is higher than rats • maximum for rats is after the maximum for woodlice • the cycles are regularly spaced over time Explanation (3 max): as the population of woodlice grows, there is more food for the rats so their population increases (so) there is more predation of woodlice so the population falls less food for rats so the population falls or less predation on woodlice so the population of woodlice increases		6	C

7	a	<p>taken in by the <u>roots</u> by diffusion or active transport transported in the xylem / transport tissue / vascular tissue (to the leaves) use in synthesis of (organic) molecules / amino acids / plant compounds / growth</p>		4	A
	b	<p>One similarity:</p> <ul style="list-style-type: none"> • both increase nutritional value of plants • both will give the desired minerals to the crops • if overused both could lead to environmental problems / accumulation of minerals in water sources <p>One difference:</p> <ul style="list-style-type: none"> • reference to price / one more expensive than other • chemically could be more controlled in terms of quantity of nutrients • organic could be produced in the same farm <p>Any two additional points for either similarities or differences (2 max)</p>		4	D
	c	a section of a chromosome or DNA and that codes for a protein or trait		1	D
	d	<p>data for at least four crops included in the table</p> <p>table to have columns for crop and year and nutrient and country in any order</p> <p>order should be logical in one column or row eg increasing year or alphabetical by country or crop or nutrient</p>		3	C

	e	<p>Restriction enzymes cut open a plasmid.</p> <p>The new genes are inserted into the plasmid.</p> <p>The plasmid is transferred into a bacterium.</p> <p>The modified bacterium inserts the new genes to the plant cell.</p> <p><i>First mark for any two in the correct sequence</i></p> <p><i>Second mark all correct</i></p>		2	D D
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8		1	2	3	4	14	D
		Health	A statement relating to health	More than one statement relating to health	More than one statement relating to health with at least one supported by reasoning or an example	Positive and negative statements relating to health with at least one supported by reasoning or an example	
		Environmental	A statement of an environmental impact	A statement of an environmental impact with a linked consequence	A statement of two environmental impacts at least one linked to a consequence		
		Ethical	A statement of an ethical impact	More than one statement of an ethical impact			
		Economic	A statement of an economic impact	A statement of an economic impact with justification	A statement of more than one economic impact with at least one justification		
		Appraisal	Appraisal given	Appraisal linked to previous impacts			

Markscheme

May 2018

Biology

On-screen examination

14 pages

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	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6		No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question			Award 1, 2, 3, 4 marks. For use in holistically marked questions only	

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- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate’s work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question	Answers	Notes	Total	Criterion
1	a Organisms of the same species that live in the same area		1	A
	b reference to survival of the fittest these organisms (with beneficial traits/characteristic survive to) reproduce (so the frequency of) the particular trait/characteristic increases in the population	WTTE Accept “black” or “grey” for trait ORA	3	A
	c the colour of the lichen or tree or background changed black moths were camouflaged increased survival (from predation) produced offspring with same colour that survived or increase in frequency of black moths (from reproduction)	If colour is not specified, assume they are referring to black moths. Award MAX 2 marks if candidate refers to moths being stained or WTTE. Do not accept change in “environment” No ORA for this marking point	4	A
	d the dark trait is hidden by the grey trait/allele or the trait/allele is not expressed in heterozygous individuals only homozygous recessive individuals would express the trait/allele correct use of the term heterozygous/Bb/Gg/Ww or homozygous/bb/gg/ww or allele	ORA Accept “carrier” Do not accept “gene”, accept any letters in genotype /gg/ww or allele	3	A D

2	a	<p>First two marks any two responses from the list:</p> <ul style="list-style-type: none"> • animals eat plants • animals produce CO₂ (during respiration) • plants use CO₂ (for photosynthesis) • CO₂ is produced when animals or plants decay <p>Third mark connecting animals and plants in the carbon cycle:</p> <p>linking carbon from animals to plants or correctly linking photosynthesis with respiration or CO₂ produced when animals decay is used by plants</p>		3	A
	b	<p>An example of a human activity affecting CO₂, for example:</p> <ul style="list-style-type: none"> • burning fossil fuels or industrialization or cars • burning of trees • (intensive) cattle rearing • deforestation. <p>A global impact of these activities, for example</p> <ul style="list-style-type: none"> • decreased carbon stored underground • increased carbon in the atmosphere or (dissolved) in the ocean • climate change or global warming or increase in greenhouse gases • emissions decrease pH or increase acidity of oceans (so change carbonate levels) <p>A further point from either list</p>	<p><i>Do not accept refs to volcano as this is not a human activity</i></p> <p><i>Accept CO₂ or CH₄ as greenhouse gases</i></p>	3	A

3	a	Meiosis		1	A							
	b	each parent has different genetic material/traits/genes/alleles half of the genetic material of the offspring comes from each parent combination of genetic material leads to a new individual	WTTE <i>Only accept "crossing over" in relation to gametes</i>	3	A							
	c	Key: <table border="1"> <tr><td>■</td><td>Follicle stimulating hormone (FSH)</td></tr> <tr><td>■</td><td>Progesterone</td></tr> <tr><td>■</td><td>Luteinising hormone (LH)</td></tr> <tr><td>■</td><td>Estrogen</td></tr> </table> one in correct position two in correct position all four in correct position	■	Follicle stimulating hormone (FSH)	■	Progesterone	■	Luteinising hormone (LH)	■	Estrogen		3
■	Follicle stimulating hormone (FSH)											
■	Progesterone											
■	Luteinising hormone (LH)											
■	Estrogen											
d	Accept any reasonable suggestion, for example: <ul style="list-style-type: none"> • more than one egg could mature • could lead to twins or multiple developing embryos/fetuses • causes hypersecretion of estrogen 	Do not accept any effects of estrogen, only FSH	1	A								

4	a	<p>Salivary amylase Pepsin Trypsin Alkaline phosphatase Carbonic anhydrase</p> <p>one in correct location two in correct location three in correct location all five in correct location</p>	<p>Accept enzyme in either position at each location</p>	4	C
b		<p>How does pH affect and the rate of colour change or How does pH affect and time taken for colour change or How does pH affect and rate of reaction</p>	<p>Do not accept how fast does the colour change without reference to pH Accept “Does …” do not accept “Why …” Can accept “rate of reaction” for this mark</p>	1	B
		<p>Independent variable pH Dependent variable time (for colour change) Control variables (any two): <ul style="list-style-type: none"> • amount of lactose/substrate • surface area of lactose/substrate • amount of enzyme/lactase • volume of water • concentration of enzyme solution • temperature • type of enzyme. </p>	<p>Do not accept rate or rate of reaction</p>	4	B

	d	<p>range: not relevant to human body</p> <p>the number of values of independent variable is not sufficient or there are not five values of independent variable</p> <p>number of trials is not sufficient or a minimum of three trials is needed</p>	3	C
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5	a	lactase		1	A
	b	<p>y axis: time for colour change (/s)</p> <p>unit included with y axis label</p> <p><u>all</u> numbers (in boxes) given in evenly spaced increments on both axes</p> <p>Plotting points</p> <p>four points plotted correctly</p> <p>all points plotted correctly</p>	<p><i>Plotting ± 1 square using the candidate's scale</i></p> <p>1 mark for four correct, 2 marks for all seven correct</p>	5	C
	c	$g\text{ dm}^{-3}$	Accept g/dm^3 or $g\text{l}^{-1}$ or g/l or g per dm^3	1	C
	d	<p>the time for colour change decreases as the concentration increases or the colour changes more quickly when the concentration is high or there is a negative/inverse trend</p> <p>linking increase in concentration to faster rate</p> <p>more lactose is interacting with enzyme (molecules)</p> <p>at a certain point, the time of colour change starts to plateau</p> <p>all of the (active sites of) enzyme molecules are being used</p> <p>A correct use of the one of the terms in the list somewhere in the response: active site, substrate, lactase, increasing rate of reaction</p>	<p><i>Do not accept inversely proportional, exponential</i></p> <p>Accept “reacting”</p> <p>WTTE</p>	6	C
	e	<p>valid at the lower concentrations</p> <p>(because) time of colour change is decreasing</p> <p>not valid at higher concentrations</p> <p>(because) all the (active sites) are being used</p> <p>(so) the hypothesis is partly valid</p>	<p>Accept references to numbers throughout</p> <p>Accept a reference to increasing speed or rate.</p>	5	C

f	<p>more trials/repeats</p> <p>reduce experimental error or make the data more reliable</p> <p>or</p> <p>extend the range of concentration</p> <p>to give a clearer indication of the trend</p> <p>or</p> <p>use of spectrometer or colorimeter</p> <p>to give time for consistent colour change</p>	<p><i>Second marking point must be correctly linked to the first to score</i></p> <p><i>Do not accept “more accurate”, “use more precise equipment”</i></p>	2	C
g	<p>change the concentration of the enzyme/lactase</p> <p>or</p> <p>change the volume of the enzyme solution (as this gives more active sites)</p>	<p><i>Do not accept “change the enzyme”</i></p> <p><i>Do not accept “add water” unless they link this to changing the concentration of the enzyme solution</i></p>	1	C

6		1	2	3	4		
	Variables (V)	Some variables are referred to that are connected to the problem but these may not be explicitly identified	Independent or dependent variable and one control variable are identified	Independent variable and dependent variable and one control variable are identified	Independent, dependent and at least two control variables are identified		
	Hypothesis (H)	Outlines a simple hypothesis or research question	Formulates a testable hypothesis linked to the independent and dependent variables with no explanation or formulates a (non-testable) hypothesis with correct scientific explanation	Formulates a testable hypothesis correctly linked to the variables (no explanation)	Formulates a testable hypothesis correctly linked to the variables with correct scientific explanation		
	Manipulation of IV (IV)	Reference to the IV being changed	Less than five stated values of the independent variable	At least five stated values of the independent variable			
	Method (M)	Attempt at a method but detail is insufficient for another student to follow	Partial method is described but detail is insufficient for another student to follow	Method correctly connected with the IV is described with some details of equipment, measurements or units and could be followed by another student	Method correctly connected with the IV is described with details of equipment, measurements and units that could be followed by another student		
	Sufficient data (D)	Mentions more than one trial	Specifies at least three trials				
	Safety (S)	Any relevant comment relating to safety					

18

B

7	a	<p>First mark: any two factors from the list:</p> <ul style="list-style-type: none"> • light • water • nutrients • CO₂ <p>Second mark: all of the four factors on the list above only</p>	<p>Award 2 marks if all factors are selected</p>	2	A
	b	<p>one factor linked to the process of photosynthesis or respiration</p> <p>a correct use of the term photosynthesis or respiration</p>			

8		<p>Any five points from the following list</p> <p>Similarities</p> <ul style="list-style-type: none"> • both types of farming maximize space for growing crops • both types of farming improve light available for crop growth • both types of farming improve the water supply to crops <p>Differences</p> <ul style="list-style-type: none"> • Light: terracing relies on natural light and light in vertical farming can be controlled • Water: terracing relies on climate or is not controlled and vertical farming reuses waste water or is controlled • Soil: terracing reduces soil erosion and vertical farming has no soil erosion • Nutrients: terracing relies on nutrients in soil or nutrients can be depleted and nutrients can be controlled in vertical farming 	<p><i>Similarities and differences must be explicitly linked</i></p> <p><i>Accept references to flooding or drainage only when linked to plants or crops.</i></p>	5	D
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9		1	2	3	4	15	D
	Change in the landscape (C)	An incomplete statement of a change in the landscape	A correct statement of a change in the landscape	A description of one change in the landscape	A description of more than one change in the landscape		
	Scientific justification linked to need of plant (S)	An attempt at a scientific justification of the changes to the landscape	Scientific justification of one change to the landscape	Scientific justification of more than one change to the landscape			
	Advantages and disadvantages to the environment (AD)	An attempt at a statement of an advantage or disadvantage	A complete statement of an advantage or a disadvantage	A complete statement of an advantage and a disadvantage	A complete statement of more than one advantage and more than one disadvantage		
	Impacts (I)	A statement of an economic or a social impact	A description of an economic or a social impact	A detailed description of an economic or a social impact			
	Appraisal (A)	A concluding appraisal					

Markscheme

May 2017

Biology

On-screen examination

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Once this process has been completed if the highest (or lowest) mark available for that band has been determined, the examiner must check the band above (or below) to ensure that the initially correct determination of the band was correctly allocated. For example, there may be sufficient detail in the candidate's response to award the lowest mark of the band above.

