Oxford Cambridge and RSA

GCE

Biology A

H420/01: Biological processes

A Level

Mark Scheme for June 2022

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris 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 scoris and mark the **required number** of practice responses ("scripts") and the **required number** of 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 scoris 50% and 100% (traditional 50% 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, email or via the scoris messaging system.

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 3enalized 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 scoris **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 scoris messaging system, or email.

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, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content 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 science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

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

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

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **17** and **19(d)**.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

12. **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	AO element	Guidance
1			C	**1**	1.1	
2			C	**1**	1.1	
3			B	**1**	2.1	
4			C	**1**	2.3	
5			A	**1**	1.1	
6			A	**1**	1.2	
7			A	**1**	1.1	
8			C	**1**	2.8	
9			B	**1**	2.8	
10			B	**1**	2.1	
11			B	**1**	1.2	
12			B	**1**	2.6	
13			D	**1**	2.6	
14			C	**1**	1.2	
15			D	**1**	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)		**any three from:** ***Max 2 from explanations…*** **1** (large size requires) transport over long distances / AW ✓ **2** diffusion too slow / diffusion distance too great / cannot rely on diffusion alone ✓ **3** low / small , surface area to volume ratio / SA to V ratio / SA:V ✓ ***Max 2 from examples…*** **4** (to) transport , water / ions , from roots to , cells / other parts of the plant ✓ **5** (to) transport , sucrose / products of photosynthesis / (named) assimilates , from , source to sink ✓ **6** (to) transport (named) hormones produced in one part to site of action / AW ✓	**3**	1.1	**MP1 ALLOW** e.g. transporting water from roots to the leaves (in a tree) is a long way =**MP1 + MP4** **MP2 ALLOW** diffusion is not sufficient to meet the needs of the plant **or** meet metabolic demand **MP 2 IGNORE** diffusion is not efficient **MP5 IGNORE** glucose **MP5 ALLOW** correct examples of source and sink **MP5 ALLOW** e.g. amino acids for assimilates
16	(b)	(i)	B = phloem ✓	**1**	1.1	**IGNORE** cambium
16	(b)	(ii)	transport of , water / (named) ions ✓ (mechanical / structural) support ✓	**2**	1.2	**Mark as continuous prose** **ALLOW** transport of (some) hormones **IGNORE** strength

Question			Answer	Marks	AO element	Guidance
16	(c)		**The feature (F) and explanation (E) must match** ***max 2 for features and max 2 for explanations*** **F1**: lignin / lignification ✓ **E1**: provides support / prevents collapse / prevents water loss ✓ **OR** **F2**: <u>spiral</u> (thickening) ✓ **E2**: allows flexibility ✓ **OR** **F3**: hollow (vessels) ✓ **E3**: minimises resistance to flow of water / AW ✓ **OR** **F4**: (bordered) <u>pits</u> / <u>pitted</u> ✓ **E4**: allows , passage / lateral movement , of water between, xylem / vessels ✓	**max 4**	2.5	**Mark as continuous prose** If reference to phloem is in incorrect context penalise once and then use ECF **E1 ALLOW** waterproofing **E1 IGNORE** strength **F3 ALLOW** no organelles / no cytoplasm / no end walls **F3 IGNORE** tube / named organelle e.g. nucleus **E3 ALLOW** allows water to flow freely / move as one (continuous) column **F4 DO NOT ALLOW** plasmodesmata **E4 ALLOW** allows passage of water into / out of xylem / vessels **E4 ALLOW** e.g. allows water to move from xylem / vessels to cells **Examples:** e.g. has lignin but no nuclei to allow water to flow freely = 2 marks e.g. is a vessel to minimise resistance to water flow and holes to allow lateral flow of water between vessels = 2 marks e.g. if **F1** , **F2** and **E3** are seen within the response = 2 marks as feature and explanation do not match

<table>
<tr>
<td>16</td>
<td>(d)</td>
<td></td>
<td>
any three from:
supports conclusion
1 adding , mycorrhiza / fungus , increased dry mass
AND phosphate content in (brb) mutants / AW ✓

2 mycorrhiza / fungus , could stimulate growth of ,
extra roots / root hair cells in mutants ✓

max 2 for MPs 3 to 7:
does not support conclusion
3 (however) dry mass / phosphate content (of mutants) ,
is less than in wild type ✓

4 adding , mycorrhiza / fungus , reduces dry
mass / phosphate content , in wild type ✓

5 no information about , (named)
control variables / sample size ✓

6 no (named) statistical test carried out / would need to perform a statistical test ✓

