

GCE

Biology A

H420/01: Biological processes

A Level

Mark Scheme for June 2024

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

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

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

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**PREPARATION FOR MARKING
RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. Crossed Out Responses

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
 - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
10. For answers marked by levels of response: Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.
Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

















The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **18(d)** and **19(b)(ii)**.

11. Annotations

Marking Annotations

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

12. Subject Specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. Subject-specific Marking Instructions

INTRODUCTION

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

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

You should ensure that you have copies of these materials.

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

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

Question	Answer	Marks	Guidance
1	B	1	
2	B	1	
3	A	1	
4	A	1	
5	D	1	
6	A	1	
7	D	1	
8	B	1	
9	B	1	
10	D	1	
11	B	1	
12	C	1	
13	B	1	
14	A	1	
15	C	1	

Question			Answer	Marks	Guidance																				
16	(a)		<table><tr><th>Biological molecule</th><th>Is a monomer</th><th>Is a polymer</th><th>Contains glycosidic bonds</th></tr><tr><td>Amino acid</td><td>✓</td><td></td><td></td></tr><tr><td>Amylopectin</td><td></td><td>✓</td><td>✓</td></tr><tr><td>Glucose</td><td>✓</td><td></td><td></td></tr><tr><td>Sucrose</td><td></td><td></td><td>✓</td></tr></table>	Biological molecule	Is a monomer	Is a polymer	Contains glycosidic bonds	Amino acid	✓			Amylopectin		✓	✓	Glucose	✓			Sucrose			✓	3	IGNORE crosses and hybrid ticks
			Biological molecule	Is a monomer	Is a polymer	Contains glycosidic bonds																			
			Amino acid	✓																					
			Amylopectin		✓	✓																			
			Glucose	✓																					
			Sucrose			✓																			
			1 mark per correct row ✓ ✓ ✓																						
16	(b)		(α-) <u>glycosidic</u> ✓	2	ALLOW marks clearly shown on annotated diagram IGNORE ref to any named carbohydrate ALLOW (α-)1,4 glycosidic bond for 2 marks DO NOT ALLOW beta / β ALLOW 1,4 (bond) DO NOT ALLOW 1,6 (bond) ECF e.g β-1,4 glycosidic bond gets MP2 beta / β 1, 6 (bond) = 0 marks																				
			carbon 1 to carbon 4 (bond) ✓																						
16	(c)	(i)	H ₂ O / water ✓ 2 / two ✓	2	ALLOW 1 mark for just H ₂ O / water IGNORE incorrect number e.g. 3 for MP1																				

16	(c)	(ii)	<p>(maltotriose is) complementary to the <u>active site</u> (of maltase / the enzyme)</p> <p>OR</p> <p>(maltotriose also) contains (α-1,4) glycosidic bonds</p> <p>OR</p> <p>(maltase / the enzyme) hydrolyses (α-1,4) glycosidic bonds ✓</p>	1	<p>ALLOW (maltotriose) can bind to or fit into <u>active site</u> (of maltase / the enzyme)</p> <p>DO NOT ALLOW beta / β</p> <p>ALLOW breaks down for hydrolyses</p>
			Total	8	

17	(a)	(i)	<p>X = water / H₂O</p> <p>Y = carbon dioxide / CO₂</p> <p>Z = oxygen / O₂ ✓ ✓</p>	2	<p>All three correct for TWO marks</p> <p>One or two correct for ONE mark</p>
17	(a)	(ii)	<p>1 <i>idea that</i> light (energy) is the only requirement from outside the terrarium / AW ✓</p> <p>2 respiration provides carbon dioxide and water for photosynthesis</p> <p>OR</p> <p>photosynthesis provides glucose and oxygen for respiration ✓</p> <p>3 water used for photolysis</p> <p>OR</p> <p>oxygen used as final electron acceptor (in respiration) ✓</p> <p>4 carbon dioxide used for , light independent stage / Calvin cycle ✓</p> <p>5 ATP (still) produced / energy provided , for (named) cell activities ✓</p> <p>6 decomposing plant material provides (named) mineral ions ✓</p>	max 3	<p>ALLOW O₂ for oxygen, H₂O for water, CO₂ for carbon dioxide and C₆H₁₂O₆ for glucose throughout</p> <p>MP1 ALLOW e.g. as light (energy) can pass through glass for photosynthesis</p> <p>MP1 ALLOW e.g. plants in glass containers will have access to light</p> <p>MP2 IGNORE equations unqualified</p> <p>MP5 ALLOW e.g. active transport / protein synthesis / active uptake of mineral ions</p> <p>IGNORE produces energy</p> <p>MP6 IGNORE nutrients</p>
17	(b)	(i)	21 or 22 or 23 or 24 (%) ✓	1	<p>ALLOW e.g. 22.0 but DO NOT ALLOW other decimal places e.g. 22.3</p>