NB. Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands.

Question	Answers	Notes	Total	Criterion
1 a	Accept any two human senses other than hearing (2 max) <ul style="list-style-type: none"> • vision/sight/seeing • taste • smell • touch/feel 	<i>Do not accept eyes or other organs. Do not accept listening as this is included in the question.</i>	2	A
b	receptor		1	A
c	Any two from the following list in the correct order: <ul style="list-style-type: none"> • receptor or sense or a named example of a receptor • sensory nerve cell or nerves or peripheral nervous system • central nervous system or brain or spinal cord or relay neuron • motor nerve cell • effector or muscles or glands • response or a descriptor of a response. 		2	A
d	cochlea		1	A
e	Mitosis Meiosis Any two valid pairs of differences (2 max), for example: <ul style="list-style-type: none"> • 2 vs 4 cells (are produced) • genetically identical vs not genetically identical • same number of chromosomes as mother cells/diploid vs halved number of chromosomes/haploid • somatic cells vs gametes (are produced). 	<i>The differences appear in separate response boxes. The order of response boxes in the candidate response is confusing. Award marks for pairs of correct differences only. Do not accept sexual vs asexual reproduction.</i>	4	A
f	(anaerobic) <u>respiration</u> <u>anaerobic</u>	<i>Aerobic respiration is a CON, award no marks.</i>	2	A
g	Any three points from the following: <ul style="list-style-type: none"> • oxygen is needed for respiration • lack of oxygen leads to cell death or damage • <u>hair cells</u> are not muscle cells, which can switch to anaerobic respiration • (hair) cells are unable to generate energy/ATP in the absence of oxygen • lack of energy/ATP can lead to damage or death of (hair) cells • hair cells cannot be repaired or replaced. 	<i>WTTE Accept ciliated cell in place of hair cell.</i>	3	A

2	a	3900 ± 100 (Hz)		1	C
	b	<p>A biological advantage, for example:</p> <ul style="list-style-type: none"> as the loudness of sounds is increased stronger vibrations are transmitted (to the cochlea) hair cells are stimulated more intensely thereby more nerve signals are generated (improving hearing). <p>A disadvantage, for example:</p> <ul style="list-style-type: none"> overstimulation/amplification could lead to further damage of (remaining) hair cells hearing aids do not help when no functioning hair cells are left hearing aids are ineffective if vibrations are not transmitted to cochlea. 	WTTE Do not accept “using the implant allows the person to hear” alone.	2	A
	c	<p>Either</p> <ul style="list-style-type: none"> electrical impulses/signals/stimuli (because) the stimulation/signal enters the cochlea where otherwise hair cells would be generating nerve signals <p>or</p> <ul style="list-style-type: none"> vibration which would otherwise originate from eardrum or middle ear bones and stimulate hair cells. 		2	A
	d	<p>Any reasonable advantage, for example:</p> <ul style="list-style-type: none"> enables hearing does not require surgery low(er) cost (than implant) readily available. <p>Any reasonable disadvantage, for example:</p> <ul style="list-style-type: none"> expensive heavy uncomfortable to wear. 	Advantage and disadvantage should not contradict each other.	2	D
	e	<p>Any reasonable advantage, for example:</p> <ul style="list-style-type: none"> enables hearing (even when hair cells do not generate any nerve impulses or even when sound is not transmitted to the cochlea). <p>Any reasonable disadvantage, for example:</p> <ul style="list-style-type: none"> expensive requires surgery to fit. 	Advantage and disadvantage should not contradict each other.	2	D

3	a	Recessive/h because parents do not have condition but child does or because if it was dominant the parents would be affected too		2	A						
	b	<table border="1"> <thead> <tr> <th>Mother</th> <th>Father</th> <th>Child</th> </tr> </thead> <tbody> <tr> <td>Hh</td> <td>Hh</td> <td>hh</td> </tr> </tbody> </table>	Mother	Father	Child	Hh	Hh	hh	Accept hH	3	A
Mother	Father	Child									
Hh	Hh	hh									
	c	the AA parent will pass on an A (allele) to every child the child will always inherit an A or dominant allele or the allele inherited from the other parent will have no effect	WTTE	2	A						

4	a	red blood cell / erythrocyte		1	A
	b	(Does) the quantity or amount of <u>oxygen in the blood</u> or <u>body</u> vary with altitude?	WTTE Accept any question that links IV and DV.	1	B
	c	there are only two data points or there is only one trial	Do not accept reference to control variable.	1	C
	d	quantity of oxygen in the blood decreases as altitude increases or there is an inverse relationship	ORA	1	C
	e	Accept any value in the range 78-82 (units).		1	C
	f	Any four points from the list: <ul style="list-style-type: none"> • a basic, correct reference to homeostasis • if there is less oxygen (in the blood) • (then) the body produces more hemoglobin • to try and increase the quantity of oxygen <u>in the blood</u> • at higher altitude availability of oxygen decreases • if there is less oxygen in the air there will be less oxygen in the blood • the availability of oxygen in the air decreases more than the quantity of oxygen in the blood decreases • hemoglobin concentration increases as altitude increases. 	WTTE, points seen in any order	4	C

5	a	<p>Independent variable: altitude</p> <p>First control variable, from: age of runners, resting heart rate of runners, time of runners acclimatizing, mass of food etc</p> <p>Dependent variable: quantity of oxygen in the blood or (percentage) blood saturation or heart rate</p> <p>Second, different control variable, from list above</p>	Accept any reasonable control variable that can be measured.	4	B
	b	blood oxygen saturation decreases with altitude heart rate increases with altitude Any additional point (1 max) <ul style="list-style-type: none"> • to move blood through the body more quickly • to supply oxygen to meet oxygen demand • (because) as the altitude increases the availability of oxygen in the air decreases 	WTTE	3	C
	c	Any two reasonable improvements, for example (2 max): <ul style="list-style-type: none"> • more than three altitudes • more than five people • another reasonable control variable. <p>Correctly linked justifications, for example (2 max)</p> <ul style="list-style-type: none"> • better idea of trend • data would be more reliable 	<i>Do not accept “use better equipment”.</i> <i>Review 5(a) before awarding a mark for an additional measurable control variable.</i>	4	C
	d	Any reasonable extension, for example (1 max): <ul style="list-style-type: none"> • study various ages • study other physiological factors. <p>Correctly linked justification</p>		2	C

6	a	<p>Any two reasonable control variables, for example (2 max):</p> <ul style="list-style-type: none"> • age of pika • sex of pika • time of year. <p>Correctly linked justification (2 max)</p>		4	B
	b	at least three individuals		1	B
	c	<p>Correct headings: altitude</p> <p><u>mean</u> or <u>average</u> (body) mass</p> <p>Both units correct: m and g</p> <p>at least five values recorded</p>	<p><i>Do not award the justification mark if the control variable is not correct.</i></p> <p><i>Can be seen in headings or with data – allow one omission if with data.</i></p>	4	C
	d	<p>correct calculation of the difference in mass: 16.6 (g)</p> <p>correct final percentage: 11.874106 or 11.87411 or 12 etc (%)</p> <p>any final value to three significant figures</p>	<p><i>Award 3 if only 11.9 is seen. Award (2 max) if 10.6 is seen.</i></p> <p><i>If working is shown and these values are not seen, use the highest and lowest values given in part (c) to calculate the % increase, do not accept the % decrease using values from (c).</i></p>	3	C D D
	e	<p>justification refers to trends in the data</p> <p>answer is supported by numerical data</p>		2	C

f	<p>One strength, for example:</p> <ul style="list-style-type: none">• separate groups were identified• measurements were taken at several altitudes• trait was reliably measured. <p>One limitation, for example:</p> <ul style="list-style-type: none">• did not check if the groups were isolated• only looked at one mountain• did not check whether the food was the same• change in mass does not necessarily mean natural selection has taken place. <p>Two further points from either list (2 max)</p> <p>A concluding appraisal that the method was inappropriate</p>	5	C
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7	<ul style="list-style-type: none"> • states the problem to be studied • some variables are referred to, that are connected to the problem, but these may not be explicitly identified <hr/> <ul style="list-style-type: none"> • describes the problem to be studied but this is incomplete • formulates a hypothesis connected to the variables but not explicitly linked to the variables with no explanation • independent or dependent variable and one control variable are identified • incomplete description of how the variables will be manipulated <hr/> <ul style="list-style-type: none"> • describes the problem to be studied • formulates a testable hypothesis correctly linked to the variables (with no explanation) or formulates a (non-testable) hypothesis with correct scientific explanation • independent variable and dependent variable and one control variable are identified • detailed description of how the variables will be manipulated • some equipment is stated • method is likely to give sufficient data relevant to the problem • any relevant comment relating to monitoring the health of the participant or an ethical concern eg keeping the test within the normal limits of the human body, informed consent <hr/> <ul style="list-style-type: none"> • describes, with reasons, the problem to be studied • formulates a testable hypothesis correctly linked to the variables and with correct scientific explanation • independent, dependent and at least two control variables are identified • detailed description of how the variables will be manipulated • relevant equipment is stated • method is likely to give sufficient data relevant to the problem • any relevant comment relating to monitoring the health of the participant • an ethical concern eg keeping the test within the normal limits of the human body, informed consent 	1-2	3-6	7-13	14-21	21	B
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8	a	fungus		1	A
	b	introduction of <u>Japanese</u> / <u>foreign</u> / <u>non-native</u> / <u>exotic</u> trees that were carrying the blight disease/fungus/infection	<i>Not “tree” alone</i>	2	D
	c	Correct use of a term from the list: xylem, phloem, transpiration, translocation Two points from the list below (2 max): <ul style="list-style-type: none">• xylem or phloem or <u>transport</u> tissue is damaged• transport or transpiration or translocation will be affected• water / mineral nutrients are not transported (by damaged xylem)• sugars / assimilates are not transported (by damaged phloem).	<i>WTTE</i>	3	D A
	d	Similarity, for example: <ul style="list-style-type: none">• both can add new traits/characteristics/features to an organism• both can create a new combination of genes. Difference, for example: <ul style="list-style-type: none">• genetic engineering produces faster results• <u>genetic engineering</u> can add traits from one species to a new species.		2	D
	e	(extract the) resistance / target or desired gene / DNA / genetic information... ...(oxo gene) from <u>wheat</u> or ...oxo gene (from wheat) insert the gene into the American chestnut (using enzymes) resistance /target or desired gene /DNA/genetic information is transferred to the offspring	<i>WTTE</i>	4	D

	f	<ul style="list-style-type: none">• a statement of an advantage or a disadvantage• a statement of an environmental or an economic impact	1-2		
		<ul style="list-style-type: none">• a statement of an advantage and a disadvantage• a statement of an environmental and an economic impact• the environmental or economic impact is linked to the advantage or disadvantage• a suggestion of how the wider ecosystem could be affected	3-6		
		<ul style="list-style-type: none">• a description of an advantage and a disadvantage• a description of an environmental and an economic impact• the environmental or economic impact is correctly linked to the advantage or disadvantage• a correct statement of how the new genetic variant would impact the wider ecosystem linking different factors	7-10		
		<ul style="list-style-type: none">• a detailed discussion of an advantage and a disadvantage• the environmental and the economic impacts are correctly linked to the advantage• the environmental and the economic impacts is correctly linked to the disadvantage• a detailed discussion of how the new genetic variant would impact the wider ecosystem linking different factors• a concluding appraisal of all factors discussed	11-15		
				15	D