7 idea that there is no information about other
(named) ions required for increasing dry mass ✓

data to support either argument
8 data to compare two sets of data for either dry mass or phosphate content / calculations from data ✓
</td>
<td>3</td>
<td>3.1, 3.2</td>
<td>
ALLOW ora for MPs 1 and 3

MP8 no units required for data quotes
<table>
<tr><th>Plant type</th><th>Mycorrhiza fungus added</th><th>Dry mass (g pot^{-1})</th><th>Phosphate content (mg plant^{-1})</th></tr>
<tr><td>brb mutant</td><td>no</td><td>0.84 ± 0.10</td><td>1.22 ± 0.13</td></tr>
<tr><td>brb mutant</td><td>yes</td><td>1.23 ± 0.16</td><td>2.15 ± 0.25</td></tr>
<tr><td>Wild type</td><td>no</td><td>3.57 ± 0.16</td><td>4.72 ± 0.23</td></tr>
<tr><td>Wild type</td><td>yes</td><td>2.97 ± 0.36</td><td>3.91 ± 0.52</td></tr>
</table>
MP8 calculated value e.g. there is a difference in dry mass of 0.39 (gpot^{-1}) between the mutant groups
</td>
</tr>
</table>

Question			Answer	Marks	AO element	Guidance
17*			***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
			Level 3 (5–6 marks) An outline that includes chemical **and** physical property of water **and** example. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** An outline that includes chemical **or** physical property of water **and** example. **OR** An outline that includes chemical **and** physical property of water. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	**6**	1.1	**Indicative points include:** **Chemical properties** • polar molecule • unequal sharing of electrons / dipole • Hydrogen is delta$^+$ / δ^+ and oxygen delta $^-$ / δ^- • hydrogen bonds between water molecules • hydrogen bonds / interactions are weak • large number of bonds collectively strong • drawn diagram **Physical properties** • lower density of ice than liquid water so ice floats • ice insulates (water below) / ice freezes from top down • cohesion • adhesion • high surface tension

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) An outline that includes **either** physical **or** chemical property of water **or** example. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*			• (polar) solvent • transparent **Examples of how life is sustained** • habitat for aquatic organisms • buoyancy / support for (named) aquatic organisms e.g. fish / seaweeds • obtaining dissolved oxygen • organisms can survive beneath ice • ice is habitat for e.g. polar bears • ice provides resting / breeding areas for e.g. penguins / seals • allow transpiration stream • allows turgor pressure • allows hydrostatic skeletons • lubricant e.g. pleural fluid • allows movement on water surface for e.g. pond skaters • cytosol of eukaryotic / prokaryotic cells • medium for chemical reactions • allows transport of dissolved substances e.g. glucose in blood / e.g. dissolved nutrients in oceans • allows removal of metabolic waste • allows light to penetrate

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>18</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Final concentration of solution (mol dm^{-3})</th><th>Volume of 1 mol dm^{-3} sucrose solution (cm^3)</th><th>Volume of distilled water (cm^3)</th><th>Final volume (cm^3)</th></tr>
<tr><td>1.0</td><td>30.0</td><td>0.0</td><td>30.0</td></tr>
<tr><td>0.8</td><td>24.0</td><td>6.0</td><td>30.0</td></tr>
<tr><td>0.6</td><td>18.0</td><td>12.0</td><td>30.0</td></tr>
<tr><td>0.4</td><td>12.0</td><td>18.0</td><td>30.0</td></tr>
<tr><td>0.2</td><td>6.0</td><td>24.0</td><td>30.0</td></tr>
<tr><td>0.0</td><td>0.0</td><td>30.0</td><td>30.0</td></tr>
</table>
both columns correct with values given to one d.p. ✓ ✓ ✓</td><td>3</td><td>2.4</td><td>ALL 12 values i.e. both columns must be correct and to 1 decimal place for 3 marks

ALLOW for 2 marks
All 12 values correct but incorrect number of decimal places

ALLOW for 1 mark
One column with correct values regardless of d.ps i.e. either volume of sucrose or volume of distilled water</td></tr>
<tr><td>18</td><td>(a)</td><td>(ii)</td><td>FIRST CHECK ANSWER ON ANSWER LINE

if answer = 0.06 (%) award 2 marks

total uncertainty = ±0.02 g ✓

Uncertainty = 0.02 ÷ 34.23 (x 100) = 0.06 (%) ✓</td><td>2</td><td>2.4</td><td>ALLOW for 1 mark calculator value not to 2d.p
e.g. 0.058428 / 0.05843 / 0.0584 / 0.058