17	(b)	(ii)	<p>1 (alga has) <u>accessory</u> pigments ✓</p> <p>2 (other pigments) absorb , different / other , wavelengths (of light) ✓</p> <p>3 little / not all , light (wavelengths) is absorbed by , chlorophyll a / primary pigment ✓</p> <p>4 (light) energy is transferred to reaction centre ✓</p> <p>5 for use in , light-dependent reaction / LDR ✓</p>	max 3	<p>MP1 IGNORE named pigments</p> <p>MP2 ALLOW longer / shorter / AW for different</p> <p>MP2 ALLOW λ for wavelength</p> <p>MP2 IGNORE more / wider range , wavelengths</p> <p>MP4 ALLOW chlorophyll a / primary pigment for reaction centre / photosystem</p> <p>MP4 ALLOW AW e.g. accessory pigments harvest (light) energy for reaction centre</p>
17	(b)	(iii)	<p>(red) algae have pigments that absorb short(er) (light) wavelengths / AW ✓</p> <p>(these wavelengths) can penetrate water to great(er) depths / AW ✓</p>	2	<p>ALLOW values in range 500 – 630nm / blue / green / yellow for short(er) wavelengths</p> <p>ALLOW e.g. can pass through water to reach the (red) algae (at depth)</p>
17	(c)	(i)	<p>GP was the only compound seen after 1 , sec(ond) / s ✓</p> <p>TP appears after 5 , sec(onds) / s ✓</p>	2	<p>ALLOW glycerate 3 -phosphate for GP and triose phosphate for TP</p> <p>ALLOW AW for compound e.g. molecule / product</p> <p>ALLOW e.g. GP and no other products were seen after 1 second</p> <p>IGNORE any other products after 5 seconds</p>
17	(c)	(ii)	<p>(TP is) converted into / source of, sugar phosphates / (named) amino acid(s) / citrate / sucrose / RuBP ✓</p>	1	<p>must be idea of synthesis into / AW not breaking down into</p> <p>ALLOW glutamic acid / serine / glycine / aspartic acid for named amino acids</p> <p>DO NOT ALLOW GP</p>
Total				14	

Question			Answer	Mark	Guidance
18	(a)	(i)	Any one (named) banned substance from: e.g. rhEPO OR (named) anabolic / androgenic , steroid e.g. nandrolone OR (named) narcotic drug e.g. cannabis / methadone OR (named) stimulant e.g. amphetamine OR e.g. (named) peptide / steroid , hormone e.g. testosterone ✓	1	ALLOW either banned substance or a named substance – check with IOC list IGNORE (named) diuretics / alcohol
18	(a)	(ii)	<i>idea that</i> collecting duct becomes less permeable to water ✓ (rapid) water loss ✓ larger volume of urine produced ✓	max 2	ALLOW e.g. fewer aquaporins inserted into collecting duct wall ALLOW reduction in ‘water weight’ ALLOW more water lost in urine ALLOW more / greater amount of urine produced
18	(a)	(iii)	it could increase removal of , (performance enhancing) drugs / other banned substances OR (performance enhancing) drugs / other banned substances , are undetectable in larger volume of urine produced ✓	1	ALLOW e.g. it could increase removal of them as drugs is mentioned in question stem ALLOW AW e.g. the concentration of drug would be too small to be noticed ALLOW more dilute for larger volume of urine