Markscheme

November 2016

Biology

On-screen examination

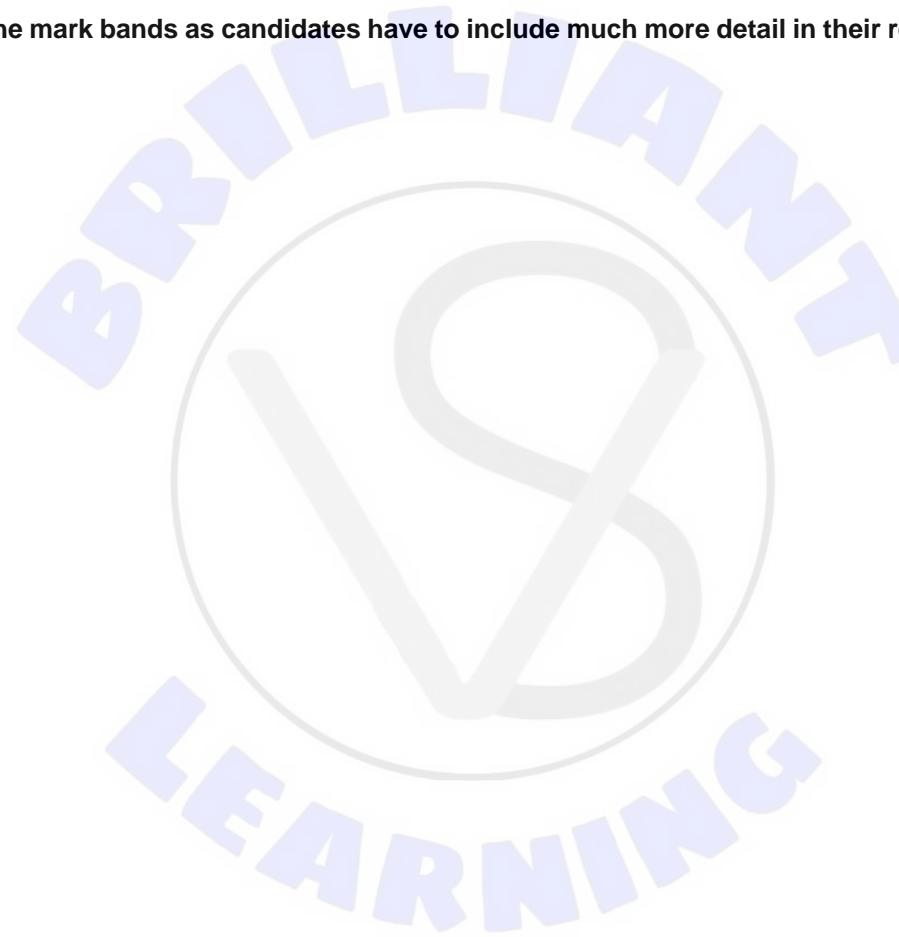
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It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word “**max**” in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by “**or**”. Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by “**and**” in the answer column.
- 12 Words in brackets () in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (*or reverse argument*) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate’s response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (*or words to that effect*) in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. Candidate’s work should be marked using a best fit approach. A candidate’s response should be reviewed to determine holistically the band in which the response falls. Once this has been determined, each bullet point within that band should be assessed to see if the candidate has met the requirements of the statement. Where those requirements are met, marks should be awarded, starting from the lowest available mark for that band.

Once this process has been completed if the highest (or lowest) mark available for that band has been determined, the examiner must check the band above (or below) to ensure that the initially correct determination of the band was correctly allocated. For example, there may be sufficient detail in the candidate's response to award the lowest mark of the band above.

NB. Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands.



Question	Answers		Notes	Total	Criterion
1	a	muscular – respiratory – cardiovascular - nervous all images correctly matched with labels		1	A
	b	tissue linked to appropriate system correctly linked function	<i>Award marks for answers seen in any of the three response boxes.</i> <i>Accept any tissue or organ linked to appropriate system.</i> <i>Must be correctly linked to the function of the tissue eg the heart pumps, do not accept the heart transports.</i>	2	A
	c	sensory / photo <u>receptors</u> neurons / nerve (cell) / impulse brain or spinal chord motor neurons / nerve (cell)	<i>Do not accept eyes.</i>	4	A
	d	option B (fight or flight) response protects the body from threat / injury / harm	WTTE	2	A

2	a	<p>One process for each location, (4 max)</p> <p>Any additional points, for example (4 max)</p> <table border="1"> <tbody> <tr> <td>Mouth</td><td> <ul style="list-style-type: none"> • mechanical breakdown/chewing • mix with amylase • chemical breakdown starts </td></tr> <tr> <td>Stomach</td><td> <ul style="list-style-type: none"> • mechanical breakdown • chemical breakdown • acid environment kills bacteria • other (named) enzyme • process linked to named enzyme </td></tr> <tr> <td>Small intestine</td><td> <ul style="list-style-type: none"> • chemical breakdown • neutralization of acid • other (named) enzymes • processes linked to named enzyme • <u>bile</u> salts/chemicals for emulsification of lipids • nutrients move/diffuse/active transport across villi into bloodstream/assimilation into the blood </td></tr> <tr> <td>Circulatory system</td><td> <ul style="list-style-type: none"> • transport to cells/around the body • diffusion of nutrients <u>across cell membrane</u>/cell absorbs nutrients by diffusion </td></tr> </tbody> </table>	Mouth	<ul style="list-style-type: none"> • mechanical breakdown/chewing • mix with amylase • chemical breakdown starts 	Stomach	<ul style="list-style-type: none"> • mechanical breakdown • chemical breakdown • acid environment kills bacteria • other (named) enzyme • process linked to named enzyme 	Small intestine	<ul style="list-style-type: none"> • chemical breakdown • neutralization of acid • other (named) enzymes • processes linked to named enzyme • <u>bile</u> salts/chemicals for emulsification of lipids • nutrients move/diffuse/active transport across villi into bloodstream/assimilation into the blood 	Circulatory system	<ul style="list-style-type: none"> • transport to cells/around the body • diffusion of nutrients <u>across cell membrane</u>/cell absorbs nutrients by diffusion 	<p>Additional points can be for any correct location.</p>	
Mouth	<ul style="list-style-type: none"> • mechanical breakdown/chewing • mix with amylase • chemical breakdown starts 											
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Circulatory system	<ul style="list-style-type: none"> • transport to cells/around the body • diffusion of nutrients <u>across cell membrane</u>/cell absorbs nutrients by diffusion 											
		8 A										
		1 A										
	c	<p>Any five points from the list below:</p> <ul style="list-style-type: none"> • converts glucose/monosaccharides to <u>energy</u> • converts glucose/monosaccharides for use in respiration • large quantity of carbohydrates metabolized into glucose/monosaccharides • blood glucose levels become high • insulin is released • (insulin is released from the) pancreas • glucose is converted to glycogen • glycogen is stored (in fatty tissues) • blood glucose level returns to normal 	WTTE	5 A								

3	a	<p>Any two reasons, (2 max)</p> <ul style="list-style-type: none"> • smoking may have damaged the alveoli • reduced surface area of alveoli • excess mucus is produced or tar present in alveoli • excess mucus or tar causes poor oxygen diffusion • oxygen cannot diffuse across alveoli as easily • less oxygen in the blood or CO/carbon monoxide accumulates in the blood • less respiration to release energy is possible 	WTTE	2	A
	b	any age in the range 55-60			
	c	<p>Yes there are benefits and correctly linked justification, for example (1 max)</p> <ul style="list-style-type: none"> • stopping at 45 delays onset of symptoms • stopping at 45 might avoid severe disability • stopping at 45 prolongs life expectancy • stopping at 65 prolongs life expectancy <p>or</p> <p>There are no benefits and correctly linked justification, (1 max)</p> <p>stopping at 65 gives longer life than not stopping at all although smoker is likely to be severely disabled</p>		1	C

4	a	(if) a model habitat has no trees (then) it will experience more evaporation / higher rate of evaporation / higher mass loss at higher temperatures (because) water is not preserved when no (model) trees are present	ORA	3	B
	b	temperature or presence of trees or absence of (model) trees mass <u>change / loss</u> or <u>water loss</u> Three control variables, for example <ul style="list-style-type: none">• quantity of soil• type of soil• <u>initial</u> quantity of water• time• surface area of container• humidity of air• wind / air movement.	Accept any reasonable and equally valid alternative.	5	B
	c	range reflects temperatures that are observed in actual habitats or this temperature range is necessary to make the model realistic	WTTE	1	B
	d	“trees” present in the petri dishes would have added to the overall masses of model habitats	WTTE <i>Do not accept random error.</i>	1	C
	e	title: the effect of (different) <u>temperature on water loss</u> or <u>mass change / loss from model habitats</u> y-axis: mass change / loss of model habitat y-axis: unit of g / grams included	Three components needed in the title. WTTE	3	C D
	f	increase in mass <u>change</u> / evaporation with temperature relationship approx. exponential / not linear or at higher temperatures the increase in mass <u>change</u> is greater	<i>Do not accept comments about rate unless rates are calculated.</i> <i>Accept non uniform.</i>	2	C

g	<p>smaller mass changes overall in absence of trees compared to model habitat with trees</p> <p>smaller increase in mass change in absence of trees as temperature increases compared to model habitat with trees</p>	WTTE	2	C
h	<p>results do not support prediction</p> <p>(because) absence of model trees causes lower water losses overall compared to presence of trees</p> <p>or</p> <p>(because) absence of model trees causes smaller increase in water loss as temperature increases compared to presence of trees</p>	<i>ECF from response in part (a)</i> <i>ORA</i>	2	C
i	1.3 / 1.4 g		1	C
j	<p>Any two valid causes, for example (2 max)</p> <ul style="list-style-type: none"> • temperature higher than 20°C • (more) air movement • containers were in the temperature controlled cabinet for more than 10 min • different, inaccurate balance used <p>Correctly linked explanation for each cause given above, for example (2 max)</p> <ul style="list-style-type: none"> • more evaporation • (different balance) causing readings to be inaccurate to roughly same extent 	Accept other plausible factors but reject factors that would not apply to both sets of data.	4	C

5	a	<table border="1"> <tr><td>35</td><td>30</td><td>25</td><td>20</td><td>15</td><td>10</td><td>5</td><td>0</td></tr> <tr><td>9.0</td><td>8.0</td><td>7.0</td><td>5.0</td><td>3.0</td><td>2.0</td><td>1.0</td><td>0.0</td></tr> <tr><td>8.0</td><td>7.0</td><td>6.0</td><td>4.0</td><td>2.0</td><td>1.0</td><td>0.0</td><td>0.0</td></tr> <tr><td>8.0</td><td>8.0</td><td>7.0</td><td>6.0</td><td>3.0</td><td>1.0</td><td>1.0</td><td>1.0</td></tr> </table> <p>measurements taken at minimum two temperatures measurements taken at minimum four temperatures measurements taken at minimum six temperatures fourth mark for evenly spaced temperatures</p>	35	30	25	20	15	10	5	0	9.0	8.0	7.0	5.0	3.0	2.0	1.0	0.0	8.0	7.0	6.0	4.0	2.0	1.0	0.0	0.0	8.0	8.0	7.0	6.0	3.0	1.0	1.0	1.0	<p>Only award the fourth mark if at least four temperature measurements are taken.</p> <p>Use candidate's values</p>	4	B
35	30	25	20	15	10	5	0																														
9.0	8.0	7.0	5.0	3.0	2.0	1.0	0.0																														
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35	30	25	20	15	10	5	0																														
8.3	7.7	6.7	5.0	2.7	1.3	0.7	0.3																														
c	<p>two points correctly plotted all data points from the data table in part (a) correctly plotted</p>	<p>Refer to candidate's values <i>More than two values must be plotted for the second mark.</i></p>	2	C																																	
d	<p>A similarity</p> <ul style="list-style-type: none"> the water loss increases as the temperature increases initially the increase is small (per 5°C temperature increase) at medium temperature the mass loss increases more than at low temperatures at low to medium temperature the increases are roughly exponential <p>A difference</p> <ul style="list-style-type: none"> at high temperatures the mass loss in real plants shows smaller increases while the model trees experience bigger increases the real plants appear to be approaching a plateau at high temperatures the mass losses in the potted plants are greater than in the model 		2	C																																	

	e	Any three points, for example (3 max) <ul style="list-style-type: none">• stomata (enable gas exchange and) permit water vapour to escape from leaves• stomata can open and close to regulate water loss (and gas exchange)• stomata open and close depending on temperature and humidity• stomata close when plants lose too much water to prevent drying out• the model trees have no stomata• model trees cannot regulate water loss so water loss will increase with temperature	WTTE		3	A
	f	transpiration / evaporation			1	A
	g	One strength of the model, for example (1 max) <ul style="list-style-type: none">• at low to medium temperatures the data collected using the model corresponds to the pattern seen in real plants One limitation of the model, for example (1 max) <ul style="list-style-type: none">• at higher temperatures there are big differences in the patterns• (so) the model no longer provides data consistent with actual vegetation• model trees cannot simulate opening and closing of stomata• model trees do not imitate conditions of light or shade• temperature controlled cabinet is poor approximation of real/varying temperature Concluding statement <ul style="list-style-type: none">• the model seems partly valid	Accept any other equally valid points.		3	C

