

GCE

Biology A

Unit **H020/02**: Depth in biology

Advanced Subsidiary GCE

Mark Scheme for June 2016

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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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Annotations

Annotation	Meaning
DO NOT CREDIT	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ACCEPT	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
	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

Question			Answer	Marks	Guidance
1	(a)	(i)	<p><i>two from</i></p> <p>(a) because</p> <p>1 lung(s) are , deflated / less inflated / small(er) / volume decreased ✓</p> <p>2 diaphragm is , domed / curved up / arched / not flat / relaxed ✓</p> <p>3 rib cage is / ribs are , in lowered position / not raised ✓</p>	2	<p>Only credit answers that refer to (a) as the chosen option DO NOT CREDIT if the 'a' is not clear enough</p> <p>Indicate that (a) has been chosen by using the green dot ●</p> <p>1 ACCEPT 'thorax has smaller volume' IGNORE ref to chest volume</p> <p>2 ACCEPT higher / moves up IGNORE pushed up</p> <p>3 ACCEPT 'rib cage moves down' IGNORE ref to intercostal muscles</p>
1	(a)	(ii)	<p>it does not use muscle contraction / muscles (just) relax</p> <p>or</p> <p>rib cage , falls / drops (due to gravity)</p> <p>or</p> <p>lungs (elastic so) will recoil ✓</p>	1	<p>IGNORE ref to energy / ATP</p> <p>IGNORE ref to pressure , changes / gradients</p> <p>IGNORE ref to intercostal muscles contracting during expiration as Q refers to a passive process</p> <p>ACCEPT 'diaphragm relaxes'</p> <p>IGNORE 'rib cage moves down' as this could involve muscle contraction</p>

Question			Answer	Marks	Guidance
1	(a)	(iii)	<p><i>two from</i></p> <p><i>(as lumen of airways decrease)</i></p> <p>1 reduction in (lumen) diameter of , <u>bronchi</u> / <u>bronchioles</u> ✓</p> <p>2 harder to exhale / more resistance to exhalation / less <u>air</u> can be exhaled ✓</p> <p>3 more air remains in the lungs ✓</p> <p>4 harder to inhale / more resistance to inhalation / less <u>air</u> can be inhaled ✓</p> <p>5 harder to ventilate / more resistance to ventilation / increased breathing rate / gasping ✓</p>	2	<p>IGNORE ref to contraction of muscle (as in Q)</p> <p>1 ACCEPT ref to 'narrowing' for 'reduced diameter' IGNORE ref to blocking / size DO NOT CREDIT ref to trachea</p> <p>2 ACCEPT ref to 'breathing out' for 'exhale' IGNORE ref to air leaving / air moving out</p> <p>4 ACCEPT ref to 'breathing in' for 'inhale' IGNORE ref to air entering / air moving in</p> <p>5 IGNORE 'hard to breathe' 'struggles to get breath' 'short of breath' wheezing ventilation rate</p>

Question			Answer	Marks	Guidance
1	(b)	(i)	<p>H ✓</p> <p>D ✓</p> <p>F ✓</p> <p>C ✓</p>	4	<p>Mark the first answer in each cell. If an additional answer is given that is incorrect then = 0 marks</p> <p>IGNORE correct combinations of letters that correspond to D (e.g. A + F + G + H)</p> <p>IGNORE correct combinations of letters that correspond to C (e.g. A + F + G or B + G)</p>
1	(b)	(ii)	<p>1 breathe in as deeply as possible / AW ✓</p> <p>2 (and) then force as much air out as possible ✓</p>	2	<p>IGNORE ref to using nose clip</p> <p>If they have the deepest breath out before the deepest breath in, then max 1 (for correct mp 2)</p> <p>1 e.g. 'breathe in as much as possible' 'inhale as much as you can' 'inhale to maximum' 'breathe in all the air that you can'</p> <p>2 e.g. 'breathe out as hard as possible' 'exhale as much as you can' 'exhale to maximum' 'breathe out all the air that you can'</p> <p>DO NOT CREDIT <i>all</i> of the air pushed out of lungs</p>
Total				11	

