

**GCE**

**Biology A**

**H020/02: Depth in biology**

AS Level

**Mark Scheme for June 2022**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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.

#### 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 SEEN 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 **1(c)(ii)** and **5**.

## 11. Annotations available in RM Assessor

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

<b>Annotation</b>	<b>Meaning</b>
/	Alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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	Mark	A O	Guidance
1	(a)	<p>any two <b>I</b> marks and matching <b>R</b> marks: If an <b>I</b> mark is just missed (e.g. for <b>I1</b> answer says weight instead of mass) can still give the matching reason mark <b>R1</b></p> <p><b>I1</b> same, number / size / mass / volume (of pieces) ✓</p> <p><b>R1</b> to control / same, <u>surface area</u> ✓</p> <p><b>I2</b> pieces from same beetroot <b>OR</b> pieces from same, part / depth / variety, of beetroot ✓</p> <p><b>R2</b> to control / same, pigment concentration ✓</p> <p><b>I3</b> rinse / wash / wipe / dry, pieces ✓</p> <p><b>R3</b> to remove pigment released by, cutting / cell damage ✓</p> <p><b>I4</b> use, one / new, flask / tube, per, temperature / repeat ✓</p> <p><b>R4</b> to, test effect of / get absorbance for, one / single, temperature ✓</p>	4 max	AO 3.3	<p><b>ALLOW</b> cubes / discs / cylinders / strips / rectangles / chips / samples / beetroot, for 'pieces' throughout</p> <p><b>ALLOW</b> betalain for 'pigment' throughout</p> <p><b>I1 ALLOW</b> cork borer cylinders of same length</p> <p><b>I1 IGNORE</b> weight for 'mass'</p> <p><b>R1 ALLOW</b> same, surface area to volume ratio / SA:V</p> <p><b>ALLOW I1</b> 'same <u>surface area</u>' + <b>R1</b> '<u>surface area</u> affects rate of pigment loss' for 2 marks</p> <p><b>I2 ALLOW</b> plant for 'beetroot'</p> <p><b>I2 ALLOW</b> species for 'variety'</p> <p><b>R2 ALLOW</b> <i>idea of</i> pigment concentration varies / AW</p> <p><b>R3 ALLOW</b> to avoid artificially high absorbance reading</p> <p><b>I4 ALLOW</b> add pieces when temperature reached</p> <p><b>I4 ALLOW</b> different / new / fresh, pieces for each, temperature / repeat</p> <p><b>R4 ALLOW</b> so pieces experience a single temperature / so pieces not affected by previous temperature <b>OR</b> as used / old, pieces damaged by high temperatures / AW</p>
1	(b)	<u>temperature</u> ✓	1	AO 3.3	<b>DO NOT ALLOW</b> room temperature
1	(c)	(i) <p>1 linear scales using half of grid or more <b>AND</b> x axis labelled <u>temperature (°C)</u> <b>AND</b> y axis labelled (mean) <u>absorbance (%)</u> ✓</p> <p>2 points plotted correctly for <u>mean</u> absorbance ✓</p> <p>3 all points joined with curved line ✓</p>	3	AO 2.4	<p>1 <b>ALLOW</b> solidus before unit (instead of brackets)</p> <p>2 <b>ALLOW</b> to <math>\pm 1</math> small square</p> <p>2 <b>IGNORE</b> figures plotted from trial 1, 2 or 3</p> <p>2 <b>DO NOT ALLOW</b> bars</p> <p>3 <b>DO NOT ALLOW</b> ruled lines between points</p> <p>3 <b>ALLOW</b> one data point outside of curved line of best fit</p> <p>3 <b>IGNORE</b> line extended beyond first or last point</p> <p>3 <b>ALLOW ECF</b> for data plot from trial 1, 2 or 3</p>