6	<ul style="list-style-type: none"> • states the problem to be studied • some variables are referred to that are connected to the problem but these may not be explicitly identified 	1-2		
	<ul style="list-style-type: none"> • formulates a hypothesis connected to the variables but not explicitly linked to the variables with no explanation • independent or dependent variable and one control variable are identified • some equipment is selected • incomplete description of how the variables will be manipulated 	3-6		
	<ul style="list-style-type: none"> • formulates a testable hypothesis correctly linked to the variables (no explanation) or formulates a (non-testable) hypothesis with correct scientific explanation • independent variable and dependent variable and one control variable are identified • relevant equipment is selected • detailed description of how the variables will be manipulated • use of some equipment outlined • method is likely to give sufficient data relevant to the problem 	7-12		
	<ul style="list-style-type: none"> • formulate a testable hypothesis correctly linked to the variables and with correct scientific explanation • independent, dependent and at least two control variables are identified • complete set of relevant equipment is selected • detailed description of how the variables will be manipulated • use of relevant equipment is described • method is likely to give sufficient data relevant to the problem • safety precaution is outlined 	13-19		
			19	B

7	a	Any three reasonable causes, for example <ul style="list-style-type: none"> • use of herbicides • use of pesticides • monoculture agriculture • farmers stop planting cover crops such as clover and alfalfa • parasites 	WTTE	3	A
	b	Any three solutions (3 max) <ul style="list-style-type: none"> • move away from monoculture or diversify farms • plant bee friendly native flowers in home gardens, along roadsides, meadows • put back in cover crops to reduce use of fertilizer • put back in cover crops to provide food for the bees • ban use of pesticides/herbicides/fungicides (that harm bees) <i>or</i> • research new pesticides/herbicides/fungicides that do not harm bees <p>Correctly linked reasons (3 max)</p>	<i>Do not allow pesticide used to kill weeds ORA.</i> <i>Allow incorrect use of pesticide for this mark.</i>	6	D

8	a	decreased / (–) minus sign 68 %		2	C
	b	Any two reasonable points (2 max), for example <ul style="list-style-type: none"> • synthetic fertilizers are more efficient at fixing nitrogen than traditional methods • more effective fertilizers have been produced • increased use of pesticides means that there is less damage to crops • monoculture has led to more efficient farming practices • GM crops have improved nutrient uptake <p>A correctly linked explanation for each point (2 max)</p>		4	C

9	<ul style="list-style-type: none"> • ref to intensive farming • statement that local changes to farming can impact global environment • clear description to intensive farming with example stated • outline of an ecological impact eg bee's role in pollination or colony collapse disorder • statement that local changes to farming can impact global environment with stated example • an economic impact identified 	1-2	3-6	7-11	12-18	18	D
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MARKSCHEME

MAY 2016

MYP BIOLOGY

ON-SCREEN EXAMINATION

17 pages

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NB Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands. Examiners should consider every statement in the holistic grid and identify the most appropriate mark band corresponding to the Candidate's response. Once the mark band is identified, the final mark is determined using a best fit approach.

Question	Answers		Notes	Total	Criterion
1	a	osmosis – neither – diffusion - diffusion two correct responses all responses correct		2	A
	b	circulatory system / blood system / transport system/ cardio-vascular system	<i>do not accept cardiac system as it refers to the heart only</i>	1	A
	c	there is a higher oxygen concentration in the air (than in the blood) oxygen moves/diffuses/ passive transport/passive movement from the area of higher concentration to the area of lower concentration or oxygen moves/diffuses down the (oxygen) concentration gradient		2	A
	d	nervous/nerve/neurological system		1	A
	e	suitable stimulus linked to sense selected response linked to the stimulus Explanation includes any two additional and equally valid points [2 max], for example: <ul style="list-style-type: none"> • route of signal transmission eg receptor to CNS • processing in brain or central nervous system • hormonal response eg adrenalin • signal from CNS to the effector 	<i>allow touch to include pain, pressure, heat and corresponding stimulus</i> <i>accept brain in examples of reflexes which involve CNS, reflex alone is not enough to score this mark</i>	4	A

2	a	deoxyribonucleic acid / DNA		1	A
	b	identical DNA molecules / genes/ chromosomes/ (sister) chromatids are separated (and) are moved to opposite poles of the cell two separate genetically identical cells are formed	WTTE	3	A
	c	meiosis produces four cells and mitosis produces two cells meiosis produces haploid/1n cells and mitosis produces diploid/2n cells or in meiosis the chromosome number gets halved, and in mitosis the chromosome number remains the same meiosis produces genetically non-identical cells and mitosis produces genetically identical cells	answer must focus on the products of meiosis and mitosis rather than the processes	3	A
	d	either <ul style="list-style-type: none">• mutation (which results in...)• translocation or addition or deletion or loss of a part of a chromosome or <ul style="list-style-type: none">• non-disjunction (which is caused by...)• failure of homologous pairs to separate in anaphase or failure of sister chromatids to separate during anaphase	accept incorrect references to changes in replication for the first mark	2	A
	e	First mark: One correct use of the term “chromosome” second and third mark, either: genes are exchanged between (homologous) <u>chromosomes</u> (because of) crossing over or independent assortment or separation of (unlinked) genes (resulting from) independent separation of (homologous) <u>chromosomes</u>	WTTE technical terms are not essential if the meaning is clear for the second and third marking point. Ignore incorrect phase	3	D A

		<p>or</p> <p>non-disjunction occurs resulting in an extra chromosome or a reduced number of chromosomes</p>	<p><i>ignore incorrect phase</i></p>		
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3	a	<p>distinguishing feature identified</p> <p>Pair 1: different hair colour or piercings or Pair 2: skin appearance is different or different hair colour or Pair 3: muscles are different</p>	WTTE	1	A
	b	accept any reasonable factor accounting for the difference identified in part (a)	ecf from part a	1	A
	c	<p>the features seen in the twins are acquired features/ features acquired during their lifetime</p> <p>only genetic characteristics are inherited/passed on to the next generation</p> <p>or</p> <p>(the twins') children will receive half of their genes from the other parent so identical genotype could not be acquired</p> <p>the different genotypes leads to different phenotypes</p>	WTTE	2	A
	d	<p>identical twins are A and C</p> <p>tongue roll is identified as a genetic trait</p> <p>A and C have this trait (so must be twins)</p>	ORA	3	C
4	a	water + carbon dioxide → glucose + oxygen	accept reactants and products in any order	1	A
	b	<p>How does temperature affect the time taken for leaf discs to float</p> <p>or</p> <p>How does temperature affect the rate of photosynthesis?</p>		1	B
	c	<p>as temperature increases the leaf discs will rise more quickly</p> <p>(because) increasing temperature increases the rate of reaction</p> <p>(however) the rate of reaction will decrease after a maximum temperature</p> <p>(because) above a maximum temperature <u>enzyme(s)</u> is denatured/destroyed/does not function</p>	<p>WTTE, accept "the rate of leaf discs floating," "the rate of photosynthesis will increase"</p> <p>Word "enzyme" is required here.</p>	4	B

	d	<p>Independent variable: temperature</p> <p>How the independent variable is manipulated: Temperature: repeat the experiment at five different temperatures</p> <p>Dependent variable: time taken for discs to float</p> <p>How the dependent variable is manipulated: Time to float or rate of floating: measure time using stop watch</p> <p>Control variables [3 max]:</p> <ul style="list-style-type: none"> • type of plant • type of leaf • number of discs • light • volume of water • size of disc • concentration of CO₂ • type of water <p>How the control variables are manipulated: Accept any reasonable and correctly linked method for the control of <u>each</u> control variable given</p>	<p>ecf for manipulation marks for any reasonable variable</p> <p>accept "rate of leaf discs floating"</p> <p>accept time even if rate is given above</p>	10	B
	e	<p>Number of trials: three or more trials</p> <p>Explanation, for example:</p> <ul style="list-style-type: none"> • reduce error • consistency of results • allows statistical analysis 		2	B

5	a	<p>Number of rows and columns either at least five rows and two columns or at least two rows and five columns</p> <p>Label for rows or columns data or results or values</p> <p>Labels for columns or rows wavelength and bubbles</p> <p>Units (wavelength in) nm and (bubbles) per minute</p>	<p>maximum eight rows</p> <p>maximum eight columns</p> <p>do not accept ranges of values</p> <p>ignore an additional column labelled “colour”</p>	4	C												
	b	<table border="1"> <thead> <tr> <th>Distance from the light source / cm</th><th>Average number of bubbles / min</th></tr> </thead> <tbody> <tr> <td>10</td><td>107</td></tr> <tr> <td>20</td><td>108</td></tr> <tr> <td>30</td><td>63</td></tr> <tr> <td>40</td><td>27</td></tr> <tr> <td>50</td><td>9</td></tr> </tbody> </table> <p>one mean calculated correctly</p> <p>all means calculated correctly</p> <p>mean given as a whole number</p>	Distance from the light source / cm	Average number of bubbles / min	10	107	20	108	30	63	40	27	50	9		3	C
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40	27																
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	c	<p>Title including reference to independent and dependent variable</p> <p>At least four data points plotted correctly ($x \pm 0$, $y \pm 2$)</p> <p>Either x axis:distance and cm</p>	<p>ecf for incorrect averages from part b</p> <p>All plotted correctly also scores this mark only, three correctly plotted only does not score here.</p>	3	C												

		<p>or y axis: average number of bubbles per minute</p>	<p>Please check the response box for part 5a. Some candidates may have recorded their axis labels in 5a for technical reasons.</p>		
--	--	---	--	--	--

6	a	<p>average mass increased in both groups after three weeks <i>or</i> biomass after three weeks increased more for plants that had received more water <i>or</i> percentage increase is greater for plants that had received more water</p>	ORA	1	C
	b	<p>in <u>both</u> groups of samples/plants the average mass increased because plants continued to grow/photosynthesis (over the three week period) (which led to the) formation of more biomass/products of photosynthesis stored on leaves <i>or</i> with more water present photosynthesis could take place at higher rate a higher rate of photosynthesis produced more glucose/sugars more glucose/sugars produced creates a higher biomass</p>	ORA	3	C
	c	<p>the data supports the hypothesis <i>or</i> <u>the hypothesis refers to plants not samples</u> so the data is inconclusive</p>	<i>accept hypothesis is correct/valid only if linked to the data</i>	1	C
	d	<p>Strength of method, for example: any of the controls – same size leaves, temperature, soil, light ten plants used for each volume of water ten trials different conditions gave measurable difference in outcome</p> <p>Description of strength, for example: (so) data is reliable less variation in data average used to remove individual variation</p> <p>Weakness, for example: range of volumes of water/only two volumes two different leaves used was plant damaged during leaf sampling</p>		4	C

		were leaves taken from same location of plant Description of weakness, for example: insufficient range of water data to see true trend two data sets are not sufficient to plot a graph if the thickness/composition of the leaves were not similar the biomass would change		
--	--	---	--	--

	e	<p>Any two reasonable improvements (2 max), for example:</p> <ul style="list-style-type: none">• use a larger range of volumes• use similar sized leaf• use similar colour of leaf• use leaf from similar location <p>Any clearly linked explanation of the benefit of each improvement, for example:</p> <p>(larger range of volume) sufficient relevant data for a graph/more accurate data (similar leaves) better control less variation in data/more precise data</p>	4	C
	f	<p>Any reasonable modification to this investigation or change in the independent variable, for example:</p> <ul style="list-style-type: none">• change humidity of surroundings• change soil• change water eg type, pH etc	1	C

7		<ul style="list-style-type: none">• attempts to state a problem or hypothesis• identifies one variable• attempts a method for manipulation of variable or collection of data	1-3		
		<ul style="list-style-type: none">• states a partly valid or unfocused problem• formulates a testable hypothesis using unconnected scientific reasoning• identifies two variables• outlines a method for collecting some relevant data	4-7		
		<ul style="list-style-type: none">• states a valid or focused problem• formulates and explains a testable hypothesis using scientific reasoning correctly linked to the problem• identifies three relevant variables• describes a method for manipulating variables• describes a method for collecting sufficient and relevant data linked to hypothesis	8-11		
		<ul style="list-style-type: none">• states a valid and focused problem• formulates and explains a testable hypothesis using detailed scientific reasoning correctly linked to the problem• identifies four relevant variables• describes a method for controlling variables and gives a reason why control of variables is important• describes and fully explains a complete method for collecting sufficient and relevant data linked to hypothesis• gives a valid comment about safety eg in use of CO₂	12-16		
				16	B