Question	Answer	Marks	Guidance																					
2 (a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>mitosis</th> <th>meiosis</th> </tr> </thead> <tbody> <tr> <th>A</th> <td></td> <td>✓</td> </tr> <tr> <th>B</th> <td>✓</td> <td></td> </tr> <tr> <th>C</th> <td>✓</td> <td></td> </tr> </tbody> </table> <p style="text-align: right; margin-right: 20px;">✓ ✓</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>mitosis</th> <th>meiosis</th> </tr> </thead> <tbody> <tr> <th>D</th> <td>✓</td> <td></td> </tr> <tr> <th>E</th> <td></td> <td>✓</td> </tr> </tbody> </table> <p style="text-align: right; margin-right: 20px;">✓</p>		mitosis	meiosis	A		✓	B	✓		C	✓			mitosis	meiosis	D	✓		E		✓	3	<p>Only credit 1 tick on each row. IGNORE crosses</p> <p>A ALLOW a tick for mitosis instead of meiosis</p> <p>Mark A, B & C together to max 2 3 correct answers = 2 marks 2 correct answers = 1 mark 1 or 0 correct answers = 0 marks 1 ✗ = max 1 2 ✗ = 0 marks</p> <p>Mark D & E together to max 1 2 correct answers = 1 mark 1 or 0 correct answers = 0 marks 1 ✗ = 0 marks</p>
	mitosis	meiosis																						
A		✓																						
B	✓																							
C	✓																							
	mitosis	meiosis																						
D	✓																							
E		✓																						
2 (b) (i)	G ₁ and S and G ₂ ✓	1	in any order IGNORE G ₀ , X, Y & Z DO NOT CREDIT if M or C are included																					
2 (b) (ii)	<i>idea that</i> (checking that) DNA has replicated correctly ✓	1	replicate = duplicate = copy ACCEPT (checking that) the chromosomes have duplicated correctly ACCEPT (checking that) the duplicated chromatids have no faults ACCEPT (checking) for , mutations / damage to DNA / damage to genes / errors in DNA IGNORE genetic material / genetic information IGNORE ref to organelle replication																					

Question			Answer	Marks	Guidance
2	(c)	(i)	Q ✓	1	If an additional incorrect answer is given = 0 marks
2	(c)	(ii)	<p>1 it / P , needs to synthesise / contains / has , more DNA / longer DNA / more genetic material / more chromosomes ✓</p> <p>2 AVP ✓</p>	1	<p>1 CREDIT ref to P being polyploid CREDIT ref to P being diploid and Q being haploid ACCEPT <i>idea of</i> has more DNA to repair after G₁ checkpoint</p> <p>2 e.g. ref to P being from an organism at a lower temperature P has a lower metabolic rate ora IGNORE replicating organelles</p>
2	(c)	(iii)	<p><i>two from</i></p> <p>1 it spends all of its time in / does not leave , G₁ or it spends all of its time in / does not leave , G₀ ✓</p> <p>2 (so) it is not , dividing / replicating / undergoing mitosis ✓</p> <p>3 specialised / differentiated ✓</p> <p>4 AVP ✓</p>	2	<p>1 DO NOT CREDIT <i>most of the time</i> in , G₁ / G₀ ACCEPT 'has been sent into G₀' IGNORE 'is in G₁' as this restates what is in the table IGNORE ref to interphase</p> <p>3 ACCEPT ref to having reached the end of its development</p> <p>4 e.g. of differentiated cell – erythrocyte / neurone / B memory cell etc damage has been detected in G₁ (so cannot progress) is dormant nutrients / size , not right to enter growth phase IGNORE is a stem cell / cancer / dead / apoptosis</p>