1	(c)	(ii)*	<p><b>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</b></p> <p><b><i>In summary:</i></b> 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, <b>Level 1</b>, <b>Level 2</b> or <b>Level 3</b>, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the <b>Communication Statement</b> (shown in italics):</p> <ul style="list-style-type: none"> <li>○ award the higher mark where the Communication Statement has been met.</li> <li>○ award the lower mark where aspects of the Communication Statement have been missed.</li> </ul> <p>• <b>The science content determines the level.</b></p> <p>• <b>The Communication Statement determines the mark within a level.</b></p>		
			<p><b>Level 3 (5–6 marks)</b> Full and detailed description of how the phospholipids in the cell membrane are affected by temperature, causing the structure of the plasma membrane to become disrupted with reference to the results between 20°C and 70°C.</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><b>Level 2 (3–4 marks)</b> A detailed description of how the phospholipids in the cell membrane are affected by temperature, causing the structure of the plasma membrane to become disrupted with reference to the results between 20°C and 70°C.</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><b>Level 1 (1–2 marks)</b> A description of some of the effects on phospholipids in the cell membrane of either high or low temperature with reference to the results between 20°C and 70°C.</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><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	<p><b>AO</b> <b>Indicative points may include:</b></p> <p>1.2 <b>Explanation of results</b></p> <p>AO At 20°C, membrane intact / impermeable / least permeable</p> <p>2.3</p> <p>AO At, low temperature / 30°C / 40°C / 50°C, pigment escapes</p> <p>3.1 Through gaps between (moving) phospholipids As temperature increases kinetic energy increases More, phospholipid movement / gaps Membrane becomes more permeable More, pigment loss / betalain release / colour in flask Higher absorbance figure Graph curves upwards</p> <p>At high temperature / 60°C / 70°C, membrane disrupted Phospholipid, arrangement / bilayer, breaks down / melts Membrane, leaky / very permeable Large increase in, pigment loss / betalain release / AW Large increase in absorbance figure Graph curves up more steeply</p> <p><b>Structure of phospholipids</b> Phosphate (and glycerol) head (Two) fatty acid / hydrocarbon, tails</p> <p><b>Properties of phospholipids</b> Heads, are hydrophilic / face out / face aqueous medium Tails, are hydrophobic / face inwards / in centre of bilayer Phospholipids form bilayer Form barrier to, water / water-soluble molecules <b>IGNORE</b> ref. proteins / cholesterol</p>

1	(d)		1 percentage / absorbance / mean, higher ✓  2 water / ice, expansion, breaks / damages, membrane <b>OR</b> ice crystals, puncture / damage, membrane ✓	2	AO 3.3	1 <b>DO NOT ALLOW</b> absorption for 'absorbance' 1 <b>ALLOW</b> ORA percentage / absorbance / mean, lower, for first experiment / in table
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Question			Answer	Mark	A O	Guidance
2	(a)	(i)	1 (named) protein, synthesis / made ✓ 2 (named) organelle, replication / synthesis ✓  3 energy stores increase ✓ 4 (replicated / new) DNA checked for errors ✓ 5 DNA repair ✓	1 max	AO 1.2	1 e.g. tubulin 2 e.g. mitochondria 2 <b>ALLOW</b> G2 checkpoint to ensure enough organelles 3 <b>ALLOW</b> G2 checkpoint to ensure enough energy stores
2	(a)	(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 3 award 1 mark</b>  3 ✓	1	AO 2.2	<b>ALLOW</b> answer given on <b>Fig. 2.1</b>  <b>ALLOW</b> an answer anywhere between 2 and 4