8	a	the variety of life/species/plants/animals	<i>accept diversity in place of variety WTTE</i>	1	A
	b	accept any reasonable action including examples given <u>correctly linked description of how this causes loss of biodiversity</u>		2	D
	c	correct use of a scientific term eg food chain, food web, trophic level, habitat identifies example of a species lost or identifies example of a role lost identifies relationship between organism lost and organism(s) affected description of effect on affected organism(s)		4	D

9	a	food web	<i>Do not accept food chain. Accept trophic web</i>	1	A
	b	flowering plant is a producer or flowering plant provides food for other organisms slug is a decomposer or slug releases nutrients back into ecosystem from dead organisms	<i>WTTE</i>	2	A
	c	flowering plant(s) are a food source for the butterfly or rabbit or ram the slug is the only decomposer in the food web (so should be protected)	<i>WTTE answer needs to be clear that the slug is the only decomposer</i>	2	D

10	a	accept any reasonable ecological reason for the importance of seed banks		1	D
	b	seeds must be collected seeds must be made dormant seeds must be stored in condition to preserve them for a long period of time		3	D
	c	<ul style="list-style-type: none"> • an incomplete statement about the importance of seed banks • a statement about the responsibility for creating or maintaining seed banks 	1-2		
	c	<ul style="list-style-type: none"> • a complete statement about the importance of seed banks • a relevant comment about an individual species or an ecosystem • a statement about the responsibility for creating and maintaining seed banks • a statement about an economic or political consideration 	3-6		
		<ul style="list-style-type: none"> • a complete statement about the importance of seed banks with full justification • a relevant comment about an individual species and an ecosystem • an issue about the responsibility for creating seed banks is described • an issue about the responsibility for maintaining seed banks is described • an economic or political consideration is described in general terms 	7-11	17	D
		<ul style="list-style-type: none"> • a complete statement about the importance of seed banks with full justification • more than one relevant comment about an individual species • more than one relevant comment about an ecosystem • a discussion about the responsibility for creating seed banks with different points of view included • a discussion about the responsibility for maintaining seed banks with different points of view included • an economic or political consideration is fully discussed in the context of the question • a concluding appraisal 	12-17		

Markscheme

November 2019

Biology

On-screen examination

12 pages

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	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the "Total" column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word "**max**" in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by "**or**". Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by "**and**" in the answer column.
- 12 Words in brackets () in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (*or reverse argument*) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (*or words to that effect*) in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question	Answers	Notes	Total	Criterion
1	a Food web b Energy flow or nutrient flow (through the system) or What organisms eat other organisms or Predation c Producer: tree or grass or shrub Secondary consumers, two needed from this list only for the mark: <ul style="list-style-type: none">• shrike• baboon• caracal• lion• vulture• leopard	Accept tropic web Do not accept food chain	1	A
	d Shrub (population) increases (because there are) fewer impalas eating the shrub Any three correctly reasoned points relating to baboon population change, for example (3 max): <ul style="list-style-type: none">• baboon population decreases• because more are eaten by leopards• because the leopards no longer eat impala• baboon population might not be affected as there is more grass for consumers lower down the food chain		2	A
e	Break down dead organisms or Recycle nutrients		5	A
f	Any reasonable suggestion, for example (1 max): <ul style="list-style-type: none">• not all relationships shown• no abiotic factors shown• no development over time• no indication of biomass or numbers	Accept specific named examples that are not included	1	A

2	a	Cells are the smallest unit of life		1	A
	b	<p>Any two from the following list (2 max):</p> <ul style="list-style-type: none"> • cell wall • chloroplasts • (large central) vacuole <p>A correctly linked outline (2 max):</p> <ul style="list-style-type: none"> • cell wall provides structure or support or protection for plant • chloroplast is where photosynthesis occurs • (large central) vacuole stores water or provides support for plant 	<p>Do not accept chlorophyll as a structure</p> <p>Accept chlorophyll for the justification mark only if linked to photosynthesis</p>	4	A
	c	<p>A correct use of the term <i>photosynthesis</i></p> <p>Chlorophyll absorbs light</p> <p>Any two points from the list (2 max):</p> <ul style="list-style-type: none"> • energy from light is needed • light energy is transformed into chemical energy • to combine carbon dioxide and water • glucose and oxygen are formed 		4	A
	d	<p>Sugar moves or is transported</p> <p>(down a tube) from where it is produced to where it is used</p> <p>A correct use of the term translocation or phloem</p>	WTTE	3	A D

3	a	<p>IV: temperature DV: size of balloon or volume of balloon or volume of CO₂ produced</p> <p>Any two reasonable control variables, for example (2 max):</p> <ul style="list-style-type: none">• volume of solutions• concentration of sugar or type of sugar• duration of reaction• starting temperature of solution	<p><i>Indication of quantity must be present</i></p>	4	B
	b	<p>Any two of the following points (2 max):</p> <ul style="list-style-type: none">• no and range is insufficient• no and no repeats are shown• no and no numerical data is generated• no and no graph is possible• no and the increment is too large• yes and there is a range of temps used or the size of the balloons can be compared		2	B
	c	<p>Any two reasonable improvements, for example (2 max):</p> <ul style="list-style-type: none">• use a better measuring tool• more trials• larger temperature range• control the mass of yeast or sugar <p>Correctly linked justification, for example (2 max):</p> <ul style="list-style-type: none">• this will give more precise data / quantitative data• reduces experimental uncertainty• this will give reliable or repeatable data		4	C

4	a	<p>A research question linking different sugars with an implied DV for example (1 max):</p> <ul style="list-style-type: none"> • respiration • rate of respiration • effect on yeast <p>Implied DV is measurable, for example (1 max):</p> <ul style="list-style-type: none"> • volume • amount of CO₂ • size of balloon 		2	B																								
	b	<p>Glucose</p> <p>(glucose) fits in the (active site of the) enzyme or glucose is the correct shape or the other sugars don't fit</p> <p>(glucose) fits best or fits better than the other sugars</p> <p>A correct use of either the term "active site" or mention of lock-and-key model</p>		4	B D																								
	c	<table border="1"> <thead> <tr> <th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr> </thead> <tbody> <tr> <td>Variables</td><td>some variables are implied</td><td>different sugars identified as IV or DV and one CV identified</td><td>different sugars identified as IV and DV and one CV identified</td><td>different sugars identified as IV and DV and two CV identified</td></tr> <tr> <td>Data</td><td>reference to different sugars or trials</td><td>all five sugars or three trials</td><td>all five sugars and three trials</td><td>all five sugars and three trials and calculates mean</td></tr> <tr> <td>Equipment</td><td>equipment is suggested but is not relevant</td><td>equipment to measure DV or to control or monitor one CV</td><td>equipment to measure DV and to control or monitor one CV</td><td></td></tr> <tr> <td>Method</td><td>attempt at a method but it may be not relevant</td><td>attempt at method, but with insufficient detail and not likely to give relevant data</td><td>method is described, could be followed and will produce relevant data</td><td>complete method to measure a rate is fully explained and could be replicated</td></tr> </tbody> </table>		1	2	3	4	Variables	some variables are implied	different sugars identified as IV or DV and one CV identified	different sugars identified as IV and DV and one CV identified	different sugars identified as IV and DV and two CV identified	Data	reference to different sugars or trials	all five sugars or three trials	all five sugars and three trials	all five sugars and three trials and calculates mean	Equipment	equipment is suggested but is not relevant	equipment to measure DV or to control or monitor one CV	equipment to measure DV and to control or monitor one CV		Method	attempt at a method but it may be not relevant	attempt at method, but with insufficient detail and not likely to give relevant data	method is described, could be followed and will produce relevant data	complete method to measure a rate is fully explained and could be replicated	15	B
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5	a	Biofuels are renewable or fossil fuels are non-renewable	Accept less pollution only if it is clear that this is linked to production and not combustion	1	D
	b	Any two reasonable points, for example (2 max) <ul style="list-style-type: none"> • if crops were used there would be less food for eating • waste would otherwise be thrown away • less waste in landfills • agricultural land could be used for crop production rather than biofuel 		2	D
	c	<p>Water chestnut</p> <p> Response Short Textbox Day 3</p> <p> Text Object</p> <p>Pineapple</p> <p> Response Short Textbox Day 5</p>		1	C
	d	<p>Title: Mass of ethanol produced linked to time (with reference to two different types of food waste)</p> <p>Plotting: Three points correctly plotted ± 0.2</p> <p>All points plotted correctly</p> <p>Axis labels: x: day or time/day(s)</p> <p>y: mass of ethanol / mg</p>	<p>No unit needed if day is given on x axis. Time must have an associated unit of day(s)</p> <p>Unit is needed for this mark</p>	5	C

	e	<p>Trend 1: Alcohol production increases initially (until day 5)</p> <p>One pair of explanatory points The yeast population increases (so) there is more respiration or Respiration generates heat Which increases rate of respiration</p> <p>Trend 2: (after day 5 or then) alcohol production decreases or plateaus</p> <p>One pair of explanatory points Food supply has become limited (so) less respiration is taking place or Ethanol increases (to toxic levels) (so) the yeast cells die (and no longer respire) or respiration is inhibited or enzymes are denatured</p>	<p>Accept trends if seen in explanation box only, ignore incorrect use of “exponential”</p> <p>WTTE</p> <p>WTTE</p>	6	C
	f	Pineapple: 22.9 (mg)	Accept correct answer in table or response box	1	C
	g	Difference in mass: (-) 5.0 (mg)	Must be quoted to 2 sig figs	1	C

	h	<p>First mark: Water chestnut has the highest amount of carbohydrate and the lowest total of ethanol produced</p> <p>Second mark, either The sugars present in the carbohydrate may not always be fermented by the yeast or Nutritional data is about food, but food waste was used in the investigation</p>	WTTE	2	C				
	i	<table border="1"> <thead> <tr> <th>Variable that was not controlled</th><th>Effect on the results</th></tr> </thead> <tbody> <tr> <td>the temperature of the water bath was not controlled</td><td>a higher temperature might give a faster rate of reaction</td></tr> </tbody> </table> <p>Variables (2 max):</p> <ul style="list-style-type: none"> storage of waste has food been dried completely different mass/amount/volume of food or yeast different volume of solutions time in the water bath <p>Any reasonable linked effect, for example (2 max):</p> <ul style="list-style-type: none"> food might already have started fermenting water present makes the food heavier or sugar might have been lost through burning more fruit will give more ethanol larger volume will give more ethanol longer time would give more ethanol 	Variable that was not controlled	Effect on the results	the temperature of the water bath was not controlled	a higher temperature might give a faster rate of reaction	<p>1. Grow the yeast.</p> <p>2. Collect food waste from different houses in the neighbourhood.</p> <p>3. Dry the food waste in an oven and grind into a powder.</p> <p>4. Mix the yeast solution and food waste powder.</p> <p>5. Place in a beaker of warm water to allow fermentation to occur.</p> <p>6. Measure the amount of ethanol present.</p>	4	C
Variable that was not controlled	Effect on the results								
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6	a	The maintenance of a constant internal environment		1	A																								
	b	1. Human insulin gene extracted 2. Plasmid DNA opened 3. Genetically modified bacteria reproduce 4. Extraction and purification of human insulin		4	D																								
	c	Any two marks from the following (2 max): <ul style="list-style-type: none"> • eating increases blood sugar • insulin reduces blood sugar • people with diabetes do not produce or respond to insulin • fast-acting insulin means people with diabetes do not need to plan ahead 		2	D																								
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	e	Any reasonable response, for example (2 max): <ul style="list-style-type: none"> • some religious groups may have concerns • vegetarians or other groups may prefer to avoid using animals for human benefit • could be concerns that diseases could be transmitted • DNA crossing the species barrier 		2	D																								