18	(b)	(i)	<p>it does not require surgery / no recovery time required ✓</p> <p>less painful / less chance of infection (after surgery) ✓</p> <p>it is more rapid / gives results more quickly ✓</p> <p>it is , less expensive / cheaper ✓</p>	max 1	<p>IGNORE disadvantages of biopsy</p> <p>ALLOW is , not / less , invasive</p> <p>ALLOW less damage to (named) tissues</p>
18	(b)	(ii)	<p>any one from (needs substance and application):</p> <p>glucose AND diabetes</p> <p>OR</p> <p>protein AND kidney disease / albuminuria</p> <p>OR</p> <p>creatinine AND kidney disease / muscle damage ✓</p>	max 1	<p>ALLOW other correct substance and condition e.g. hCG AND pregnancy</p> <p>ALLOW kidney failure / kidney damage for kidney disease</p>
18	(c)	(i)	<p>FIRST CHECK ANSWER ON ANSWER LINE</p> <p>If answer = -1.5 (kPa) award 2 marks ✓✓</p> <p>net hydrostatic pressure = $1.7 - 1.1 = 0.6$</p> <p>net oncotic pressure = $-3.3 - (-1.2) = -2.1$</p> <p>net pressure = $0.6 + (-2.1) = -1.5$ (kPa)</p>	2	<p>Minus sign needed for two marks</p> <p>For one mark 1.5 (without the minus)</p> <p>OR anywhere within calculation (net hydrostatic pressure) = 0.6</p> <p>OR anywhere within calculation (net oncotic pressure) = -2.1</p>

18	(c)	(ii)	<p>hydrostatic (pressure) at arteriole end is <u>higher</u> than oncotic (pressure) so fluid moves out (of blood / capillaries)</p> <p>OR</p> <p>net positive pressure at arteriole end so fluid moves out (of blood / capillaries) ✓</p> <p>hydrostatic (pressure) at venule end is <u>lower</u> than oncotic (pressure) so fluid moves in (to blood / capillaries)</p> <p>OR</p> <p>net negative pressure at venule end so fluid moves in (to blood / capillaries) ✓</p>	2	<p>Must be comparative</p> <p>ALLOW arterial for arteriole and venous for venule</p> <p>ALLOW e.g. plasma / water for fluid</p> <p>DO NOT ALLOW blood</p> <p>ALLOW ora e.g. oncotic is <u>lower</u> at arteriole end than hydrostatic so fluid moves out</p>
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18	(d)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) Describes in detail the regulation of the water content of blood with reference to action of ADH AND role of receptors AND (posterior) pituitary</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Describes the regulation of the water content of blood with reference to action of ADH AND receptors OR Describes the regulation of the water content of blood with reference to receptors AND (posterior) pituitary OR Describes the regulation of the water content of blood with reference to action of ADH AND (posterior) pituitary</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Describes the regulation of water content of blood with reference to the action of ADH OR receptors OR (posterior) pituitary</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	<p>Loss of mark for communication statement if incorrect science / terminology used e.g anterior pituitary rather than (posterior) pituitary / ADH secreted by adrenal gland OR give details of setting up a water potential gradient OR if no ref to homeostatic mechanism e.g. returning water potential of blood to normal value / ref to negative feedback</p> <p>Indicative scientific points may include:</p> <p>Mechanism of ADH action</p> <ul style="list-style-type: none"> • ADH targets / binds to cells of collecting duct • release of second messenger • vesicles with aquaporins fuse with plasma membrane • increase in permeability of collecting duct wall • more water moves down water potential gradient into cells <p>Role of Receptors <i>Sensory receptors</i></p> <ul style="list-style-type: none"> • sensory receptors located in the hypothalamus • osmoreceptors • detect changes in osmotic pressure / water potential of blood • respond to effects of osmosis by shrinking or swelling <p><i>Receptors in collecting duct</i></p> <ul style="list-style-type: none"> • receptors located on cells of collecting duct <p>(Posterior) pituitary</p> <ul style="list-style-type: none"> • ADH made in hypothalamus • moves down axon to posterior pituitary
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					<ul style="list-style-type: none">• stored in vesicles• action potentials in neurosecretory cells• ADH released by posterior pituitary• by exocytosis• from neurosecretory cells
			Total	16	