Question			Answer	Marks	Guidance
2	(d)	(i)	<p><i>W / it , has</i></p> <p>(many) more cells in prophase and (far) fewer cells in telophase ✓</p>	1	<p>CREDIT correct ref to the relative numbers of cells in <u>both</u> phases</p> <p>CREDIT stated correctly calculated differences e.g. 'W has 20 more cells in prophase and 23 less in telophase' 'W has 20 more cells in prophase and V has 23 more cells in telophase' 'a difference of 20 in prophase and 23 in telophase'</p> <p>ACCEPT answers referring to speed rather than no. of cells (i.e. W spends longer in prophase but less time in telophase etc)</p> <p>DO NOT CREDIT if Metaphase and/or Anaphase are suggested</p>
2	(d)	(ii)	<p>t-test compares two (or more) means or <i>idea that</i> this data does not include mean(s) or cannot calculate mean from this data or cannot calculate SD from this data ✓</p>	1	<p>CREDIT ref to not being a normal distribution / is not continuous data / is discrete data</p> <p>ACCEPT the idea that there are more than 2 categories</p> <p>IGNORE ref to 'average' instead of 'mean'</p>

Question			Answer	Marks	Guidance																																				
2	(e)	(i)	<i>calculation</i> $\chi^2 = 13.835$ or 13.833 or 13.834 ✓ ✓ ✓	3	<p>Correct value of $\chi^2 = 3$ marks</p> <p>Answer should be to 3 dp to be consistent with the rest of the table. If answer unrounded or over-rounded but otherwise correct, max 2</p> <table border="1"> <thead> <tr> <th>Cells</th> <th>O</th> <th>E</th> <th>(O - E)</th> <th>(O - E)²</th> <th>$\frac{(O - E)^2}{E}$</th> </tr> </thead> <tbody> <tr> <td>In prophase</td> <td>85</td> <td>65</td> <td>20</td> <td>400</td> <td>6.154</td> </tr> <tr> <td>In metaphase</td> <td>59</td> <td>55</td> <td>4</td> <td>16</td> <td>0.291</td> </tr> <tr> <td>In anaphase</td> <td>6</td> <td>7</td> <td>-1</td> <td>1</td> <td>0.143</td> </tr> <tr> <td>In telophase</td> <td>50</td> <td>73</td> <td>-23</td> <td>529</td> <td>7.247</td> </tr> <tr> <td>Total</td> <td>200</td> <td>200</td> <td></td> <td></td> <td>13.835</td> </tr> </tbody> </table> <p>Award 1 mark per <u>correct</u> row (whether rounded or not)</p> <p>plus 1 mark for χ^2</p> <p>Only penalise the same type of error once. ALLOW ecf for χ^2 from incorrect row value(s)</p>	Cells	O	E	(O - E)	(O - E) ²	$\frac{(O - E)^2}{E}$	In prophase	85	65	20	400	6.154	In metaphase	59	55	4	16	0.291	In anaphase	6	7	-1	1	0.143	In telophase	50	73	-23	529	7.247	Total	200	200			13.835
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2	(e)	(ii)	<u>3</u> (degrees of freedom) ✓	1																																					