Markscheme

May 2019

Biology

On-screen examination

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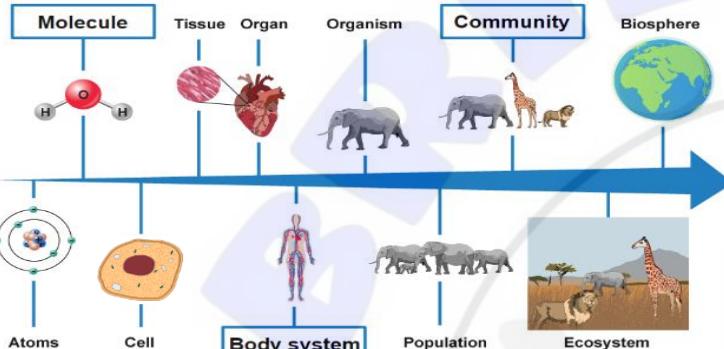
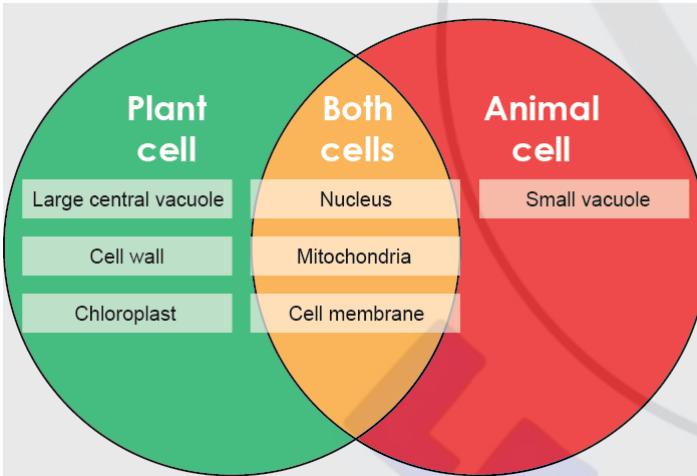
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Question	Answers	Notes	Total	Criterion
1 a	 <p>All correct</p>		1	A
b	 <p>One correct term in each zone All correct</p>	<p>Award marks separately</p>	2	A

	c	(Function of mitochondria is to) convert or produce energy or produce ATP (From a) source of energy Correct use of one of the following terms: (1 max) <ul style="list-style-type: none">• respiration• ATP• glucose	WTTE Accept powerhouse Do not accept storage of energy For example, accept glucose, protein, sugar, food Do not accept a general reference to a substance or “calories”	3	A
	d	(Folds give) increase in (surface) area More sites for reactions (energy production) to take place	WTTE Do not accept exchange of materials	2	A
2	a	Growth and repair and asexual reproduction	Do not award a mark if more than these three are selected	1	A
	b	Each pair of statements is listed in the order meiosis and mitosis Any two points from the following list only (2 max) <ul style="list-style-type: none">• haploid and diploid or 23 and 46 chromosomes• 4 cells and 2 cells• (genetically) non-identical and (genetically) identical• gametes (sex cells) and somatic cells	WTTE Accept half the number of chromosomes compared to the parent Both statements must be explicitly stated	2	A
	c	Statement of two sources (2 max): <ul style="list-style-type: none">• sexual reproduction / two parents• mutation• crossing over• random assortment• arrival of new individuals Correctly linked statement of how the variation occurs in that source, for example (2 max): <ul style="list-style-type: none">• new combination of genes from two individuals• change in DNA sequence resulting from external event• exchange of small segments DNA within a chromosome• new combination of chromosomes• new traits brought from a different gene pool	Award mark for statement of source even if link to variation is not correct	4	A

3	a	<p>Disappearance of a species and disappearance of many species</p> <p>A correct use of the word “<u>species</u>”</p>	<p>WTTE Accept population for the first marking point only</p> <p>Only award the second mark if the first is awarded.</p>	2	A
	b	<p>One example of a change, for example (1 max):</p> <ul style="list-style-type: none"> • increased predation • habitat reduction • decreased food supply • increased competition • disease • natural disaster • a specific example of human interference <p>Correct justification, for example:</p> <ul style="list-style-type: none"> • eaten before they reproduce • insufficient resources for shelter or camouflage • unlikely to be healthy enough to reproduce • decreased availability of resources • large scale death • any direct link to human interference 	<p>Do not award two marks for two examples</p> <p>Two marks can be awarded for two correct justifications</p>	2	A
	c	<p>Any two points, for example (2 max):</p> <ul style="list-style-type: none"> • fur (for warmth) • insulating layer (for warmth) • warm-blooded (control their temperature) • carry their young or high level of parental care or give birth to live young • mothers feed their young 	WTTE	2	A
	d	<p>Any four of the following points (4 max):</p> <ul style="list-style-type: none"> • rabbits are more likely to survive when fur colour matches location (as they are not found easily by predators) • longer survival means greater chance of reproduction • concentration of fur types by location means breeding more likely between similar types • offspring are more likely to have advantageous fur colour • offspring born with disadvantageous fur type less likely to survive 	WTTE	4	A

4	a	Biotic: fungi and microbes and Abiotic: water	Accept soil in either list	1	A
	b	Water Glucose		2	A
	c	Presence of fertilizer	WTTE	1	B
	d	Height or colour of leaves or leaf appearance	WTTE <i>Do not accept growth</i>	1	B
	e	Quantitative data: numerical or states example Qualitative data: non-numerical or descriptive or states example		2	B
	f	329.66666667 330	Accept 329.6(66...) or 329.7 or print of calculator display <i>Award (2 marks) if only this number is seen</i>	2	C
	g	Strength: three trials or both quantitative and qualitative data recorded Limitation: limited range or two values of IV only or specific reference to lack of control variables	Accept two types of data <i>Do not accept general refs to CV</i> <i>Do not accept only three trials as a limitation</i>	2	C

5		1	2	3	4	14	B
		5 1.V (Identification of variables)	Some variables are referred to that are connected to the problem but these may not be explicitly identified	Independent or one control variable is identified	Independent variable and one control variable are identified		
		5 2.H (Hypothesis)	Formulates a hypothesis connected to the variables but not explicitly linked to growth, number of plants or rate of growth	Formulate a testable hypothesis correctly linked to the growth, number of plants or rate of growth (no explanation)	Formulate a testable hypothesis correctly linked to the growth, number of plants or rate of growth with correct scientific explanation		
		5 3.M (Manipulation of variables/ description of method)	Attempt at a method but detail is insufficient for manipulation of variables	Partial method is described with detail sufficient for IV and DV only	Partial method is described with detail sufficient for IV and DV and one CV	Method is described with detail sufficient for IV and DV and two CV	
		5 4.D (Collection of data)	Plans to repeat at least three groups of duckweed or measures for at least five different light conditions	Plans to repeat at least three groups of duckweed and measures for at least five different light conditions			
		5 5.S (Safety)	Any relevant comment relating to safety				

6	a	<ol style="list-style-type: none"> 1. Collect duckweed plants from pond 2. Select equally healthy duckweed plants 3. Label beakers 4. Measure water from pond into each 500 cm³ beaker 5. Count initial duckweed plants and place 10 duckweed plants into each of 24 beakers 6. Set the temperature of each water bath 7. Add thermometer to water bath 8. Place lamp facing water bath 9. Place three beakers with samples into each water bath 10. Wait two weeks 11. Count final number of duckweed plants and record values <p>First mark for one label in correct location Second mark for all labels in correct location</p>		2	B
b	<p><i>Either add detail to an existing step or specify a control, for example (1 max):</i></p> <ul style="list-style-type: none"> • measure volume of water • place the lamp at a fixed distance • set the temperature at evenly spaced increments <p><i>or</i></p> <p><i>add an extra step, for example (1 max):</i></p> <ul style="list-style-type: none"> • stir the pond water before adding the duckweed • allow for time for the temperature in the beaker to reach the temperature in the water bath <p><i>Correctly linked justification to improvement, for example (1 max):</i></p> <ul style="list-style-type: none"> • ensures constant value of a control variable • the light level is constant • ensures nutrients are equally distributed • duckweed experience constant temperature 		<p><i>Do not accept more trials or shorter temperature increments</i></p>	2	C

c	<table border="1" data-bbox="294 223 1118 552"> <thead> <tr> <th data-bbox="294 223 698 255">Temperature / °C</th><th data-bbox="698 223 1118 255">Mean number of plants</th></tr> </thead> <tbody> <tr><td data-bbox="294 255 698 287">7.5</td><td data-bbox="698 255 1118 287">20</td></tr> <tr><td data-bbox="294 287 698 319">10.0</td><td data-bbox="698 287 1118 319">28</td></tr> <tr><td data-bbox="294 319 698 350">12.5</td><td data-bbox="698 319 1118 350">40</td></tr> <tr><td data-bbox="294 350 698 382">15.0</td><td data-bbox="698 350 1118 382">50</td></tr> <tr><td data-bbox="294 382 698 414">20.0</td><td data-bbox="698 382 1118 414">70</td></tr> <tr><td data-bbox="294 414 698 446">27.5</td><td data-bbox="698 414 1118 446">80</td></tr> <tr><td data-bbox="294 446 698 477">30.0</td><td data-bbox="698 446 1118 477">70</td></tr> <tr><td data-bbox="294 477 698 552">37.5</td><td data-bbox="698 477 1118 552">18</td></tr> </tbody> </table> <p data-bbox="287 600 601 632">temperature on the x axis</p> <p data-bbox="287 663 691 695">mean number of plants on y axis</p> <p data-bbox="287 727 541 759">°C included on x axis</p> <p data-bbox="287 790 765 822">evenly numbered intervals on both axes</p> <p data-bbox="287 854 720 886">two points plotted correctly (± 1 unit)</p> <p data-bbox="287 917 714 949">all points plotted correctly (± 1 unit)</p>	Temperature / °C	Mean number of plants	7.5	20	10.0	28	12.5	40	15.0	50	20.0	70	27.5	80	30.0	70	37.5	18	<p data-bbox="1365 711 1843 774">Accept (degrees) Celsius, C°, (degrees) centigrade</p>	6	C
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d	<p data-bbox="287 949 698 981">Trend, any three points (3 max):</p> <ul data-bbox="287 981 1304 1160" style="list-style-type: none"> <li data-bbox="287 981 1304 1013">• below 27.5 (°C) the rate of photosynthesis or growth increases with temperature <li data-bbox="287 1013 1304 1044">• max rate is at a temp of 27.5 (°C) <li data-bbox="287 1044 1304 1076">• after 27.5 (°C) the rate decreases <li data-bbox="287 1076 1304 1160">• general description of the trend without values for example the graph is asymmetrical or increases gradually before max and decreases rapidly after the max <p data-bbox="287 1192 1080 1224">Explanation, any two reasonable points, for example (2 max):</p> <ul data-bbox="287 1224 1349 1379" style="list-style-type: none"> <li data-bbox="287 1224 1260 1292">• photosynthesis or growth or mitosis increases with temperature controlled by enzymes <li data-bbox="287 1292 1260 1324">• chemical reactions increase with temperature <li data-bbox="287 1324 1260 1356">• enzymes denature at temp higher than 27.5 (°C) <li data-bbox="287 1356 1260 1379">• at higher temp, water is lost through evaporation and this affects availability of water 	<p data-bbox="1365 970 1709 1033">ECF from the graph in part c WTTE</p>	5	C																		

	e	<p>Below 27.5 (°C) the increase was proportional or at the lower temperatures the increase was proportional</p> <p>Above 27.5 (°C) there was a decrease or the increase was not proportional over the full temperature range</p> <p>The prediction is not supported by the data or partially supported by the data</p>	<p><i>Values are not needed if trends are described correctly</i></p> <p><i>WTTE, do not award the third mark unless at least one of the other marks is awarded.</i></p>	3	C
7	a	<p>If we add water hyacinth to waste water</p> <p>Then there will be a decrease in a (named) contaminant</p> <p>Because (scientifically correct use of information from the table) eg water hyacinth has been shown to uptake or store or remove or absorb nitrogen or lead</p>		3	B
	b	<p>Accept any two reasonable suggestions, for example (2 max):</p> <ul style="list-style-type: none"> • temperature • size of test pond/container • contaminants • light 	<p><i>Do not accept anything related to plants as it is the IV</i></p>	2	B
	c	<p>Poor control of variables, invalid results</p> <p>Different amounts of nitrogen could lead to different growth rates of the water hyacinth or</p> <p>The starting point of nitrogen concentration is not the same so the final difference may not be due to the water hyacinth</p>		2	C
	d	<p>Use a known amount of nitrogen each trial or</p> <p>Measure the amount of nitrogen at the beginning (so percent change could be calculated)</p>		1	C