2	(a)	(iii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 18 (mm year<sup>-1</sup>) award 2 marks</b></p> <p><math>\frac{110 - 21}{6 - 1}</math> OR <math>\frac{89}{5}</math> ✓</p> <p>18 ✓</p>
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2	AO 2.2	<p><b>ALLOW</b> data from <b>any pair of years</b> to calculate growth rate (change in y axis ÷ change in x axis). E.g. working &amp; answer <b>OR</b> correct answer alone for <b>2 marks</b></p> <table border="1" style="margin: 10px auto;"> <tr> <th>year</th> <th>0</th> <th>1</th> <th>3</th> </tr> <tr> <td>1</td> <td><math>\frac{21 - 3}{1}</math> = 18.0</td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>3</td> <td><math>\frac{56 - 3}{3}</math> = 17.7</td> <td><math>\frac{56 - 21}{2}</math> = 17.5</td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>6</td> <td><math>\frac{110 - 3}{6}</math> = 17.8</td> <td><math>\frac{110 - 21}{5}</math> = 17.8</td> <td><math>\frac{110 - 56}{3}</math> = 18.0</td> </tr> </table> <p><b>ALLOW</b> answer given to 3 significant figures as shown (<b>2 marks</b>)                  If answer given to more than 3 sig. fig. <b>max 1 mark</b></p> <p><b>ALLOW ECF</b> from candidate's 2(a)(ii) figure for year 0</p> <p><b>ALLOW</b> calculations from variant y axis readings as shown:</p> <table border="1" style="margin: 10px auto;"> <tr> <th>year</th> <th>length (mm)</th> </tr> <tr> <td>0</td> <td>2 or 4</td> </tr> <tr> <td>1</td> <td>20.5</td> </tr> <tr> <td>3</td> <td>56.5</td> </tr> <tr> <td>6</td> <td>109.5</td> </tr> </table> <p>e.g. (yrs 6 and 1) <math>110 - 20.5 = 89.5</math> and <math>89.5 \div 5 = 17.9</math> <b>OR</b>  <math>109.5 - 21 = 88.5</math> and <math>88.5 \div 5 = 17.7</math>  <math>109.5 - 20.5 = 89</math> and <math>89 \div 5 = 17.8</math></p>	year	0	1	3	1	$\frac{21 - 3}{1}$ = 18.0			3	$\frac{56 - 3}{3}$ = 17.7	$\frac{56 - 21}{2}$ = 17.5		6	$\frac{110 - 3}{6}$ = 17.8	$\frac{110 - 21}{5}$ = 17.8	$\frac{110 - 56}{3}$ = 18.0	year	length (mm)	0	2 or 4	1	20.5	3	56.5	6	109.5
year	0	1	3																									
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1	20.5																											
3	56.5																											
6	109.5																											

2	(b)	(i)	(position / arrangement, of) chromosomes visible ✓	1	AO 2.7	<p><b>ALLOW</b> chromosomes, different colour to cytoplasm / contrast with rest of cell / show up / stand out, for ‘visible’  <b>ALLOW</b> to, identify / distinguish, chromosomes  <b>ALLOW ORA</b> ‘otherwise we could not see chromosomes’  <b>ALLOW</b> chromatids / genetic material / DNA / chromatin, for ‘chromosomes’</p>																																															
2	(b)	(ii)	chromosomes lined up at, equator / metaphase plate ✓	1	AO 3.1	<p><b>ALLOW</b> middle (of cell) for ‘equator’  <b>ALLOW</b> pairs of sister chromatids for ‘chromosomes’</p>																																															
2	(b)	(iii)	<p>all columns with informative headings ✓                      stages of mitosis in correct order ✓</p>	2	AO 3.2	<p><b>IGNORE</b> data in table.</p> <table border="1" data-bbox="1335 480 2119 863"> <thead> <tr> <th rowspan="2">Stage (of mitosis)</th> <th colspan="3">Number of cells (counted)</th> </tr> <tr> <th>Student 1</th> <th>Student 2</th> <th>Student 3</th> </tr> </thead> <tbody> <tr> <td>Prophase</td> <td>3</td> <td>5</td> <td>2</td> </tr> <tr> <td>Metaphase</td> <td>1</td> <td>0</td> <td>5</td> </tr> <tr> <td>Anaphase</td> <td>3</td> <td>4</td> <td>0</td> </tr> <tr> <td>Telophase</td> <td>0</td> <td>1</td> <td>3</td> </tr> </tbody> </table> <p><b>OR</b></p> <table border="1" data-bbox="1335 970 2119 1310"> <thead> <tr> <th rowspan="2">Student</th> <th colspan="4">Number of cells (at stage of mitosis)</th> </tr> <tr> <th>Prophase</th> <th>Metaphase</th> <th>Anaphase</th> <th>Telophase</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3</td> <td>1</td> <td>3</td> <td>0</td> </tr> <tr> <td>2</td> <td>5</td> <td>0</td> <td>4</td> <td>1</td> </tr> <tr> <td>3</td> <td>2</td> <td>5</td> <td>0</td> <td>3</td> </tr> </tbody> </table> <p><b>ALLOW</b> Trial / test, for ‘Student’  <b>ALLOW</b> Amount for ‘Number’  <b>ALLOW</b> Phase for ‘Stage’  <b>ALLOW</b> student 1, student 2, student 3 on left in 2<sup>nd</sup> table</p>	Stage (of mitosis)	Number of cells (counted)			Student 1	Student 2	Student 3	Prophase	3	5	2	Metaphase	1	0	5	Anaphase	3	4	0	Telophase	0	1	3	Student	Number of cells (at stage of mitosis)				Prophase	Metaphase	Anaphase	Telophase	1	3	1	3	0	2	5	0	4	1	3	2	5	0	3
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2	5	0	4	1																																																	
3	2	5	0	3																																																	

