GCE

Biology A

H020/02: Depth in biology

AS Level

Mark Scheme for June 2025

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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.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

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 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 RM Assessor messaging system.

5. **Work crossed out:**

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. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

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 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, 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 **3(a)(ii)** and **4(g).**

11. Annotations available in RM Assessor

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. 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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>One mark per row

<table>
<tr><th>Description</th><th>Starch</th><th>Cellulose</th></tr>
<tr><td>Is made of amylose and amylopectin</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>Is a long unbranched chain</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Is made up of beta glucose molecules</td><td></td><td>✓</td><td>✓</td></tr>
</table></td><td>3</td><td>1.1</td><td>DO NOT ALLOW hybrid tick and hybrid crosses
ALLOW crosses in place of ticks where only 1 response is used per row</td></tr>
<tr><td></td><td>(b)</td><td></td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.51 award 1 mark
If answer = fructose award 1 mark

4.34/8.50 = 0.5106
To two decimal places = 0.51 ✓</td><td>2</td><td>2.8
2.7</td><td>Max one mark if answer not given to 2 decimal places
ALLOW ecf from calculation to name</td></tr>
</table>

	(c)		(solvent) <u>dissolves</u> the carbohydrates / acts as <u>mobile</u> phase ✓ (solvent) carries, (dissolved) carbohydrates through <u>stationary</u> phase ✓ different carbohydrates will travel different distances, depending on their solubility in the solvent ✓ different carbohydrates will have, high**er** / low**er**, affinity for solvent / solubility in solvent ✓	**2 max**	**2.7**	**IGNORE** general references to separates the carbohydrate(s) – as this relates to the whole process of chromatography, not specifically the solvent **ALLOW** 'solute' for carbohydrate(s) in all MP **IGNORE** 'samples' (in place of carbohydrate) **ALLOW** carries, carbohydrate / solute(s), up the paper **ALLOW** e.g. more soluble sunstances move furth**er ORA** **IGNORE** 'different carbohydrates have different solubilities' unqualified
			Total	**7**		

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	*Independent variable* grade / thickness, of (dialysis) tubing ✓ *Dependent variable* concentration of glucose (found in the external bathing solution samples taken at 30s intervals) ✓	2	2.7	**IGNORE** 'membrane' in place of (dialysis) tubing **IGNORE** 'conc.' in place of concentration
		(ii)	repeated investigation, with wider range of grade(s) of dialysis tubing **OR** repeat investigation, with larger number of grade(s) of tubing within the range ✓ carry out investigation in (thermostatically controlled) water bath (to control temperature) / AW ✓ repeat the investigation, and calculate a mean (concentration of glucose in external solution) ✓	2	3.4	**ALLOW** repeat investigation, with named example(s) of wider range e.g. 7, 9, 11 **ALLOW** repeat investigation, with named example(s) of smaller increments within the existing range e.g. 2, 3, 4 etc

<table>
<tr>
<td></td><td></td><td>(iii)</td>
<td>the thicker the tubing / higher the tubing grading, the slower (the rate of) diffusion across the membrane ✓

any correct comparison using TWO sets of figures with both sets of appropriate units (‘s’ for time & ‘mmol dm^{-3}’ for concentration of glucose) ✓
<table>
<tr><th rowspan="2">Grade of dialysis tubing</th><th colspan="5">Concentration of glucose found in the samples of external solution taken at 30 s intervals (mmol dm^{-3})</th></tr>
<tr><th>0 s</th><th>30 s</th><th>60 s</th><th>90 s</th><th>120 s</th></tr>
<tr><td>1</td><td>0.00</td><td>1.31</td><td>2.52</td><td>3.59</td><td>4.80</td></tr>
<tr><td>3</td><td>0.00</td><td>0.82</td><td>2.24</td><td>2.39</td><td>3.31</td></tr>
<tr><td>5</td><td>0.00</td><td>0.31</td><td>0.64</td><td>0.96</td><td>1.22</td></tr>
</table>
</td>
<td>2</td>
<td>3.2</td>
<td>MP1 must be comparative
ALLOW ‘the higher grading tubing, the longer it takes for glucose to diffuse across (the membrane)’

ALLOW ‘4.8’ in place of ‘4.80’ mmol dm^{-3}

Correct comparison or calculated difference referring to both time interval(s) AND glucose concentration(s) with both respective units
e.g.
<i>because at grade 5 only 1.30 mmol dm^{-3} of glucose had diffused across in 120s, whereas at grade 1, 4.9 mmol dm^{-3} of glucose had diffused across ORA

because at grade 3 an additional 2.09 mmol dm^{-3} of glucose had diffused across in 120s, compared to grade 5.</td>
</tr>
<tr>
<td></td><td>(b)</td><td></td>
<td>similarity
both are passive processes