Question	Answer	Marks	Guidance																																																					
<p>2 (e) (iii)</p>	<p>Any statement(s) made must be correct for the candidate's responses to (i) <u>and</u> (ii). two from</p> <p>1 calculated value is , > / greater than , 7.82 / the critical value at p = 0.05 / the value for (p =) 0.05</p> <p>or 7.82 / the critical value at p = 0.05 / the value for (p =) 0.05 , is , less than / < , 13.835 ✓</p> <p>2 (difference / deviation) is , significant / not due to chance ✓</p> <p>3 95% certain that the results are not due to chance or difference would only occur by chance 5% of the time ✓</p> <p>4 (difference / deviation) also significant at p = 0.01 value or 99% certain that the results are not due to chance or difference would only occur by chance 1% of the time or value is , > / greater than , p = 0.01 / 11.35 or probability is , < / less than , 0.01 or probability is between 0.01 and 0.001 or probability is not significant at p = 0.001 ✓</p> <p>5 the <u>null</u> hypothesis can be rejected ✓</p>	<p>2</p>	<p>ALLOW ecf from candidate's calculated χ^2 value in (i) using the number of degrees of freedom they stated in (ii).</p> <table border="1" data-bbox="1335 327 2016 638"> <thead> <tr> <th rowspan="2">Degrees of freedom</th> <th colspan="5">Probability (p)</th> </tr> <tr> <th>0.99</th> <th>0.95</th> <th>0.05</th> <th>0.01</th> <th>0.001</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0.00</td> <td>0.00</td> <td>3.84</td> <td>6.64</td> <td>10.83</td> </tr> <tr> <td>2</td> <td>0.02</td> <td>0.10</td> <td>5.99</td> <td>9.21</td> <td>13.82</td> </tr> <tr> <td>3</td> <td>0.11</td> <td>0.35</td> <td>7.82</td> <td>11.35</td> <td>16.27</td> </tr> <tr> <td>4</td> <td>0.30</td> <td>0.71</td> <td>9.49</td> <td>13.28</td> <td>18.47</td> </tr> <tr> <td>5</td> <td>0.55</td> <td>1.15</td> <td>11.07</td> <td>15.09</td> <td>20.52</td> </tr> <tr> <td>6</td> <td>0.84</td> <td>1.64</td> <td>12.59</td> <td>16.81</td> <td>22.46</td> </tr> <tr> <td>7</td> <td>1.24</td> <td>2.17</td> <td>14.07</td> <td>18.48</td> <td>24.32</td> </tr> </tbody> </table> <p>For incorrect χ^2 and degrees of freedom values, apply mark points 1 to 5 to correspond to their results.</p>	Degrees of freedom	Probability (p)					0.99	0.95	0.05	0.01	0.001	1	0.00	0.00	3.84	6.64	10.83	2	0.02	0.10	5.99	9.21	13.82	3	0.11	0.35	7.82	11.35	16.27	4	0.30	0.71	9.49	13.28	18.47	5	0.55	1.15	11.07	15.09	20.52	6	0.84	1.64	12.59	16.81	22.46	7	1.24	2.17	14.07	18.48	24.32
Degrees of freedom	Probability (p)																																																							
	0.99	0.95	0.05	0.01	0.001																																																			
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	<p>Total</p>	<p>17</p>																																																						

Question			Answer	Marks	Guidance
3	(a)	(i)	it contains , N / nitrogen or monosaccharide does not contain nitrogen ✓	1	CREDIT any correct ref to the nitrogen-containing group in Fig. 3.1 NHCOCH_3 ACCEPT 'OH is replaced with NHCOCH_3 ' or ' NHCOCH_3 is replaced with OH' ACCEPT ref to H not being twice C / 15 H instead of 12 / 8 C instead of 6 ACCEPT has no OH on carbon 2 ACCEPT 'monosaccharide only contains C, H & O' DO NOT CREDIT 'it has a nitrogen molecule'
3	(a)	(ii)	beta / β ✓ glucose ✓	2	IGNORE alpha / α DO NOT CREDIT B / b / beta pleated sheet
3	(a)	(iii)	<i>four from</i> 1 (in chitin glycosidic bond(s) formed by) condensation ✓ 2 (molecule of) H_2O / water , produced / released ✓ 3 alternate monomers are , upside-down / flipped / rotated through 180° ✓ 4 because of the position of the , OH / H , on carbon 1 ✓ 5 forms a , straight / linear / unbranched , chain / molecule / polymer ✓ 6 similar to cellulose ✓	4	IGNORE ref to 1-4 linkage & glycosidic (as given in Q) ACCEPT shown on a diagram 3 ACCEPT sugars / units / residues / molecules DO NOT CREDIT glucose 4 Must be a clear statement ACCEPT the 2 OH groups cannot , line up / bond 5 IGNORE ref to branching IGNORE ref to polysaccharide 6 ACCEPT ref to H bonds crosslinking between , molecules / chains

Question			Answer	Marks	Guidance
3	(b)	(i)	support or prevents the trachea(e) from collapsing / keeps the airways open ✓	1	IGNORE protection / structure / shape / squashed / strength / stability
3	(b)	(ii)	<i>idea that</i> (their presence) restricts the airflow in the trachea / blocks the airways or (leakage of haemolymph) deprives the , tissues / cells , of , oxygen / O ₂ / nutrients or use of , oxygen / O ₂ / nutrients , by mites or disease transmission or (mites) release toxins ✓	1	IGNORE statements that simply refer to the mites feeding on the haemolymph (as given in Q) ACCEPT causes the trachea to collapse IGNORE 'affects airflow' unqualified IGNORE ref to 'difficult to breathe' ACCEPT ref to inflammatory / immune , response
			Total	9	