Question			Answer	Mark	Guidance
19	(a)	(i)	directional growth in response to a stimulus ✓	1	ALLOW grows towards / away from a stimulus DO NOT ALLOW 'growth' unqualified – it must have the sense of being directional
19	(a)	(ii)	phototropism / geotropism / hydrotropism / thigmotropism / chemotropism ✓	1	ALLOW any correct plant tropism ALLOW gravitropism DO NOT ALLOW 'trop h ism'
19	(a)	(iii)	<p><i>abiotic stress</i>: drought / lack of water ✓ <i>response</i>: closing stomata / leaf drop / wilting ✓</p> <p>OR</p> <p><i>abiotic stress</i>: freezing / cold or low temperatures ✓ <i>response</i>: closing stomata / leaf drop / wilting / production of anti-freeze chemicals ✓</p> <p>OR</p> <p><i>abiotic stress</i>: high temperature ✓ <i>response</i>: closing stomata / opening stomata / wilting ✓</p> <p>OR</p> <p><i>abiotic stress</i>: low light levels / short day length ✓ <i>response</i>: closing stomata / abscission / leaf fall / etiolation ✓</p> <p>OR</p> <p><i>abiotic stress</i>: high wind (speeds) ✓ <i>response</i>: closing stomata / wilting ✓</p>	2	<p>For two marks correct response linked to abiotic stress ALLOW one mark for a correct abiotic stress factor with incorrect response DO NOT ALLOW grazing / herbivory or other examples of biotic stress. IGNORE ref to hormones</p>

19	(b)	(i)	by enclosing the (donor / recipient) plant in (airtight plastic) bag ✓	1	ALLOW container / AW for bag ALLOW e.g. glass jar to cover the aerial parts e.g. cover that prevents interaction between aerial parts IGNORE separate the plants in containers alone as the answer must imply separating aerial parts
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19	(b)	<p>(ii) *</p> <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) An evaluation that includes statements for supporting evidence AND statements for non-supporting evidence AND includes general statement about quality of data</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) An evaluation that includes statements for supporting evidence OR statements for non-supporting evidence AND includes general statement about quality of data OR An evaluation that includes a statement for supporting evidence AND a statement for non-supporting evidence AND includes general statement about quality of data</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) An evaluation that includes a statement for supporting evidence OR a statement for non-supporting evidence OR includes a general statement about quality of data</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	<p>Loss of mark for communication statement if incorrect science e.g. muddled group comparisons Group 1 = leaves / small mesh bag / no hyphae Group 2 = no leaves / small mesh bag / no hyphae Group 3 = leaves / large mesh bag / hyphae Group 4 = no leaves / large mesh bag / hyphae Assume points relate to PPO activity</p> <p>Indicative scientific points may include:</p> <p>Supporting evidence</p> <ul style="list-style-type: none"> • defoliation increased (PPO) activity • non defoliation did not increase (PPO) activity as much • group 2 bigger increase than 1 / group 4 bigger increase than 3 • bigger increase with large-mesh bag / hyphae involved • groups 2 and 4 had large increase / groups 1 and 3 had small increase • group 1 had smallest increase • group 1 SDs overlap • group 4 had largest increase • calculation of comparative difference in increase • group 1 activity only increased by 11% and group 2 increased by 213% • group 3 increased by 83% and group 4 increased by 544% <p>Non-supporting evidence</p> <ul style="list-style-type: none"> • increase in all groups • plants not defoliated also showed increase
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					<ul style="list-style-type: none"> groups 1 and 3 still increased even though they didn't have leaves removed increase in activity even when leaves are not removed from donor plant some transmission by mycorrhizae regardless of whether donor leaves removed or not increase even with small-mesh bag / no hyphae involved increase in even when hyphae cannot grow between plants some transmission by means other than mycorrhizae / hyphae <p>Quality of data -general statements</p> <p><i>Good quality because</i></p> <ul style="list-style-type: none"> SD calculated low spread of results about the mean small standard deviations compared to size of mean increases (in activity) could be significant <p><i>Poor quality because</i></p> <ul style="list-style-type: none"> no control for effect of mesh bag sample size relatively small may not be representative of mature trees / trees growing in the wild no statistical test only two species used / different species for donor and recipient raw data not shown – possible anomalies were included
			Total	11	