ALLOW for 1 mark 0.03 (%)
(calculated with incorrect total uncertainty)</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
18	(b)	(i)	-1.5(0) / 3rd replicate / 3rd repeat , at 0.4 (mol dm^{-3}) **OR** -2.9% ✓	1	2.8	**If value not circled in the table, response must include 0.4 (mol dm^{-3})** **ALLOW** anomalous result circled in the table **ALLOW** any value in the 3rd replicate row for 0.4 **IGNORE** 0.7%
18	(b)	(ii)	**Any two marks** for **one** variable **and one** explanation **V1** temperature ✓ **E1** (because temperature) affects the rate of , diffusion / osmosis ✓ **OR** **V2** type / variety / species / age , of potato ✓ **E2** (because potatoes have) different , density / water potential / AW ✓ **OR** **V3** ensure enough solution to fully immerse potato cylinders / AW ✓ **E3** so osmosis occurs across the whole surface of the cylinder ✓	2	3.3	**variable (V) and explanation (E) must match** **DO NOT ALLOW** two variables or two explanations **DO NOT ALLOW** shape as the question stem says 'cylinders' **E1 ALLOW** temperature affects kinetic energy (of molecules) **E1 ALLOW** (temperature) changes **or** affects permeability of membranes **V2 ALLOW** use peeled potato **V2 ALLOW** same potato

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>19</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>skeletal</th><th>cardiac</th><th>involuntary</th></tr>
<tr><td>contraction speed is slow</td><td></td><td></td><td>✓</td></tr>
<tr><td>fibres are multinucleated</td><td>✓</td><td></td><td></td></tr>
<tr><td>fibres are branched and interconnected</td><td></td><td>✓</td><td></td></tr>
<tr><td>under conscious control</td><td>✓</td><td></td><td></td></tr>
</table>
✓
✓
✓
</td><td>3</td><td>1.1</td><td>IGNORE use of crosses / hybrid ticks
DO NOT ALLOW more than 1 tick per row</td></tr>
<tr><td>19</td><td>(b)</td><td>(i)</td><td>actin ✓
tropomyosin ✓
troponin ✓</td><td>3</td><td>1.1</td><td>Mark first three answers even if on same line
ALLOW correct proteins in any order</td></tr>
<tr><td>19</td><td>(b)</td><td>(ii)</td><td>X contains , myosin / thick filaments ✓

Y contains (only) , actin / thin filaments ✓</td><td>2</td><td>2.7</td><td>ALLOW dark or A band for X
IGNORE actin

ALLOW light or I band for band Y

IGNORE ref to H zone or M line or Z line</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
19	(b)	(iii)	light / I , band is smaller ✓ dark / A , band remains the same ✓ sarcomeres are shorter ✓ H zone becomes smaller ✓ there is greater overlap between actin and myosin (filaments) ✓	**max 3**	2.7, 3.2	**ALLOW** band Y (as labelled on diagram) **ALLOW** band X (as labelled on diagram) **ALLOW** Z lines closer together
19	(c)		**Any two from:** ATP , is required to , break cross-bridges / detach myosin from actin ✓ actin and myosin (filaments) remain cross-linked / AW ✓ prevents relaxation of muscle / muscle stays contracted✓	**2**	2.5	**ALLOW** e.g. ATP is needed to break the links between myosin and actin so they remain attached = 2 marks

Question			Answer	Marks	AO element	Guidance
19	(d)*		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
			Level 3 (5–6 marks) A description of source of ATP during strenuous exercise **AND** detail of both aerobic **AND** anaerobic respiration *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A description of source of ATP during strenuous exercise **AND either** detail of aerobic **OR** anaerobic respiration. **OR** A description that includes detail of aerobic **AND** anaerobic respiration *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)**	**6**	1.2, 2.5	**Indicative points include** *Sources of ATP* • Free ATP in muscle cells / sarcoplasm • ATP formed from creatine phosphate or phosphocreatine • runs out in a few seconds / quickly *Aerobic respiration stated* • occurs if oxygen available • oxidative phosphorylation • greater yield of ATP • delivery of O_2 to tissues does not meet demand • O_2 is limited during strenuous exercise *Anaerobic respiration stated* • needed during strenuous exercise • anaerobic only involves glycolysis • ATP formed by substrate level phosphorylation • net yield of 2 ATP / smaller yield of ATP