OR
both allow movement of molecules down a concentration gradient ✓

difference – must be comparative
facilitated diffusion allows the transport of larger molecules
OR
only facilitated diffusion can use,
transport / carrier / channel, proteins ✓</td>
<td>2</td>
<td>1.2</td>
<td>ALLOW neither require an input of, energy / ATP

ALLOW movement of molecules from high concentration to low concentration
IGNORE follow / along, the concentration gradient

ALLOW ORA</td>
</tr>
</table>

	(c)		*affect* (membrane becomes) <u>more</u> permeable / AW ✓ *explanation* <u>phospholipid</u> molecules will gain (more) kinetic energy ✓ (so) more gaps form between the (phospholipid) molecules ✓ (so) more (small) molecules can cross the membrane ✓ (if temperature increases further) phospholipids, lose mechanical stability / may melt, which increases the permeability (even) more ✓	**3 max**	**2.5**	**IGNORE** any reference to proteins becoming denatured **ALLOW** 'phospholipid bilayer becomes more permeable' **ALLOW** larger gaps form between (phospholipid) molecules **ALLOW** phospholipid molecules become less closely packed together
	(d)		(as) <u>energy</u> is needed, for movement of (secretory) vesicles along cytoskeleton ✓ *reference to* using motor proteins ✓ (as) <u>energy</u> is needed, for membrane fusion ✓ hydrolysis / breakdown, of ATP to, provide / release, energy ✓	**2 max**	**1.2**	**IGNORE** references to 'active process' (in Q stem) **IGNORE** 'energy is required' unqualified **IGNORE** any reference to endocytosis **DO NOT ALLOW** 'make / create / produce, energy'
			Total	**12**		

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	metabolism ✓ extracellular ✓	2	1.1	**ALLOW** metabolic reactions **ALLOW** hydrolytic / catabolic / carbohydrase
		*(ii)	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed evaluation including evidence from the table that supports the statement and evidence from the table that undermines the statement. A conclusion may be drawn from the evidence that the candidate has given. *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)** Detailed evaluation including evidence from the table that supports the statement **and** undermines the statement. ***OR*** Detailed evidence for supporting the statement **and** basic evidence for undermining the statement **and** a conclusion. ***OR*** Basic evidence for supporting the statement **and** detailed evidence for undermining the statement **and** a conclusion. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	3.2	**Loss of mark for communication statement if the answer is poorly structured, or a lack of units for yield.** **Indicative points may include:** **Points in SUPPORT of the statement** • Enzyme assisted extraction (potatoes & soya beans) gives the highest yields • Yield for potatoes is 88.8%, the highest value • Yield for split peas is 88.7%, the second highest value • Yield for soya beans with no enzyme is only 48.7%, which is much lower than the enzyme assisted methods/ potatoes and split peas **Points that UNDERMINE the statement** • Yield for mung beans is still quite high at 77.3%, though not enzyme assisted • No control experiment was done, so we don't know if the yields for potatoes and split peas would have been high without enzymes • Insufficient data as only one set of results given for each protein extraction method / no replicates for any protein source or extraction method • Assumptions have been made that the same mass of protein source was used • Assumptions made that same duration of time for all extraction methods

			Level 1 (1–2 marks) An attempt at an evaluation has been made, using some of the evidence from the table that supports the statement **and** undermines the statement. *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.*			• Use of 'always' implies enzyme based extraction method would apply to all protein sources but only 4 sources given • No data for enzyme assisted method alone (as always with chemical method as well) • No details on other variables which may have been uncontrolled **Conclusion** • Disagree with statement: e.g. data does not prove that enzyme assisted method will always give a greater yield, insufficient data / sources to agree with the student confidently • Agree with statement: yield in potatoes and peas are highest

	(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.0 cm^3 s^{-1} award 3 marks** Initial rate = 16/8 = 2.0 cm^3 s^{-1} appropriately drawn tangent between 0 to 8s **OR** single data point used between 0 to 8s ✓ correct working: difference in *y* axis readings divided by difference in *x* axis ✓ correct answer to two significant figures ✓	**3**	**2.4**	**ALLOW** a range of 2.0 to 2.2 with supporting tangent line drawn **ALLOW** ECF for tangent drawn at incorrect position
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.1 award 1 mark.** 4.34 / 2.1 = 2.06666 = 2.1 ✓	**1**	**2.4**	**ALLOW** ECF from **(i)** **DO NOT ALLOW** if answer not given to 2 sig. figs.
	(c)		*vary by:* adding, acid(s) / alkali(s) (solutions) **OR** using buffer solutions (to regulate the pH) ✓ *detect by:* using, universal indicator paper / universal indicator solution / pH paper / pH probe / pH meter ✓	**2**	**3.4**	**ALLOW** correct description of use of acid **and** alkali (solutions) **IGNORE** addition of H^+/OH^- unqualified **IGNORE** add "different solutions of different pH" or "use different pH solutions" unqualified **IGNORE** litmus paper (as does not determine actual pH value) **IGNORE** indicator paper unqualified **ALLOW** pH test strips **ALLOW** 'universal indicator'