Question			Answer	Mark	Guidance
20	(a)	(i)	(inhaled) oxygen is , being used / removed ✓	1	ALLOW (exhaled) carbon dioxide , absorbed / removed ALLOW less oxygen in exhaled air
20	(a)	(ii)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 12 / 13 / 14 / 15 (cm³ kg⁻¹) award 2 marks ✓✓ oxygen consumption in 120 s = 1.0 dm ³ = 1000 cm ³ so consumption $\frac{1000}{75} = 13$ (cm ³ kg ⁻¹)	2	If answer is incorrect MAX 1 mark for answer not to 2 sig. figs. Range of 0.9 to 1.1dm ³ from Fig.20.1 ALLOW 1 mark for failure to convert to cm ³ e.g. 1.3×10^{-2} / 0.013 / 0.014 (dm ³ kg ⁻¹) OR volume ÷ 75 (Kg)
20	(a)	(iii)	<i>At 120-240s</i> deeper / AW , breaths ✓ amplitude / tidal volume , becomes more variable ✓ same / similar , (calculated) breathing rate ✓	max 2	ALLOW ora MPs 1 and 2 for 0-120s ALLOW greater tidal volume ALLOW breaths per minute for breathing rate

20	(a)	(iv)	<p>1 breathing rate AND heart rate both increase ✓</p> <p>2 (blood) oxygen , saturation / concentration , decreases / increased concentration of CO₂ (in the blood) ✓</p> <p>3 reduction in pH ✓</p> <p>4 (detected by) chemoreceptors in medulla (oblongata) ✓</p> <p>5 cardiovascular centre controls heart rate ✓</p> <p>6 impulses along , sympathetic / accelerator , nerve (to heart / SAN) ✓</p> <p>7 sino-atrial node / SAN , responds by increasing rate at which it generates wave of excitation ✓</p>	max 4	<p>MP3 ALLOW increase in H⁺ / H ions for reduction in pH</p> <p>MP4 ALLOW chemoreceptors , in carotid arteries / aorta for 'in medulla'</p> <p>MP6 IGNORE signals / messages</p>
20	(b)		<p>enrich / AW , the air in the spirometer with oxygen ✓</p> <p>so that high (blood) oxygen saturation is maintained / AW ✓</p>	2	<p>IGNORE bigger spirometer</p> <p>IGNORE take resting intervals</p> <p>ALLOW so oxygen saturation , does not drop too low / is kept above 90%</p>
20	(c)	(i)	<p>(volume of) oxygen , consumed / inhaled / AW</p> <p>AND</p> <p>(volume of) carbon dioxide , produced / exhaled / AW ✓</p>	1	Both needed for the mark

20	(c)	(ii)	<p>RQ of carbohydrate is 1 / RQ of fat is (approx) 0.7 ✓</p> <p>at rest fat is used ✓</p> <p>as intensity increases (more) carbohydrate is used ✓</p> <p>(even) at highest intensity some fat is used</p> <p>OR</p> <p>(even) at highest intensity <u>not just</u> carbohydrate is used ✓</p>	max 3	<p>ALLOW named carbohydrates e.g. sugars</p> <p>ALLOW fatty acids / named fats e.g. lipids</p> <p>IGNORE ref to protein at 0.8 (approx.)</p> <p>ALLOW 0% / low / 0-10% intensity for at rest</p> <p>ALLOW at 100% intensity</p> <p>ALLOW at high intensities mixed respiratory substrates / <u>mainly</u> carbohydrate being used</p> <p>IGNORE protein and fat / carbohydrate and fat</p>
			Total	15	