2	(c)	<p><i>any three similarities from:</i></p> <p><b>S1</b> chromosomes consist of two (sister) chromatids ✓  <b>S2</b> chromosomes / chromatids, condense ✓  <b>S3</b> nuclear, envelope / membrane, breaks down ✓  <b>S4</b> centrioles move to opposite, poles / ends of the cell ✓  <b>S5</b> spindle (fibres) form(s) ✓</p> <p><i>any three points unique to meiosis (differences):</i></p> <p><b>D6</b> meiosis has, prophase 1 and 2 / two prophases ✓  <b>D7</b> homologous chromosomes pair / bivalents form /  synapsis occurs, in prophase (1) ✓  <b>D8</b> crossing over occurs / chiasma(ta) form, in prophase (1) ✓  <b>D9</b> in prophase 2 chromatids are genetically different ✓</p>	4 max	AO 2.5	<p><b>S2 ALLOW</b> nucleolus disappears</p> <p><b>S4 ALLOW</b> centrosomes for 'centrioles'</p> <p><b>D8 DO NOT ALLOW</b> crossing over between sister chromatids</p>
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Question			Answer	Mark	AO	Guidance															
3	(a)	(i)	glycosidic (bond) ✓ hydrolysis <b>OR</b> water, added / needed ✓	2	AO 1.1	<b>IGNORE</b> numbers <b>DO NOT ALLOW</b> condensation / water produced <b>ALLOW</b> description OH joins, one sugar / galactose, and H joins, the other / glucose (plus O from glycosidic bond)															
3	(a)	(ii)	1 (undigested) lactose lowers the water potential ✓ 2 water enters (the large intestine) by osmosis ✓	2	AO 2.6	1 <b>ALLOW</b> bacteria break down the lactose so, (unabsorbed) glucose / galactose, lower $\psi$ 2 <b>ALLOW</b> down $\psi$ gradient for 'osmosis'															
3	(b)	(i)	1 more than one, C=C / double bond (between carbons) ✓ 2 more than one, kink / bend ✓ 3 fewer H atoms ✓	1 max	AO 1.1	1 <b>ALLOW</b> has double bonds (between carbons) 2 <b>ALLOW</b> has, kinks / bends															
3	(b)	(ii)	1 (yes because) both fall 2006-2012 / 2006-2016 / 2002-2012 / 2002-2016 ✓ 2 (no because) 1994-2002 / 1994-2006 / 2012-2016, hypercholesterolemia rises but (CVD) deaths fall / two factors show opposite trends <b>OR</b> 2002-2006 / 2012-2016 / 1994-2016, hypercholesterolemia does not change but (CVD) deaths fall <b>OR</b> no positive correlation in 1994-2006 <b>and</b> 2012-2016 ✓ 3 % hypercholesterolemia figure and CVD deaths figure per 100 000 people for two named years ✓ 4 correlation does not (necessarily) imply causation ✓ 5 other (named) factor affects death rate (from CVD) ✓	3 max	AO 3.4	<b>ALLOW</b> (22-44 year olds / people) with high blood cholesterol / with the condition, for 'hypercholesterolemia' MPs 1 and 2 <b>IGNORE</b> single years (look for ranges) <table border="1" data-bbox="1317 817 2092 1082"> <thead> <tr> <th>time frame</th> <th>change in % hypercholesterolemia in 20-44 age group</th> <th>change in CVD deaths per 100 000</th> </tr> </thead> <tbody> <tr> <td>1994 → 2002</td> <td>13 → 16</td> <td>270 → 220</td> </tr> <tr> <td>2002 → 2006</td> <td>16 → 16</td> <td>220 → 185</td> </tr> <tr> <td>2006 → 2012</td> <td>16 → 12</td> <td>185 → 150</td> </tr> <tr> <td>2012 → 2016</td> <td>12 → 13</td> <td>150 → 145</td> </tr> </tbody> </table> 3 <b>ALLOW</b> hyperchol. figures $\pm 2$ and CVD figs $\pm 10$ 3 <b>ALLOW</b> processed figs e.g. 2006-2012 CVD decreases by 35 5 e.g. obesity, physical inactivity, alcohol use, nicotine use, other (named) dietary factors, other (named) health problems, medical treatment, statins	time frame	change in % hypercholesterolemia in 20-44 age group	change in CVD deaths per 100 000	1994 → 2002	13 → 16	270 → 220	2002 → 2006	16 → 16	220 → 185	2006 → 2012	16 → 12	185 → 150	2012 → 2016	12 → 13	150 → 145
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2012 → 2016	12 → 13	150 → 145																			