8	a	<p>Accept any reasonable suggestion, for example (1 max):</p> <ul style="list-style-type: none">• over fishing• habitat loss• pollution• increased fish consumption (from human population increase)		1	D
	b	<p>Accept any two reasonable suggestions, for example (2 max):</p> <ul style="list-style-type: none">• sonar has helped fishermen locate fish• (sonar can therefore) allow fishermen to catch more fish• larger boats have allowed fishermen to catch more fish at one time• GPS has allowed boats to be more accurate at locating fishing areas and tracking fish• Technical use of larger nets such as trawling or dredging or new materials	<p>Accept radar</p> <p><i>Do not accept bigger nets alone</i></p>	2	D

c	<p>The tuna food web</p> <p>Not to scale</p> <p>Identifies the change in an organism if the number of tuna changes, for example (2 max):</p> <ul style="list-style-type: none"> • shark population reduced • mahi mahi population increases • mahi mahi population decreases <p>Correctly linked justification for change, for example (2 max):</p> <ul style="list-style-type: none"> • because less food for sharks • because there are fewer tuna to eat the mahi mahi • sharks have to eat mahi mahi rather than tuna <p>A correct use of ecologic terminology, for example (1 max):</p> <ul style="list-style-type: none"> • predator • prey • trophic level • consumer • producer • herbivore • carnivore • omnivore • species • population 	<p>Refer to food web for other examples of possible changes</p> <p>Change must be clearly stated not just implied</p> <p>Do not accept food web, organism, or ecosystem</p>	5 D
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9	a	<p>An advantage, for example (1 max):</p> <ul style="list-style-type: none"> • fish grow faster so reach market sooner • provides more kg of fish • less feed required to feed fish <p>A disadvantage, for example (1 max):</p> <ul style="list-style-type: none"> • potentially more expensive • people may not want to buy GM fish • do not know the impact of GM organisms on ecosystem <p><i>Do not accept GMOs are not good for human health</i></p>					2	D																			
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4. A (Concluding appraisal)	Attempts a concluding appraisal	Gives a concluding appraisal with opinion in general terms	Gives a concluding appraisal with opinion that includes specific detail																								

Markscheme

November 2020

Biology

On-screen examination

11 pages

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The following are the annotations available to use when marking responses.

Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Horizontal wavy line that can be expanded
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
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Question		Answers	Notes	Total	Criterion
1	a	<p>grass – cricket – frog – snake two consecutive organisms correct all correct</p>		2	A
	b	<p>Competition Predation Parasitism</p>		3	A
	c	<p>the living things and the non-living things/physical environment or biotic and abiotic factors a reference to the interaction of living and non-living things</p>		2	A
	d	<p>Any three of the following points (3 max):</p> <ul style="list-style-type: none"> • individuals in a population show variation or a cause of variation is identified • reference to survival of the fittest (competition, camouflage) • these organisms (with beneficial traits/characteristic survive to) reproduce or pass on allele to offspring • (so the frequency of) the particular trait/characteristic increases in the population <p>Fourth mark: A correct use of one of following terms: variation, population, gene, allele, trait</p>		4	A

2	a	maintaining (a constant) internal environment of the body		1	A
	b	(cell) membrane		1	A
	c	<p>Diffusion: Movement of solute / salts / particles / toxins from area of high concentration to low concentration</p> <p>Osmosis: movement of water from area of low salt concentration to high salt concentration or (osmosis takes place) through or across a semi-permeable or partially permeable membrane</p> <p>Final marking point: until (concentration) is in equilibrium</p>	<p>WTTE</p> <p>Accept high water potential to low water potential Do not accept water concentration</p>	5	A
	d	<p>to maintain a concentration gradient between blood and fluid toxin / salt removal from blood will stop or the toxins will build up</p>	WTTE	2	A
	e	<p>the rate of salt removal is faster or more efficient (than for one large tube) (because there is a) greater surface area (for diffusion or osmosis)</p>	WTTE	2	A

3	a	<p>Any two characteristics (2 max):</p> <ul style="list-style-type: none"> • movement • respiration • sensitivity (homeostasis) or response • growth • reproduction • excretion • nutrition 		2	A
	b	(in <i>Daphnia</i>) no cell wall or no chloroplasts or no (large) vacuole	ORA	1	A
	c	<p>if level of sugar increases, then heart rate will increase</p> <p>(because) sugar can be broken down rapidly or (the sugar) provides a quick increase of energy or (because of) the hormones released due to high sugar levels</p>	ORA	2	B
	d	<p>IV: amount of sugar</p> <p>DV: heart rate</p> <p>Accept any two reasonable control variables, for example (2 max):</p> <ul style="list-style-type: none"> • temperature • light • volume of water • species of <i>Daphnia</i> 	<p><i>Do not award marks for duplicated variables, add CON annotation to response</i></p> <p><i>Accept amount of water</i></p>	4	B
	e	at least five different levels of sugar should be provided to <i>Daphnia</i> so that a trend can be seen in the data		2	B
	f	minimum of three trials reduce random error or calculate average or identify an anomaly	<i>Award this mark independently</i>	2	B

4	a	evidence of one calculation one correct calculation all three correct calculations (141, 249 and 288)	<i>Please check response box and table for correct answers</i>	3	C
	b	Accept any two weaknesses, (2 max): <ul style="list-style-type: none">• only one trial• only three increments of temperature• different <i>Daphnia</i> was used for each temperature• increments were not evenly spaced• no controls listed Correctly linked justification (2 max)		4	C
	c	Accept any reasonable independent variable, for example (1 max): <ul style="list-style-type: none">• light• Type of sugar• type of water• species of <i>Daphnia</i>• if they have eggs in the egg chamber		1	C
	d	At higher temperatures, reactions occur faster or There is less dissolved oxygen in warmer water or The <i>Daphnia</i> are more stressed at higher temps (so heart rate is higher) (so) cells require more oxygen for respiration or Heart rate increases to increase the supply of oxygen or More CO ₂ needs to be excreted		2	C
	e	(the data supported the hypothesis but) the data was not sufficient / relevant because not enough trials or not enough increments or the same <i>Daphnia</i> was not tested Or there was not sufficient/ relevant data to test the hypothesis because not enough trials or not enough increments or the same <i>Daphnia</i> was not tested		2	C

	f	x axis: temperature and °C y axis: heart rate and bpm		2	C
	g	average at 10 °C: 88±1 average at 20 °C: 95±1		2	C

5		1	2	3	4	17	B
		1. V (Variables)	Some variables implied	IV or DV and one CV identified explicitly	IV and DV and one CV identified explicitly		
		2. H (Hypothesis)	Simple RQ	A prediction linking IV to DV			
		3. D (Manipulation of IV / sufficient data)	Reference to different increments or trials	At least five increments or three trials	At least five increments and three trials		
		4. M (Method)	Attempt at method but may not be relevant	Attempt at method, insufficient detail and not likely to give relevant data	Method described, could be followed, will produce relevant data		
		5. E (Ethics)	A comment about ethical conditions being needed in experiments using humans	A comment about ethical conditions being needed in experiments using humans and conditions linked to caffeine or its effects	A comment about ethical conditions being needed in experiments using humans and conditions linked to caffeine or its effects and linked to a specific health concern eg heart problems		

6	a	95 - 97 LOBF – points should be approximately equally distributed above and below the line		2	C
	b	increase in heart rate calculated correct ratio dividing by predicted heart rate percentage expressed correctly to 3 sig figs (17.9%)	<i>ECF from part a</i> <i>ECF from part a, seen or implied</i>	3	C
	c	sugar was present in the drink (not just caffeine) (so) the sugar could have affected the heart rate also, not just caffeine	<i>WTTE</i>	2	C

7	a	respiration photosynthesis		2	A
	b	<p>Any two human actions, for example (2 max):</p> <ul style="list-style-type: none"> • mass transportation • intensive agriculture • using fossil fuels as a source of energy <p>Correctly linked consequence for the carbon cycle, for example (2 max):</p> <ul style="list-style-type: none"> • combustion of fossil fuels (from mass transport) • (combustion of fossil fuels) releasing CO₂ into the atmosphere • release of CH₄ (from intensive agriculture) • CH₄ causes global warming 	<i>Award marks either for two consequences or for one consequence and its effect.</i> <i>Award marks if consequence is seen in either box.</i>	4	D
	c	<p>Any two reasonable biological consequences of increased temperature on the environment, for example (2 max):</p> <ul style="list-style-type: none"> • increased rate of photosynthesis • (increased rate of photosynthesis) removes carbon dioxide • stress on animals • (stress on animals) leads to poor health or lower rates of reproduction • animals migrating to cooler areas • leading to change in predator-prey relationships or changing food web in another ecosystem • invasive species could move into area • leading to change in predator-prey relationships • organisms unable to extend range • leading to extinction 	<i>Award marks either for two consequences or for one consequence and its effect.</i>	2	D

8		1	2	3	4		
1. Ac (Action to reverse climate change?)	An incomplete statement of how humans can reduce climate change	A correct statement of how humans can reduce climate change	A description how humans can reduce climate change	More than one description of ways humans can reduce climate change			
2. S (Scientific effect of the human action)	An attempt at a scientific justification of one of the climate change solutions	A correct scientific justification of one climate change solutions and a second is named <i>Or</i> An attempt at a scientific justification of two solutions	A correct scientific justification of both climate change solutions				
3. Ad (Advantages)	An incomplete statement of an advantage	A complete statement of an advantage <i>Or</i> Incomplete statements of two disadvantages	A complete statement of one advantage and an incomplete statement of a second advantage	A complete statement of more than one advantage			
4. Dis (Disadvantages)	An incomplete statement of a disadvantage	A complete statement of a disadvantage <i>Or</i> an incomplete statement of two disadvantages	A complete statement of one disadvantage and an incomplete statement of a second disadvantage	A complete statement of more than one disadvantage			
5. Ap (Appraisal)	A concluding statement	A concluding choice with justification					

Markscheme

May 2024

Biology

On-screen examination

18 pages

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The following are the annotations available to use when marking responses.

Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Underline tool that can be expanded
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses. Do not deduct marks for spelling errors.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word “**max**” in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by “**or**”. Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by “**and**” in the answer column.
- 12 Words in brackets () in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (*or reverse argument*) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate’s response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (*or words to that effect*) in the Notes column.
- 16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate’s work should be reviewed holistically to determine the mark awarded for each aspect.