	(d)		*as substrate concentration:* *affect* rate of reaction increases ✓ *explanation* (it) increases chance of collision(s) between substrate(s) and active site ✓ (so) more enzyme-substrate complexes form ✓ at (very) high concentration of substrate, all the active sites become occupied ✓ (so) the rate of reaction plateaus / Vmax is achieved ✓ (and) enzyme concentration becomes the limiting factor ✓	**4 max**	**1.2**	 **ALLOW** 'enzyme activity increases' **IGNORE** 'enzyme works faster' (as turnover rate will be unaffected) **ALLOW** increases chance of successful collision **ALLOW** 'ESC' for enzyme-substrate complex **ALLOW** (at very high concentrations) rate of, enzyme activity/reaction, levels off **ALLOW** (at very high concentrations) rate of reaction will no longer increase **DO NOT ALLOW** rate decreases or slows down
			Total	**19**		

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>standardises classification across the world / AW ✓

each organism has its own unique name / AW ✓

avoids confusion, in naming species ✓

simplifies communication between, people with different languages / scientists in different countries ✓</td><td>Max 1</td><td>1.1</td><td>ALLOW ‘universal naming system’ / ‘used across the world’
IGNORE ‘universal’ unqualified

ALLOW avoids ambiguity caused by common local names
ALLOW universally understood (between countries with different languages)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>Taxa</th><th>Name</th></tr><tr><td>Kingdom</td><td><u>Animalia</u></td></tr><tr><td>Genus</td><td>Dermatophagoides</td></tr><tr><td>Species</td><td>pteronyssinus</td></tr></table>✓ ✓</td><td>2</td><td>1.1</td><td>IGNORE capitalisation of both genus and species terms as the skill being assessed here is the recognition of correct taxa

All three correct award 2 marks
Any two correct award 1 mark
Only one correct award no marks</td></tr>
</table>

	(b)		*Organisms in Plantae kingdom:* (have) cell wall composed of cellulose ✓ (contain) chlorophyll / chloroplasts ✓ photosynthesise / autotrophic ✓ store starch ✓	**Max 2**	**2.1**	**IGNORE** multicellular **IGNORE** membrane bound organelles **IGNORE** reference to no mycelium
	(c)		classification is based on phylogeny / AW ✓	**1**	**1.1**	**IGNORE** individual definitions of both terms as the questions asks for the **relationship** between the terms **ALLOW '**phylogeny informs classification'
	(d)		*Mark first 2 answers* *Three domain system has:* six kingdoms (not five) ✓ domains are Archaea, Bacteria and Eukarya ✓ domains are based on (similarities in biological) molecules ✓ organisms in different domains contain a, specific / unique, form of rRNA ✓	**Max 2**	**2.1**	**ALLOW** ORA for five kingdom **ALLOW** description of the 6 kingdoms e.g. 4 eukaryotic and 2 prokaryotic **ALLOW** 'eukaryotes' for Eukarya

	(e)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed description of Darwin's theory of evolution by natural selection **and** detailed use of the information from the table. Logical explanations of how the finches in the table were naturally selected because of their beak types, related to the food in their environment. *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)** Detailed description of Darwin's theory of evolution by natural selection ***OR*** Brief description of Darwin's theory of evolution by natural selection with limited use of the information from the table, relating natural selection of the finches to their beak types, and to the food in their environment. ***OR*** Outline of Darwin's theory of evolution by natural selection with detailed use of the information from the table, relating natural selection of the finches to their beak types, and to the food in their environment. *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)** Brief outline of Darwin's theory of evolution by natural selection ***OR*** Limited use of the information from the table	**6**	**2.1** **3.3**	**Loss of mark for communication statement if incorrect science / terminology used e.g. gene passed on (instead of allele), idea of beak shape changing during the lifetime of an individual finch (Lamarck).** **Indicative points may include:** • Variation existed within the finch population • Reference to mutations leading to genetic variation • Reference to genetic and phenotypic variation • Different food sources acts as the selection pressure • Physical differences in the beaks gave some individuals a selective advantage over other (finches) • Those finches with beaks which were suitable to the food available were able to feed and survive • These finches were able to breed • Those finches without the selective advantage died out • Reference to survival of the fittest • The allele for the beneficial characteristic was passed on to the next generation • Over time the number of finches with the advantageous beak shape increased • This led to speciation (resulting in 3 different species of finches) • Further detail e.g. reference to changes in allele frequency / gene pool / divergent evolution