<b>3</b>	<b>(c)</b>			<b>3 max</b>	AO 3.4	<p><b>ALLOW max 1 mark</b> for 2 errors identified without corrections <b>OR</b> for 2 corrections without errors <b>OR</b> for 1 error + 1 (different) correction</p> <p><b>2 ALLOW in B</b> it is not the atrioventricular valve that opens it is the semi-lunar valve</p> <p><b>4 ALLOW</b> it is not the semi-lunar valve that opens it is the, atrioventricular / bicuspid / mitral, valve</p>
			<p><b>1 (A)</b> it is not atrioventricular node (AVN), it is sino-atrial node (SAN) ✓</p> <p><b>2 (B)</b> atrioventricular valve doesn't open, it closes ✓</p> <p><b>3 (B)</b> the pressure in the aorta doesn't fall, it rises ✓</p> <p><b>4 (C)</b> semilunar valve doesn't open, it closes ✓</p>			

Question			Answer	Mark	A O	Guidance
<b>4</b>	<b>(a)</b>	<b>(i)</b>	phagocyte / neutrophil ✓	<b>1</b>	AO 1.1	<p><b>ALLOW</b> (non-human) macrophage</p> <p><b>IGNORE</b> leucocyte / white blood cell</p>
<b>4</b>	<b>(a)</b>	<b>(ii)</b>	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 14 or 15 (µm) award 2 marks</b></p> <p>14mm ÷ 950 = 0.0147mm ✓</p> <p>0.0147 x 1000 = 15µm ✓</p>	<b>2</b>	AO 2.8	<p><b>ALLOW</b> answer given to <b>3 significant figures for 2 marks</b> e.g. 13.7 / 14.2 / 14.7µm</p> <p>If answer given to <b>more than 3 sig. fig. max 1 mark</b></p> <p><b>ALLOW</b> (13 000 ÷ 950) = 13.7µm <b>for 2 marks</b></p> <p><b>ALLOW</b> (13 500 ÷ 950) = 14.2µm <b>for 2 marks</b></p> <p>If final answer incorrect <b>award 1 mark for two clearly shown</b> correct steps in working (other than 1 plus 4). <b>IGNORE</b> crossed-out working.</p> <p><b>steps in working:</b></p> <p><b>1</b> (diameter with units =) 13 / 13.5 / 14mm <b>OR</b> 1.3 / 1.35 / 1.4cm</p> <p><b>2</b> divide by 950</p> <p><b>3</b> convert <b>EITHER</b> original diameter <b>OR</b> answer to µm (mm → µm x 1000, cm → µm x 10 000)</p> <p><b>4</b> round to 2 significant figures</p>
<b>4</b>	<b>(a)</b>	<b>(iii)</b>	made up of different cells / not made up of different tissues ✓	<b>1</b>	AO 1.1	<p><b>IGNORE</b> differentiated cells</p> <p><b>ALLOW</b> two or more named blood cells for 'different'</p>