Question			Answer	Marks	Guidance
4	(a)	(i)	<i>Amanita</i> ✓	1	First letter must be a capital, the rest must be lower case.
4	(a)	(ii)	<p><i>one from</i></p> <p>1 (starch) digestion in the regions where the , fungus / hyphae , not present ✓</p> <p>2 <i>enzymes / they , are</i> released / diffuse away , from the fungus or extracellular / secreted ✓</p>	1	1 ACCEPT breaks down (starch) in the , region / area / agar , around the fungus
4	(b)	(i)	<p><i>one from</i></p> <p>pH / it , is , the dependent variable / being measured ✓</p> <p>(pH changes as) fatty acids are produced ✓</p>	1	<p>ACCEPT pH (change) indicates the rate of the reaction if pH were controlled there would be no , colour change / end point indicated because the pH (change) shows that the , reaction is happening / lipid is being broken down</p> <p>IGNORE we are investigating pH / pH is being investigated</p>

Question			Answer	Marks	Guidance
4	(b)	(ii)	<p><u>volume</u> of , alkaline / (alkaline) lipid / substrate , <u>solution</u></p> <p>or</p> <p>concentration of , lipase / enzyme , <u>solution</u></p> <p>or</p> <p><u>volume</u> of , lipase / enzyme , <u>solution</u></p> <p>or</p> <p><u>temperature</u></p> <p>or</p> <p>time / intervals , between testing of samples ✓</p>	1	<p>Mark 1st answer IGNORE amount</p> <p>IGNORE 5 cm³ - this is how the variable was controlled 'volume of 5 cm³ of alkaline solution' = 1 mark '5 cm³ of alkaline solution' = 0 marks</p> <p>IGNORE 0.5% - this is how the variable was controlled 'concentration of 0.5% enzyme solution' = 1 mark '0.5% enzyme solution' = 0 marks</p> <p>IGNORE 1 cm³ - this is how the variable was controlled 'volume of 1 cm³ of lipase solution' = 1 mark '1 cm³ of lipase solution' = 0 marks</p> <p>IGNORE 20°C - this is how the variable was controlled 'a temperature of 20°C' = 1 mark 'keep it at 20°C' = 0 marks</p> <p>IGNORE 30 seconds - this is how the variable was controlled 'the times the samples were taken were at intervals of 30 seconds' = 1 mark 'samples taken every 30 seconds' = 0 marks</p>

Question			Answer	Marks	Guidance
4	(b)	(iii)	<p>concentration of , alkaline / (alkaline) lipid / substrate , solution or volume of indicator (added) or number of drops of indicator (added) or volume of , sample / mixture / solution (removed) or number of drops of , sample / mixture / solution (removed) ✓</p>	1	<p>Mark 1st answer IGNORE amount IGNORE size / volume , of drops</p>
4	(b)	(iv)	<p><i>one from</i></p> <p>(looking at , a small volume / against a white background) makes it easier to see the colour change ✓</p> <p>the indicator (if added to test tube) might affect the progress of the enzyme reaction ✓</p> <p>better temperature control as test tube not taken in and out of water bath ✓</p> <p>AVP ✓</p>	1	<p>ACCEPT provides a contrasting background to see the colour</p> <p>ACCEPT ora e.g. harder to see colour change in the test tube</p>
4	(b)	(v)	<p>(the optimum temperature) is between 30°C and 35°C ✓</p>	1	<p>Must give a range °C must be stated once</p> <p>IGNORE 35°C alone / 'around 35°C'</p>