Question			Answer	Mark	Guidance
21	(a)		<p><u>rough</u> endoplasmic reticulum / RER ✓</p> <p>Golgi (body / apparatus) ✓</p> <p>(secretory / transport) vesicle(s) ✓</p>	3	<p>ALLOW lysosome</p>
21	(b)	(i)	<p>(because) hydrogen peroxide / H_2O_2 , is toxic / damages cells OR</p> <p>breakdown of hydrogen peroxide / H_2O_2 , minimises / prevents, damage (to cells) ✓</p> <p>products of breakdown are, harmless / water and oxygen ✓</p>	2	<p>ALLOW damage to organelles / triggers apoptosis / damage to enzyme</p> <p>ALLOW prevents damage to organelles / prevents apoptosis / prevents damage to enzyme</p> <p>ALLOW H_2O and O_2</p>
21	(b)	(ii)	<p>FIRST CHECK ANSWER ON ANSWER LINE</p> <p>If answer = 3.7 ± 0.6 award 2 marks ✓✓</p> <p>drawn tangent at $t = 30 \text{ s}$</p> <p>figures from tangent e.g. $170 \text{ (}\mu\text{g)} \div 46 \text{ (s)}$</p> <p>Unit = $\mu\text{g s}^{-1}$ ✓</p>	3	<p><i>Max 2 if answer given to more than 3 significant figures</i></p> <p>If answer incorrect</p> <p>One mark for</p> <p>tangent drawn with straight line that meets the curve at 30s and can be any length</p> <p>OR</p> <p>calculation showing difference in volume \div difference in time (from tangent / triangle)</p> <p>ALLOW $\mu\text{g} / \text{s}$</p>

21	(c)	(i)	because they have many mitochondria ✓ catalase activity may be (too) low ✓ mutation in / less transcription of , catalase gene✓ (or) SOD activity may be (too) high ✓	max 2	ALLOW catalase may be inactive ALLOW low concentration of catalase ALLOW high concentration of SOD
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21	(c)	(ii)	<p><i>Evidence to support</i></p> <p>1 as (H₂O₂) concentration increases motility (of treated sperm) decreases ✓</p> <p>2 as (H₂O₂) concentration increases cells with changes to (composition of) plasma membrane increase ✓</p> <p><i>Evidence that does not support -max 2</i></p> <p>3 correlation does not prove causation ✓</p> <p>4 sample size was (relatively) small / only 10 men ✓</p> <p>5 no statistical test has been performed ✓</p> <p>6 (sperm cell) samples , not representative / show bias ✓</p> <p>7 (some motility) error bars overlap ✓</p>	max 3	<p>MP1 ALLOW e.g. negative correlation between hydrogen peroxide concentration and motility MP1 DO NOT ALLOW normal sperm cells</p> <p>MP2 ALLOW e.g. positive correlation between concentration of hydrogen peroxide and cells with changes to plasma membrane</p> <p>MP3 ALLOW there may have been another cause of low motility</p> <p>MP5 ALLOW no correlation coefficient calculated / no Spearman's rank MP6 ALLOW samples from fertility clinic more likely to have abnormal sperm MP6 ALLOW idea of skewed results</p>
21	(c)	(iii)	<p>oxidises / reacts with / AW , fatty acids / phospholipids / cholesterol ✓</p> <p>damages / denatures (named) , membrane proteins ✓</p> <p>disrupts phospholipid bilayer ✓</p> <p>causes membrane to be more permeable ✓</p>	max 2	<p>ALLOW changes the fluidity of the membrane</p> <p>ALLOW causes breaks / pores in membrane</p>
			Total	15	

Question			Answer	Mark	Guidance
22	(a)		<p>any two from:</p> <p>size / shape / surface area / dimensions , of (beetroot) pieces ✓</p> <p>type / varieties , of beetroot ✓</p> <p>same part of beetroot / no skin on beetroot ✓</p> <p>age of beetroot ✓</p> <p>time (beetroot) pieces are kept in ethanol (before measuring absorbance) ✓</p> <p>volume of ethanol (solution) ✓</p>	max 2	<p>IGNORE mass of beetroot / temperature / 25°C (these are given in the stem)</p> <p>IGNORE pH</p> <p>ALLOW same beetroot / same species</p>
22	(b)	(i)	<p>(increased) ethanol (concentration) increases permeability of membranes / AW ✓</p> <p>(curve) levels off as , no more / all , pigment is released ✓</p>	2	<p>ALLOW e.g. ethanol disrupts phospholipid bilayer so more pigment leaks out</p> <p>IGNORE positive correlation</p> <p>ALLOW until concentration of pigment inside and outside cell is the same</p>
22	(b)	(ii)	<p>curve to the left of the student's curve ✓</p> <p>reaches same max value ✓</p>	2	<p>IGNORE start point (increased temperature may cause release of pigment at 0% ethanol)</p> <p>Max 1 if curve drops below student curve at any point (allow if touches points) or if goes above maximum shown by last two points</p>
			Total	6	

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