4	(b)	(i)	<u>artificial active</u> (immunity) ✓	1	AO 1.1	
4	(b)	(ii)	1 low shallow hump labelled 'primary' first and higher steeper hump labelled 'secondary' later ✓  2 primary starts at 5-10 days and secondary at 25-28 days ✓	2	AO 2.1	1 <b>IGNORE</b> timing 1 <b>ALLOW</b> curve that plateaus and does not come back down  2 <b>ECF</b> missing label
4	(b)	(iii)	1 (memory cells) divide to form plasma cells ✓ 2 plasma cells, produce / release, antibodies (rapidly) ✓ 3 antibodies, bind to / disable / destroy, antigen / virus ✓	2 max	AO 1.2 AO 2.1	3 <b>ALLOW</b> pathogen for 'virus'
4	(c)		1 phagocyte engulfs pathogen in a, vesicle / phagosome / endosome ✓ 2 lysosomes combine with, phagosome / vesicle / endosome ✓ 3 (lysosome) enzymes, break down / digest / destroy, pathogen ✓	3	AO 1.1	1 <b>ALLOW</b> encloses / traps / captures / AW for 'engulfs' 1 <b>ALLOW</b> vacuole for 'vesicle' 2 <b>ALLOW</b> fuse with / join to / attach to / bind to, for 'combine' 3 <b>IGNORE</b> combat / fight / attack, for 'destroy' 3 <b>DO NOT ALLOW</b> lysozymes for 'enzymes'
4	(d)	(i)	1 CO <sub>2</sub> + water form carbonic acid ✓ 2 carbonic acid dissociates giving, H <sup>+</sup> / protons ✓ 3 H <sup>+</sup> / protons, bind to Hb ✓ 4 so CO <sub>2</sub> can be carried as HCO <sub>3</sub> <sup>-</sup> ✓	2 max	AO 2.5	
	(d)	(ii)	1 more CO <sub>2</sub> during exercise so curve shifts to right ✓ 2 at same pO <sub>2</sub> Hb has a lower % saturation of oxygen ✓ 3 so oxygen, dissociates / is released, from Hb more readily ✓ 4 more oxygen (provided / needed) for, muscles / aerobic respiration ✓	2 max	AO 1.2 AO 2.5	2 <b>ALLOW</b> haemoglobin's affinity for oxygen is decreased  4 <b>ALLOW</b> to help supply sufficient oxygen to muscles

Question	Answer	Mark	AO	Guidance
5*	<p><b>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</b></p> <p><b>In summary:</b> 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, <b>Level 1</b>, <b>Level 2</b> or <b>Level 3</b>, best describes the overall quality of the answer.</p> <p>Then, award the higher or lower mark within the level, according to the <b>Communication Statement</b> (shown in italics):</p> <ul style="list-style-type: none"> <li>○ award the higher mark where the Communication Statement has been met.</li> <li>○ award the lower mark where aspects of the Communication Statement have been missed.</li> </ul> <ul style="list-style-type: none"> <li>• <b>The science content determines the level.</b></li> <li>• <b>The Communication Statement determines the mark within a level.</b></li> </ul>			
	<p><b>Level 3 (5–6 marks)</b> A full and detailed account of the changes that take place during inspiration and the similarities and differences between the apparatus and the ventilation system in mammals, including correct reference to volume and pressure changes.</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><b>Level 2 (3–4 marks)</b> A detailed account of the changes that take place during inspiration, and some of the similarities and differences given between the apparatus and the ventilation system in mammals.</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><b>Level 1 (1–2 marks)</b> An account of some of the changes that take place during inspiration. Must mention at least one correct comparison with the apparatus in and the ventilation system in mammals.</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><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	AO 1.1 AO 2.1 AO 2.3	<p><b>Indicative points can include:</b></p> <p><b>How used:</b></p> <p><b>Pull down, elastic sheet / button, at base to make balloons expand</b></p> <ul style="list-style-type: none"> <li>+ Models diaphragm muscle contracting / diaphragm flattening</li> </ul> <p><b>Volume in bell jar, gets bigger / increases</b></p> <ul style="list-style-type: none"> <li>+ Models thorax volume increase</li> </ul> <p><b>Pressure in bell jar, gets lower / decreases</b></p> <ul style="list-style-type: none"> <li>+ Models thorax pressure decrease</li> </ul> <p><b>Air pressure outside now higher than in bell jar</b></p> <ul style="list-style-type: none"> <li>+ Models higher pressure outside lungs</li> </ul> <p><b>Air pushed into balloons / balloons fill</b></p> <ul style="list-style-type: none"> <li>+ Models air, pushed into / inflating, lungs</li> </ul> <p><b>Appropriateness:</b></p> <ul style="list-style-type: none"> <li>+ Glass tubing represents trachea</li> <li>+ Two balloons to model two lungs</li> <li>+ Elastic sheet represents diaphragm</li> <li>– Sides of bell jar cannot change shape</li> <li>– Cannot model rib cage, expanding / moving up and out</li> <li>– Cannot model contraction of external intercostal muscles</li> </ul> <p><b>IGNORE</b> expiration, elastic sheet stretching <b>DO NOT CREDIT</b> steps in <b>model</b> or mammal process in reverse sequence</p> <p>(+ = similarity, – = difference)</p>