Question			Answer	Marks	AO element	Guidance
			A description of a source of ATP for muscle contraction **OR** detail of aerobic **OR** anaerobic respiration. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*			• NAD regenerated so glycolysis can continue • cannot continue indefinitely due to lactic acid build-up

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	**any two from:** thermostat (to control temperature whilst taking measurements) ✓ thermometer (to monitor temperature in the respirometer chamber) ✓ oxygen probe , in water entering / before respirometer ✓	2	3.3	**Mark as continuous prose** **ALLOW** e.g. use heater **or** iced water to get water to (required) temperature **or** use thermostatically controlled water bath **ALLOW** temperature probe
20	(a)	(ii)	**any one from:** allows continual data collection ✓ less risk of error / remove human error ✓ allows for , easier / direct / immediate , data analysis ✓	1	3.3	**IGNORE** refs to accuracy / precision **ALLOW** person does not need to be present **ALLOW** e.g. description of experimental or operator error **ALLOW** reduces bias or results not subjective
20	(a)	(iii)	**any two from:** **1** to maintain (adequate) supply of oxygen / AW ✓ **2** so that fish can respire (aerobically) ✓ **OR** **3** to remove (named metabolic) waste products / AW ✓ **4** that could , damage / kill / be toxic to , fish ✓	2	3.3	**Mark in pairs e.g.** either MP1 and MP2 **OR** MP3 and MP4 **MP1 ALLOW e.g.** maintains gaseous exchange **or** allows counter current flow across the gills **MP2 ALLOW** so fish doesn't respire anaerobically

Question			Answer	Marks	AO element	Guidance
20	(a)	(iv)	**P1** allow temperature to reach the required point before taking measurements ✓ **E1** allow fish to acclimatise to the temperature of the tank / AW ✓ **OR** **P2** use , appropriate / suitable , temperature range ✓ **E2** to avoid stress to the fish / oxygen solubility varies with temperature ✓ **OR** **P3** idea of waiting for fish to calm down / adjust to the tank or new surroundings ✓ **E3** because , stress / AW , can affect oxygen consumption ✓ **OR** **P4** ensure correct , salt concentration / AW , of the water ✓ **E4** because it is a saltwater fish / maintain osmotic balance ✓ **OR** **P5** maintain , optimum / correct , pH ✓ **E5** changes in pH can , damage the fish / affect metabolism ✓ **OR** **P6** *idea of* removing other (micro)organisms from the , tank / water ✓ **E6** (micro) organisms remove oxygen from the water / may cause disease ✓	**Max 2**	3.4	**ALLOW** e.g. any one precaution **(P)** or any one explanation **(E)** mark point but to get 2 marks **(P) and (E)** must match **P2 ALLOW** don't use too high **or** too low temperatures **P2 ALLOW** stated temperature range between 5 and 35 ^{o}C

Question			Answer	Marks	AO element	Guidance
20	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer is 2.22 / 2.20 award 2 marks** $Q_{10} = \frac{R_2}{R_1}$ 200 / 90 = 2.22222 correct values for O_2 consumption at 23 ºC **AND** 13 ºC ✓ correct calculation of Q_{10} based on values from graph ✓	**2**	3.1, 3.2	**If answer incorrect then:** **ALLOW** 1 mark if answer not given to 3 sig. fig. e.g. 2.22222 **OR** **ALLOW** 1 mark if you see 200 and 90 or 91 as the two correct readings from Fig. 20.2 **DO NOT ALLOW** if 170 is also given as this is the incorrect reading for 18ºC

20	**(b)**	**(ii)**	*Conclusion supported because…* **1** larger increase in O_2 consumption between 13 ºC and 18 ºC ✓ **2** *idea that* higher temperature / 23ºC , may not be economic / ORA ✓ ***Max 3 marks from MPs 3 to 7:*** *Conclusion not supported because…* **3** greater O_2 consumption may indicate high metabolic rate (rather than growth rate) ✓ **4** greater O_2 consumption may result in , more food consumption / higher feeding costs ✓ **5** temperatures below 13 ºC and above 23 ºC not used / only three temperatures used ✓ **6** no indication of sample size used ✓ **7** *idea that* there is no evidence of , statistical tests / replicates / repeats / mean values obtained ✓	**max 4**	3.1, 3.2	**MP1 ALLOW** smaller increase between 18 ºC and 23 ºC **MP2 ALLOW** reference to e.g. extra heating costs