Question			Answer	Marks	Guidance
4	(b)	(vi)	<p>1A use more intermediate temperature values ✓</p> <p>1B in the 30°C - 35°C range ✓</p> <p>-----</p> <p>2A take samples at more frequent intervals (than 30 seconds) ✓</p> <p>2B e.g. every 15 seconds ✓</p> <p>-----</p> <p>3A use of colorimeter ✓</p> <p>3B colour change would be less , subjective / biased ✓</p> <p>-----</p> <p>4A use of pH , meter / probe / sensor ✓</p> <p>4B obtain a numerical value ✓</p>	4	<p>Mark the first 2 suggestions seen. B mark must relate to the appropriate A mark point</p> <p>1A e.g. test , every 2 °C / at 1 °C intervals use temperatures less than 5°C apart</p> <p>1B CREDIT a range of 25°C - 40°C Units must be given once</p> <p>Note: 'test a range of temperatures between 30°C and 35°C' 'carry out more experiments between 30°C and 35°C' = 2 marks (mps 1 & 2)</p> <p>2A ACCEPT sample more regularly</p> <p>2B time interval must be experimentally workable, so should be from 10 and less than 30 seconds. Note: 'take samples every 15 seconds' = 2 marks (mps 3&4) 'take samples every 5 seconds' = 1 mark (mp 3 only)</p> <p>3B obtain a numerical value</p>

Question	Answer	Marks	Guidance
4 (c)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><i>In summary:</i> <i>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.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i></p> <ul style="list-style-type: none"> ○ award the higher mark where the Communication Statement has been met. ○ award the lower mark where aspects of the Communication Statement have been missed. <p>• <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i></p> <p>Level 3 (5–6 marks)</p> <ul style="list-style-type: none"> • Provides a description of the 2 mechanisms of enzyme action • Provides a description of the ways in which high and low temperature affects the reactants and active site. <p><i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i></p> <p>Awarding at this Level = L3 & 5 ticks ✓ ✓ ✓ ✓ ✓ Communication = ✓ or ✗</p>	6	<p>Use the green dot ● in the margin to indicate places where good scientific points are made about the 2 models of enzyme action.</p> <p>Use a highlight square ■ in the margin to indicate places where good scientific points are made about the effect of temperature.</p> <p><i>[Indicative scientific points are to be found on the next page.]</i></p>

Question	Answer	Marks	Guidance
	<p>Level 2 (3–4 marks)</p> <ul style="list-style-type: none"> • Describes 1 or both of the mechanisms of enzyme action • Describes some ways in which temperature affects the reactants and/or active site. <p><i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i></p> <p>Awarding at this Level = L2 & 3 ticks ✓✓✓ Communication = ✓ or ✗</p> <p>-----</p> <p>Level 1 (1–2 marks)</p> <ul style="list-style-type: none"> • either Describes some aspects of the mechanism of enzyme action • or Describes an effect of temperature <p><i>The information is communicated with some structure but may include a small amount of irrelevant material and some inappropriate use of scientific language.</i></p> <p>Awarding at this Level = L1 & 1 tick ✓ Communication = ✓ or ✗</p> <p>-----</p> <p>0 marks No response or no response worthy of credit.</p>		<p>Indicative scientific points may include but are not limited to:</p> <p><i>enzyme action</i> ●</p> <ol style="list-style-type: none"> 1 enzyme-substrate complex formed 2 enzyme-product complex formed 3 product(s) leave the active site 4 lock and key = shape of substrate and enzyme's active site are complementary and so enzyme is specific 5 induced fit = enzyme active site changes shape to accommodate substrate once substrate binds <p><i>effect of temperature reactants</i> ■</p> <ol style="list-style-type: none"> 6 increase in temperature increases kinetic energy of molecules 7 results in more successful collisions 8 more enzyme-substrate complexes form 9 decrease in temperature reduces kinetic energy of molecules 10 results in fewer successful collisions 11 fewer enzyme-substrate complexes form <p><i>active site</i> ■</p> <ol style="list-style-type: none"> 12 enzymes have an optimum temperature 13 (small) increase in temperature affects the bonds involved in tertiary structure 14 change in shape of active site 15 prevents substrate binding to active site 16 high temperature results in denaturing 17 effects of high temperature are irreversible 18 effects of low temperature are reversible
	Total	17	