Question			Answer	Mark	AO	Guidance										
6	(a)	(i)	(look larger) to, scare / deter, predators ✓ protection ✓	1 max	AO 1.1	<b>IGNORE</b> attract mates / camouflage										
6	(a)	(ii)	<u>Uraba</u>	1	AO 1.1											
6	(a)	(iii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Taxonomic description</th> <th>Hierarchical position</th> </tr> </thead> <tbody> <tr> <td>Phylum Arthropoda</td> <td>2</td> </tr> <tr> <td>Order Lepidoptera</td> <td>4</td> </tr> <tr> <td>Kingdom Animalia</td> <td>1</td> </tr> <tr> <td>Class Insecta</td> <td>3</td> </tr> </tbody> </table> <p style="text-align: right;">✓</p>	Taxonomic description	Hierarchical position	Phylum Arthropoda	2	Order Lepidoptera	4	Kingdom Animalia	1	Class Insecta	3	1	AO 2.1	
Taxonomic description	Hierarchical position															
Phylum Arthropoda	2															
Order Lepidoptera	4															
Kingdom Animalia	1															
Class Insecta	3															
6	(b)		<p><b>1</b> (pale and) dark / colour difference, due to, genetic variation / (different) alleles / (random) mutation ✓</p> <p><i>in, industrial / polluted / urban / lichen-free, area:</i>  <b>2</b> pale, selected against / eaten / less likely to survive <b>OR</b>  dark, selected for / not eaten / more likely to survive ✓</p> <p><b>3</b> (more) dark, reproduce / pass on <u>allele</u> / pass on mutation  <b>OR</b> fewer / no, pale, reproduce / pass on their <u>allele</u> ✓</p> <p><b>4</b> <u>frequency of allele</u> for, dark colour increases / pale colour decreases ✓</p>	4	AO 1.2 AO 2.1	<p><b>1</b> look for statement</p> <p><b>ALLOW REVERSE ARGUMENTS</b>  <i>in, non-industrial / unpolluted / rural / lichen-rich, area:</i>  <b>2</b> pale, selected for / not eaten / more likely to survive <b>OR</b>  dark, selected against / eaten / less likely to survive</p> <p><b>3</b> (more) pale, reproduce / pass on their <u>allele</u> <b>OR</b>  fewer / no, dark, reproduce / pass on <u>allele</u> / pass on mutation</p> <p><b>4</b> <u>frequency of allele</u> for, pale colour increases / dark colour decreases</p>										
6	(c)		<p><b>1</b> not closely related / no (recent) common ancestor / evolved separately, as,  in different (named) families <b>OR</b>  live / evolved, in different parts of the world ✓</p> <p><b>2</b> adapted / evolved, similarly / for same niche / for soil, as,  both have / share, streamlined shape / modified fore limbs / velvety fur / diet of grubs and worms ✓</p>	2	AO 1.2 AO 2.6	<p><b>1 ALLOW</b> different (named), countries / continents for 'parts of the world'</p> <p><b>2 ALLOW</b> developed to suit, same environment / same diet / soil, for 'adapted similarly' idea</p>										

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