Question	Answers	Notes	Total	
1 a	<p>Production of offspring <input type="checkbox"/> Reproduction</p> <p>Permanent increase in size <input type="checkbox"/> Growth</p> <p>Reaction to an internal or external stimulus <input type="checkbox"/> Response</p> <p>One correct</p> <p>All correct</p>		2	A
b	<p>One reasonable feature, for example [max 1]</p> <ul style="list-style-type: none"> • large size or surface area • can flap ears • thin • increased blood flow or can vasodilate <p>Link to heat loss, for example [max 1]</p> <ul style="list-style-type: none"> • large area for heat loss or evaporative cooling • can fan itself or create a breeze • smaller distance for heat exchange • increased heat exchange as blood carries heat away from body to ears 	<i>Do not accept to balance body temperature</i>	2	A
c	<p>(larger surface area) means more light can be absorbed or more chlorophyll present or More stomata may be present</p> <p>Any correct justification from the list, [max 1]</p> <ul style="list-style-type: none"> • (more) photosynthesis or glucose produced • (more) transpiration • (more) gas exchange 	<i>Allow absorbance of CO₂, ignore reference to O₂</i>	2	A

	<p>d</p> <p>(smaller surface area) minimizes water loss or (cacti) can survive in areas with limited water (due to) less evaporation or transpiration</p>	<p><i>Do not accept protection against being eaten</i></p>	2	A
	<p>e</p> <p>(large) surface area allows for more efficient exchange of (named) materials or heat (small) volume means fewer metabolic processes or less material required or shorter distance for materials to travel (high) SA to V ratio allows exchange rates to meet metabolic needs</p>	<p><i>Do not award mp1 when the ratio is used.</i></p>	3	A

2	a	<p>The diagram consists of three separate food chains, each starting with phytoplankton. The first chain shows phytoplankton → copepods → Pacific herring → Pacific halibut → Resident killer whale. The second chain shows phytoplankton → krill → armhook squid → Pacific halibut → Resident killer whale. The third chain shows phytoplankton → krill → Pacific herring → Pacific halibut → Resident killer whale. Each chain is preceded by the word "or".</p> <p>All correct</p>		1	A
	b	<p>Killer whales feed on organisms from different trophic levels Armhook squid or pacific herring are secondary consumers and chinook salmon or pacific halibut are tertiary consumers or Killer whales are tertiary consumers when they eat armhook squid or pacific herring and killer whales are quaternary consumers when they eat chinook salmon or pacific halibut</p>	<p><i>Mp1 can be shown through complete food chains. Allow ref to food chain in 2a.</i></p> <p><i>Mp2 gets mp1.</i></p>	2	A
	c	<p>To reduce competition or They eat what is (abundant) in their areas</p>	WTTE	1	A
	d	<p>Relevant differences between the whales, for example, [max 2]</p> <ul style="list-style-type: none"> • fins size or shape • size • patches or markings • prey • communication <p>Could stop them interbreeding</p> <p>However further data is needed to confirm this hypothesis</p>	Accept physical differences, behavioural differences, different hunting preferences, different geographical locations	4	A

	e	(Genome mapping) compares the genetic code (of different organisms) Genetic similarities or differences can be used to decide if they are different species or not A correct use of the term base or chromosome or DNA or gene or genetic	WTTE <i>Mp2 implies mp 1</i> <i>Only award mp3 if one of the previous mp is given.</i>	3	A D
	f	(Yes) references to more than one difference between the whales or (No) not enough information or variation within a species is natural or they are still too similar	<i>Accept reference to sub-species or ecotype, not type.</i>	1	A

3	a	Tape measure		1	B
	b	54 years	<i>Check table and response box for value</i>	1	C
	c	Accept any reasonable suggestion, for example [max 1] <ul style="list-style-type: none"> values in different units will lead to incorrect estimates depends on the units in the growth factor 		1	B
	d	Please award zero for this question		0	
	e	Accept any reasonable justification, for example [max 1] <ul style="list-style-type: none"> wood at the top of the tree is younger the age may be underestimated distance between rings is bigger (so easier to count) 	<i>ORA</i>	1	C
	f	Tropical one has a wider diameter or circumference or larger cross-section Faster growth due to more optimal conditions or there are fewer limiting factors Tropical one has no or less obvious growth rings Less (no) significant seasonal variation or trees grow continuously	<i>Accept named example, ORA</i> <i>Do not accept references to size of bark</i>	4	C
	g	Accept any reasonable limitation for growth factor values, for example [max 1] <ul style="list-style-type: none"> using growth factors only gives an estimate growth factor values are (global) averages growth can be affected by variables not considered in the growth factor Accept any reasonable limitation for counting growth rings, for example [max 1] <ul style="list-style-type: none"> counting rings can only be done on dead trees cannot be used for trees without growth rings (like tropical trees) 	<i>Accept named factor like location, climate, disease or damage</i> <i>Do not accept references to human error</i>	2	C

4	a	Too long to do the whole forest (Random sample) is representative (of the forest) or avoids bias	<i>WTTE</i>	2	B												
	b	Accept any reasonable suggestion, for example [max 1] <ul style="list-style-type: none"> • use a random number generator to select coordinates on the map • drop a pin (on a map) 		1	B												
	c	Student B and this prediction links DV to IV or Student B and is the only one with the correct DV (measuring height)	<i>ORA</i>	1	B												
	d	Given age in months or Use more significant figures or do not round (values) or Take the average height of trees for each age		1	C												
	e	2 points correctly plotted All 5 points correctly plotted x axis label Age and y axis label Height Units for age and height given as y(ears) and m(etres) Title refers to age and height Title includes reference to sycamore tree	<table border="1"> <thead> <tr> <th><i>Age / y</i></th> <th><i>Height / m</i></th> </tr> </thead> <tbody> <tr> <td>80</td> <td>22</td> </tr> <tr> <td>40</td> <td>17</td> </tr> <tr> <td>20</td> <td>12</td> </tr> <tr> <td>10</td> <td>7</td> </tr> <tr> <td>5</td> <td>3</td> </tr> </tbody> </table>	<i>Age / y</i>	<i>Height / m</i>	80	22	40	17	20	12	10	7	5	3	6	C
<i>Age / y</i>	<i>Height / m</i>																
80	22																
40	17																
20	12																
10	7																
5	3																
	f	(Growth rate is) initially rapid or tree grows fast at the start (Growth rate) slows with age or plateaus (but does not stop)	<i>Do not accept references to linear or proportional relationships Mp2 gains mp1</i>	2	C												

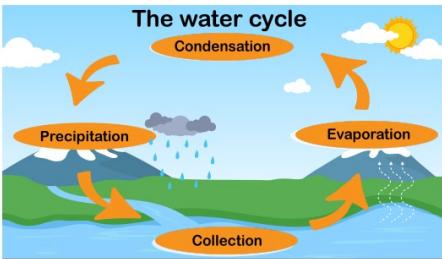
5	a	<p>IV: Height from which the seed is dropped DV: Time spent in the air</p> <p>Accept any two control variables, for example [max 2]</p> <ul style="list-style-type: none"> • mass of seed or one paperclip used • length of wings • angle of wing • no wind in the testing space 	<p><i>All variables must be qualified</i></p> <p><i>Accept same seed for one CV. 2nd CV must then not refer to properties of the seed</i></p>	4	B
	b	<p>Only tested three heights Only two repeats per height</p>	<p><i>Accept reference to number not being enough</i></p>	2	C
	c	<p>Accept any relevant improvement, for example [max 2]</p> <ul style="list-style-type: none"> • increase the height • reduce the mass or size of the seeds • change the shape of the paper model • carry out the experiment outside <p>Accept any correctly linked justification, for example [max 2]</p> <ul style="list-style-type: none"> • trees are taller than 2 metres • seeds are much lighter or smaller than the paper models • (change the size) to better match the size of real seeds • (outside would give) a more realistic environment 		4	C

6		16	B
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	1 mark	2 marks	3 marks	4 marks	Notes
1.V	Explicitly states appropriate: IV or DV	Explicitly states appropriate: IV and DV	Explicitly states appropriate: IV and DV and one CV	Explicitly states appropriate: IV and DV and two CVs	<p><i>Only requirement is to state using the terminology of IV, DV and CV. No need to explain further.</i></p> <p><i>Do not accept reversed IV and DV.</i></p> <p><i>Do not accept “keeping equipment the same” as a CV.</i></p> <p><i>Do not accept calculated values as DV unless explicitly shown how calculated from measured values.</i></p>
2.H	Formulates a hypothesis connected to the variables but not explicitly linked to time	Formulates a hypothesis correctly linked to time with no explanation	Formulates a hypothesis with reasoning linked to relevant scientific ideas		<p><i>For two marks change alone is not good enough, IV and DVs need the direction of change.</i></p> <p><i>Scientific ideas might include drag, air resistance.</i></p>
3.E	Protractor and stopwatch				
4.M	Method is linked to IV or DV	Method is linked to IV and DV but is incomplete	Method linked to IV and DV and can be followed	Method linked to IV and DV and can be followed and include details on how to control main CVs	<p><i>A method that does not include how to vary the IV is incomplete and cannot be followed.</i></p> <p><i>Limited information about main CVs mean that data is unlikely to be relevant.</i></p> <p><i>If the method is repeated with a second IV, the maximum mark is 1 as there can only be one IV.</i></p>

5.D	Plans to conduct at least three trials or measures time for at least five different IV increments	Plans to conduct at least three trials and measures time for at least five angles	Plans to conduct at least three trials and measures time for at least five stated angles and plans to calculate averages		<i>The values of the five or more IV variations should be explicitly stated for 3 marks.</i>
6.S	A relevant comment about safety that is specific to the investigation				<i>Do not accept general considerations not linked to the specific investigation, e.g. wear a mask, tie hair back.</i> <i>Accept a comment about there not being any safety concerns if this is true for the planned investigation.</i>

7	<p>a</p> <p>Excretion of waste: Waste builds up in the body or more water is reabsorbed (so) urine volume decreases or urine becomes more concentrated</p> <p>Temperature control: Sweat production decreases or less evaporative cooling (so) harder to regulate body temperature or cool down</p>	<p>Accept toxins for waste. Accept harder stool or feces or constipation for mp1</p>	4	D
	<p>Two arrows pointing left only Large arrow pointing left and small arrow pointing right</p>	Mp2 gains mp1	A	
	<p>c</p> <p>Accept any two impacts on ecosystems, for example [max 2]</p> <ul style="list-style-type: none"> • habitat destruction • space needed for equipment • disposal of concentrated waste <p>Accept any two consequences of high energy use, for example [max 2]</p> <ul style="list-style-type: none"> • emissions from fossil fuels • cost (of fuels) • fresh water produced may be expensive to buy • renewable energy source means consequences are low impact <p>A concluding appraisal considering the benefits of a reliable supply of fresh water</p>	<p>Do not accept a decrease in sea water</p>	5	D

8	a	 <p>All correct</p>		1	A
	b	<p>Accept any reasonable consequence of increased precipitation, for example [max 1]</p> <ul style="list-style-type: none">• flooding• decrease in water quality• change in growing season• loss of habitat <p>Accept any reasonable consequence of decreased precipitation, for example [max 1]</p> <ul style="list-style-type: none">• drought• effect on water supply (animals, humans, agriculture)• change in growing season• (fertile) land gained from lowering river levels• wildfires		2	D

8	c		12	D
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Steps that could be taken to reduce water shortage in the home		
Mark	Descriptor	Notes
1	A statement of how water is used in the home	<p>Examples of statements</p> <ul style="list-style-type: none"> • taking a shower • washing clothes • watering plants in the garden
2	A statement of how water is used in the home and a justification of how this use can be reduced	<p>Examples of justifications</p> <ul style="list-style-type: none"> • turning the shower off while using shampoo to wash your hair • using the water saving settings on the washing machine • using water left over from other task (grey water) to water the garden
3	Statements of at least two uses of water in the home and justification of how both of these uses can be reduced	

A description of how an individual's dietary choices can affect their water footprint		
Mark	Descriptor	Notes
1	A simple reference to the use of water in food production or transportation	<p>Examples of simple references</p> <ul style="list-style-type: none"> • crops must be watered • 15 415 l of water are required to produce 1 kg of beef
2	A statement of the effect of one dietary choice on water footprint	<p>Examples of statements</p> <ul style="list-style-type: none"> • meat-based diet increases water footprint • eating more vegetables reduces water footprint • buying seasonal produce decreases water footprint
3	A statement of the effect of two dietary choices on water footprint and one supported by evidence	<p>Examples of supporting evidence</p> <ul style="list-style-type: none"> • beef requires the highest volume of water to produce 1 kg • less water is used to prepare or process the produce • less water is required to transport the food (from where it is grown)
4	A statement of the effect of two dietary choices on water footprint and both supported by evidence	

A suggestion of how government policies can influence water usage		
Mark	Descriptor	Notes
1	A statement of a government action	<p>Examples of government actions</p> <ul style="list-style-type: none"> • educate about sustainable water use • encourage through campaigns • enforce by passing water use laws or imposing limits
2	A statement of a government action and how this would reduce water usage	<p>Examples of how actions would reduce water usage</p> <ul style="list-style-type: none"> • making sustainable water use part of the curriculum would give people the tools to make sustainable decisions • subsidising water efficient technology would encourage consumers to buy it • tax or fine industries for excessive water use
3	Two government actions and how both would reduce water usage	

Conclusion (Concluding appraisal)		
Mark	Descriptor	Notes
1	A basic conclusion	<p>Examples of a basic conclusion</p> <ul style="list-style-type: none"> • as individuals we can make small steps to reduce the water we use daily • too much water is wasted in food production
2	An appraisal including actions by both individuals and groups	<p>Examples of an appraisal</p> <ul style="list-style-type: none"> • everyone can do their bit, but domestic usage is tiny compared to industry and agriculture. • governments actions can directly affect individual choices Imposing rules can ensure that individuals use water responsibly