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	(a group of cells that) secretes / releases / produces , hormones ✓ (directly) into the blood (stream) ✓	2	1.2	**DO NOT ALLOW** excretes **ALLOW** doesn't have ducts / ductless
21	(a)	(ii)	(because digestive enzymes) are released into ducts ✓	1	2.1	**ALLOW** (because digestive enzymes) are not released (directly) into the blood
21	(b)		inside cells / in cytoplasm / in the nucleus ✓ because steroids can cross the , cell surface / plasma , membrane ✓	2	2.1	 **ALLOW** can cross phospholipid bilayer
21	(c)	(i)	cortisol / glucocorticoids , regulate carbohydrate metabolism ✓ lack of , aldosterone / mineralocorticoids , cause , low blood pressure / salt craving , as regulate ion concentration ✓	2	2.1	**ALLOW** helps regulate availability of glucose **or** ref to gluconeogenesis **or** glycogenolysis **IGNORE** aldosterone **ALLOW** for ions either sodium ions **or** Na^+ **or** potassium ions **or** K^+ **DO NOT ALLOW** cortisol
21	(c)	(ii)	**any three from:** ACTH only affects (adrenal) cortex ✓ adrenaline is produced by the (adrenal) medulla ✓ adrenaline is responsible for , response to danger / flight or fight response ✓ response to danger / fight or flight response , is also , mediated by / AW , (autonomic/sympathetic) nervous system ✓	3	2.1	 **ALLOW** ACTH does not affect medulla **DO NOT ALLOW** parasympathetic

Question			Answer	Marks	AO element	Guidance
21	(d)	(i)	can , differentiate / specialise , into , any / all , (adult) cell type / tissue type ✓ cannot form , whole organisms / extra-embryonic tissues ✓	2	1.2	**ALLOW** for extra-embryonic e.g. placenta **or** umbilical cord **or** amnion

21	(d)	(ii)	**any three from:** ***max 2 marks supporting conclusion from MPs 1 to 5*** **1** group 4 has a higher concentration of thyroxine than group 3 ✓ **2** group 4 can produce thyroxine ✓ **3** group 2 shows destroying thyroid gland lowers , concentration / production of , thyroxine ✓ **4** *idea that* group 4 produces almost as much thyroxine as , group 1 / control ✓ **5** *idea that* if the anomalous result in group 4 had been ignored , errors bars / SDs , between groups 1 and 4 would overlap ✓ ***max 2 marks not supporting conclusion from MPs 6 to 11*** **6** group 4 <u>mean</u> is lower than , that of group 1 / control ✓ **7** error bars / SDs , of groups 1 and 4 don't overlap ✓ **8** there was an , anomaly / outlier , in group 4 ✓ **9** relatively small groups of mice / small sample sizes / larger sample sizes should have been used ✓ **10** group 4 has more mice which could affect , results / analysis ✓ **11** *idea that* thyroxine concentration may not be a measure of (differentiation into) functional thyroid tissue ✓	**3**	3.2	**ALLOW** use of descriptions for groups **MP1 ALLOW** ORA **MP6 ALLOW** ORA **MP7 DO NOT ALLOW** range bars **MP10 ALLOW** groups 1 to 3 have fewer mice than group 4 which could affect results

21	**(d)**	**(iii)**	***Supports*** less / no , risk of rejection ✓ ***Does not support*** (adult stem cells) may have accumulated mutations **or** iPSCs may increase risk of , cancer / tumour formation **or** may still carry the allele for hypothyroidism ✓	**2**	3.2	**IGNORE** reference to ethics **ALLOW** no need for immunosuppression

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>22</td><td>(a)</td><td></td><td>
<table>
<tr><th>Structure or function</th><th>Letter</th></tr>
<tr><td>chloroplast envelope</td><td>F ✓</td></tr>
<tr><td>site of light independent reactions</td><td>E ✓</td></tr>
<tr><td>inter-granal lamellae</td><td>D ✓</td></tr>
<tr><td>contains starch grains and lipid droplets</td><td>E ✓</td></tr>
</table>
</td><td>4</td><td>1.1, 2.1</td><td>DO NOT ALLOW more than one letter for each response</td></tr>
<tr><td>22</td><td>(b)</td><td></td><td>RuBP / ribulose (-1,5-) bisphosphate ✓

GP / glycerate (3-) phosphate / G3P ✓

ATP ✓

NADPH / red(uced) NADP / $NADPH_2$ / $NADPH + H^+$ ✓

sucrose ✓</td><td>5</td><td>1.1</td><td>ALLOW (3-) phosphoglycerate / (3-) phosphoglyceric acid / 3PGA / 3PG / PGA

ALLOW ATP and NADPH in either order</td></tr>
</table>

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