Question			Answer	Marks	Guidance
5	(a)	(i)	<u>closed</u> ✓	1	DO NOT CREDIT incorrect additional answers
5	(a)	(ii)	the fish has a single (circulation) and the mammal has a double (circulation) ✓	1	<p>ACCEPT descriptions of the circulations, but both must be described to be awarded the mark. e.g. deoxygenated and oxygenated blood passes separately through the mammalian heart but only deoxygenated blood through the fish heart in a circuit of the body the blood passes through the heart twice in mammals but once in fish</p> <p>ACCEPT single (fish circulatory system) versus a double (mammalian circulatory system) DO NOT CREDIT double versus single</p>

Question	Answer	Marks	Guidance
5 (b)*	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p><i>In summary:</i> <i>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.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i></p> <ul style="list-style-type: none"> <i>o award the higher mark where the Communication Statement has been met.</i> <i>o award the lower mark where aspects of the Communication Statement have been missed.</i> <p>• <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i></p> <p>Level 3 (5–6 marks)</p> <ul style="list-style-type: none"> • Describes both frog and mammalian circulations • Gives some detail on the relative effectiveness of the two systems. <p><i>There is a well-developed line of reasoning which is clear and logically structured, relates to Figs 5.1 and 5.2 and uses scientific terminology at an appropriate level.</i> <i>All the information presented is relevant and forms a continuous narrative.</i></p> <p>Awarding at this Level = L3 & 5 ticks ✓✓✓✓✓ Communication = ✓ or ✗</p>	6	<p>Use the green dot ● in the margin to indicate places where good scientific points are made about the 2 circulations.</p> <p>Use a highlight square ■ in the margin to indicate places where good scientific points are made about the relative effectiveness.</p> <p><i>[Indicative scientific points are to be found on the next page.]</i></p>

Question	Answer	Marks	Guidance
	<p>Level 2 (3–4 marks)</p> <ul style="list-style-type: none"> • Describes the mammalian or frog circulation. • Attempts a description of the circulation of the other organism. • Comments on the effectiveness of the two systems. <p><i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i></p> <p>Awarding at this Level = L2 & 3 ticks ✓✓✓ Communication = ✓ or ✗</p> <p>-----</p> <p>Level 1 (1–2 marks)</p> <ul style="list-style-type: none"> • either Describes the mammalian or frog circulation. or Comments on the effectiveness of the two circulatory systems. <p><i>The information is communicated with some structure but may include a small amount of irrelevant material and some inappropriate use of scientific language.</i></p> <p>Awarding at this Level = L1 & 1 tick ✓ Communication = ✓ or ✗</p> <p>-----</p> <p>0 marks No response or no response worthy of credit.</p>		<p>Indicative scientific points may include but are not limited to:</p> <p><i>circulations</i> ●</p> <p>19 both are double circulations 20 blood from mammalian heart transported separately to lungs and body 21 oxygenated and deoxygenated blood never mix 22 blood from frog heart transported to lungs and body together 23 blood going to the body in the frog is , partially oxygenated / mixed 24 oxygenated blood only separate when returning from lungs 25 reference to the spiral valve partly separating oxygenated and deoxygenated blood 26 flow of blood through the hearts described 27 ref to differences between structure of frog and mammalian hearts</p> <p><i>effectiveness of circulation</i> ■</p> <p>28 both can be considered to be effective 29 frog could be considered to be less effective 30 frog has less oxygen available for the body cells 31 circulation is effective enough for the frog’s needs 32 frog has lower metabolic rate 33 frog maintains body temperature by other means 34 frog heart may beat faster (to compensate) 35 frog oxygenates blood at skin / mouth 36 frog circulation may limit its size 37 frog circulation developed from that of tadpole</p> <p>38 mammalian body cells get maximum available O₂ 39 mammal has higher metabolic rate 40 mammal (uses metabolism to) maintain body temperature</p>
	Total	8	