			OR A statement about Darwin's theory of evolution by natural selection **AND** an example of information from the table relating to natural selection *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.*			Reference to the **using information from the table** relating to beak shape and feeding habit: • Qualified example of beneficial beak shape linked to food availability o e.g. those finches with a probing beak with probing tips will have the selective advantage when flying insects are in abundance • Qualified example of disadvantageous beak shape o e.g. those finches with crushing beak with biting tips will have a selective disadvantage when buds, leaves and fruits are in short supply • Qualified example of how the beak shape enables finch to feed successfully o e.g. vegetarian finch has a crushing beak with biting tips which can crush fruit o e.g. warbler finch has a probing beak therefore it can seek out the insects within grass habitats but will be unable to crush fruit o e.g. cactus finch has a probing beak with crushing tips to access nectar from nectary at the base of the flower

						• Qualified example of how mutation resulted to differences in beak phenotypes leading to the specific species of finch ○ e.g. mutation resulting in a crushing beak led to the evolution of the vegetarian finch over many generations ○ e.g. mutation resulting in a probing beak with probing tip led to the evolution of the warbler finch over many generations ○ e.g. mutation resulting in a probing beak with crushing tip led to the evolution of the warbler finch over many generations
			Total	**14**		

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	symmetrical bell-shaped curve drawn **AND** peak at 8cm ✓	1	2.6	
		(ii)	*Any two from:* genetics / genes / genetic factors environment / environmental (factors) crossing over independent assortment (of chromosomes / chromatids) random mating random fertilisation ✓✓	1	1.2	**BOTH** causes needed for one mark **IGNORE** meiosis unqualified **IGNORE** sexual reproduction unqualified **ALLOW** mutation
	(b)		diffusion, distance / pathway, is (too) large ✓ (due to) a low surface area to volume ratio ✓ *ref to* rate of diffusion is too slow to meet demand ✓	2 max	1.1	**ALLOW** 'SA:vol ratio' and 'SA:V ratio' **IGNORE** reference to 'high metabolic demand' unqualified
	(c)		large surface area / thin surface / short diffusion distance ✓	1	2.1	**ALLOW** large, SA:vol ratio / SA:V

	(d)		to, maintain / create, (a steep) concentration gradient ✓ to maximise / for higher / the faster, rate of diffusion ✓ blood (in efferent blood vessels) flows in opposite direction to water (entering gills) ✓ *ref to* counter current (flow / system / mechanism) ✓ gill <u>filaments</u> need a flow of water, to keep them apart / AW ✓	**Max 4**	**2.1**	**IGNORE** contraflow system
			Total	**9**		

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10 award 2 marks** breathing rate = ventilation rate/tidal volume ventilation rate = $5dm^3$ per minute = $5000cm^3$ per minute breathing rate = $5000cm^3$/ $480cm^3$ = 10.4167 = 10 *5000 / 480* ✓ *correct rounding to nearest whole number* ✓	**2**	**2.4**	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = $816cm^3$ award 1 mark** Increase in tidal volume = 480/100 x 70 = $336cm^3$ New tidal volume = 480 + 336 = = $816cm^3$	**1**	**2.4**	
	(b)		the large peak, will be lower / AW **AND** trough, will be smaller ✓	**1**	**2.3**	**IGNORE** references to vital capacity being lower as the Q asks for how the ***trace*** will be different

<table>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>In any order:

Error 1 and correction
external intercostal muscle (contract), not internal ✓

Error 2 and correction
pressure in the thorax is now lower (than atmospheric pressure), not higher ✓</td>
<td>2</td>
<td>3.1</td>
<td>Both error and correction are needed for the mark.
Correction must be matched with the appropriate error.

IGNORE references to internal intercostal muscles relax (as that would not bring about the ribcage moving upwards)</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td></td>
<td>
<table>
<tr><th>Components</th><th>Role</th><th></th></tr>
<tr><td>Incomplete rings of cartilage in the trachea</td><td>stop trachea from collapsing
OR
(incomplete) to allow food to move down (the oesophagus)</td><td>✓</td></tr>
<tr><td>Smooth muscle in the bronchioles</td><td>contract and relax to control the size of the lumen (of the bronchioles)
OR
controls / changes, volume of air reaching lungs</td><td>✓</td></tr>
<tr><td>Elastic fibres in the alveoli</td><td>enables alveoli to <u>stretch</u>, and <u>recoil</u>
OR
recoils to force the air out
OR
prevent alveoli, collapsing / over expanding</td><td>✓</td></tr>
</table>
</td>
<td>3</td>
<td>1.1</td>
<td>IGNORE support / strengthens trachea
IGNORE ‘keeps trachea open’
ALLOW ‘flexibility during swallowing’

IGNORE references to dilation and constriction of lumen unqualified

IGNORE ‘controls air flow’ unqualified

DO NOT ALLOW ‘alveoli contract and relax’</td>
</tr>
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