Question			Answer	Marks	Guidance
6	(a)	(i)	<i>idea that</i> the third diagram shows that the resistant , bacteria / colonies , were already present (on the original plate) or these (resistant) bacteria on the original plate continued to grow when flooded with penicillin ✓	1	IGNORE penicillin will kill them so in order for them to survive the mutation must have already happened IGNORE no time for natural selection to take place - as these are explanations and not evidence
6	(a)	(ii)	natural <u>selection</u> ✓	1	CREDIT directional <u>selection</u> IGNORE evolution / survival of the fittest / binary fission / mutation
6	(b)	(i)	3140 ✓ ✓	2	Correct answer = 2 marks , even if no working shown. • If the answer is incorrect or has not been rounded to 3 sig. figs., then award 1 mark for seeing either $\frac{1652 - 51}{x} \quad \text{or} \quad \frac{1601}{x} \quad \text{where } x = \text{any number}$ or an unrounded answer (e.g. 3139.2156 or 3139) • If the incorrect peak has been chosen, then award 1 mark only for a correct answer which is correctly expressed to 3 sig. figs. Using 1649 the correct answer is 3130 Using 1593 the correct answer is 3020

Question			Answer	Marks	Guidance
6	(b)	(ii)	was lower (in 1993) or has increased / is higher (in 2012) ✓ <i>(in 2012)</i> 52% or 0.52 ✓	2	IGNORE ref to raw data ACCEPT 'over 4 x greater in 2012' ACCEPT 52.4%

Question			Answer	Marks	Guidance																														
6	(b)	(iii)	<p><i>two of</i></p> <p>1 (trend is) decrease in (number of) deaths (since 2007) ✓</p> <p>2 consistent / steady / large / dramatic , decrease in (deaths from <i>S. aureus</i> specified as) MRSA (from 2007) ✓</p> <p>3 ref to better specific cross-infection control measure in health care ✓</p> <p>4 any correct processed data comparing either years or cause of death using figures from table 6 ✓</p>	2	<p>IGNORE raw data quotes</p> <p>2 <i>idea that</i> non-specified fluctuates Note 'a large decrease in the number of deaths from MRSA' = 2 marks (mps 1 & 2)</p> <p>3 e.g. isolating MRSA cases / dress code for health professionals / hygiene measures / pre operation screening</p> <p>4 <i>MRSA</i> e.g. decrease of , 1301 / approx. 260 per year 2012 value is , 18.3% / approx. 20% / approx. $\frac{1}{5}$, of 2007 value a drop of , 82% / approx. 80% , from 2007 to 2012</p> <p><i>total</i> e.g. decrease of , 1495 / approx. 39 per year 2012 value is , 27.1% / approx. 25% / approx. $\frac{1}{4}$, of 2007 value a drop of , 73% / approx. 70% / approx. 75% , from 2007 to 2012</p> <table border="1" data-bbox="1377 989 2011 1276"> <thead> <tr> <th rowspan="2">Year</th> <th colspan="2">% death certificates mentioning <i>S. aureus</i></th> <th rowspan="2">Total number of death certificates mentioning <i>S. aureus</i></th> </tr> <tr> <th><i>S. aureus</i> not specified as resistant</th> <th><i>S. aureus</i> specified as MRSA</th> </tr> </thead> <tbody> <tr> <td>2007</td> <td>22 or 22.4</td> <td>78 or 77.6</td> <td>2052</td> </tr> <tr> <td>2008</td> <td>18</td> <td>82</td> <td>1500</td> </tr> <tr> <td>2009</td> <td>38 or 37.7</td> <td>62 or 62.3</td> <td>1253</td> </tr> <tr> <td>2010</td> <td>49 or 49.5</td> <td>51 or 50.5</td> <td>960</td> </tr> <tr> <td>2011</td> <td>43 or 42.9</td> <td>57 or 57.1</td> <td>638</td> </tr> <tr> <td>2012</td> <td>48 or 47.6</td> <td>52 or 52.4</td> <td>557</td> </tr> </tbody> </table>	Year	% death certificates mentioning <i>S. aureus</i>		Total number of death certificates mentioning <i>S. aureus</i>	<i>S. aureus</i> not specified as resistant	<i>S. aureus</i> specified as MRSA	2007	22 or 22.4	78 or 77.6	2052	2008	18	82	1500	2009	38 or 37.7	62 or 62.3	1253	2010	49 or 49.5	51 or 50.5	960	2011	43 or 42.9	57 or 57.1	638	2012	48 or 47.6	52 or 52.4	557
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