

# Mark Scheme (Results)

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark
<b>1 (a) (i)</b>	100 (mV) ;	<b>(1)</b>

Question Number	Answer	Mark																												
<b>1 (a) (ii)</b>	<table border="1"> <thead> <tr> <th>Description</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>Stage when the concentration of positive ions is greatest inside the axon</td> <td></td> <td></td> <td><input checked="" type="checkbox"/></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Stage when hyperpolarisation first occurs</td> <td></td> <td></td> <td></td> <td></td> <td><input checked="" type="checkbox"/></td> <td></td> </tr> <tr> <td>Site showing the resting potential</td> <td><input checked="" type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Description	A	B	C	D	E	F	Stage when the concentration of positive ions is greatest inside the axon			<input checked="" type="checkbox"/>				Stage when hyperpolarisation first occurs					<input checked="" type="checkbox"/>		Site showing the resting potential	<input checked="" type="checkbox"/>						<b>(3)</b>
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<b>1* (b)</b>	<p>QWC – Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence</p> <ol style="list-style-type: none"> <li>1. diffuses across {gap /eq} ;</li> <li>2. binds to (receptors on) post-synaptic membrane / eq ;</li> <li>3. idea of gated-channels opening or Na<sup>+</sup> travels through post-synaptic membrane ;</li> <li>4. causing a depolarisation / eq ;</li> <li>5. (if sufficient present) an action potential is set up in {post-synaptic membrane/adjacent cell / eq} ;</li> <li>6. details such as temporal or spatial summation ;</li> <li>7. idea that allows coordination / one way flow of information ;</li> <li>8. idea that it allows integration in post-synaptic cell ;</li> <li>9. neurotransmitter broken down (by enzyme) / eq ;</li> <li>10. so that do not get {prolonged /eq} action potential in post-synaptic membrane / make receptors available again ;</li> <li>11. credit reference to fate of products e.g. reabsorbed through pre-synaptic membrane OR to be re-synthesised into neurotransmitter substance ;</li> </ol>	<b>(5)</b>

Question Number	Answer	Mark
<b>2(a)</b>	molecule R - ATP / adenosine triphosphate ; molecule S - ADP / adenosine diphosphate ;	<b>(2)</b>

Question Number	Answer	Mark
<b>2(b)(i)</b>	1. carbon dioxide / CO <sub>2</sub> ;  2. idea that the C has been removed from C <sub>6</sub> or C <sub>5</sub> ;	<b>(2)</b>

Question Number	Answer	Mark
<b>2(b)(ii)</b>	1. cycle would stop / eq ;  2. 4 carbon compound would accumulate / eq ;  3. 6 carbon compound would {run short / not be synthesised} / 5 carbon compound would run short / eq ;  4. idea that {molecule T / H} reduce ;	<b>(3)</b>

Question Number	Answer	Mark
<b>2(c)</b>	1. idea of electrons being {passed along / eq} the electron transport chain ;  2. idea of {losing / eq} energy ;  3. (used to) add a phosphate to ADP to make ATP / eq ;  4. reference to ATPase ;  5. idea of chemiosmosis ;  6. idea of oxygen as the final acceptor ;	<b>(3)</b>

Question Number	Answer	Mark
<b>3(a)</b>	(leave it) in the dark / eq ;	<b>(1)</b>

Question Number	Answer	Mark
<b>3 (b) (i)</b>	1. mass higher in A ( compared with B) for both studies ; 2. the difference is less in repeat study ; 3. comparative manipulation of data e.g. 13g decrease for A to B for original and 5 g for repeat ; 4. mass lower in repeats (of both A and B) / eq ;	<b>(3)</b>

Question Number	Answer	Mark
<b>3(b) (ii)</b>	1. { increase / eq} in stem length ; 2. correct manipulation of the data e.g. by 23cm / 18.4% ; 3. reference to {taller / faster growing / eq} seedling ; 4. to receive {more light / higher red light / eq} / to maximize photosynthesis / eq ; 5. idea of allows {active phytochrome / eq} to be made ;	<b>(3)</b>

Question Number	Answer	Mark
<b>3(b) (iii)</b>	1. less red light {increases / eq} mean stem length / more far red light increases stem length / eq ; 2. the (significant) difference in mean stem length is not due to {chance / eq} / eq ; 3. the mean length for repeat was close to the original ; 4. suggesting it is likely to be reliable ;	<b>(3)</b>

Question Number	Answer	Mark
<b>4(a)</b>	<ol style="list-style-type: none"> <li>1. heart rate increases / eq ;</li> <li>2. {stroke volume / eq} increases / eq ;</li> <li>3. {SAN /eq} activity increases / ;</li> <li>4. AVN time delay decreases / eq ;</li> <li>5. idea that more blood returning (to the heart) causes {heart / muscle} to stretch ;</li> <li>6. idea that ventricles contract with greater force ;</li> </ol>	<b>(4)</b>

Question Number	Answer	Mark																		
<b>4(b) (i)</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Approximate value for</th> <th style="text-align: center;">0.1 dm<sup>3</sup></th> <th style="text-align: center;">0.5 dm<sup>3</sup></th> <th style="text-align: center;">6 dm<sup>3</sup> min<sup>-1</sup></th> <th style="text-align: center;">6 breaths min<sup>-1</sup></th> <th style="text-align: center;">12 breaths min<sup>-1</sup></th> </tr> </thead> <tbody> <tr> <td>Resting breathing rate</td> <td></td> <td></td> <td></td> <td></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>Resting tidal volume</td> <td></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Approximate value for	0.1 dm <sup>3</sup>	0.5 dm <sup>3</sup>	6 dm <sup>3</sup> min <sup>-1</sup>	6 breaths min <sup>-1</sup>	12 breaths min <sup>-1</sup>	Resting breathing rate					<input type="checkbox"/>	Resting tidal volume		<input type="checkbox"/>				<b>(2)</b>
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Question Number	Answer	Mark
<b>4(b) (ii)</b>	<ol style="list-style-type: none"> <li>1. more {peaks / eq} in the same time / higher frequency / distance between (consecutive) peaks would decrease ;</li> <li>2. idea of distance from peak to trough would increase ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>4(c)</b>	<p>Any <b>two</b> from the following:</p> <ol style="list-style-type: none"> <li>1. how often they play</li> <li>2. age</li> <li>3. body size / BMI / eq</li> <li>4. gender / eq</li> <li>5. fitness level / eq</li> <li>6. health status / eq</li> <li>7. lifestyle e.g. smoker or swimmer ; ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark						
<b>5(a)</b>	<table border="1"> <thead> <tr> <th>Region of the brain</th> <th>One role while she is on the beam</th> </tr> </thead> <tbody> <tr> <td>Cerebellum</td> <td>maintaining balance / coordination of movement / muscle control / eq ;</td> </tr> <tr> <td>Medulla oblongata</td> <td>regulation of {breathing / heart beat} / eq ;</td> </tr> </tbody> </table>	Region of the brain	One role while she is on the beam	Cerebellum	maintaining balance / coordination of movement / muscle control / eq ;	Medulla oblongata	regulation of {breathing / heart beat} / eq ;	<b>(2)</b>
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Medulla oblongata	regulation of {breathing / heart beat} / eq ;							

Question Number	Answer	Mark
<b>5(b)</b>	<ol style="list-style-type: none"> <li>1. idea more blood flows near the skin surface / eq ;</li> <li>2. due to {vasodilation / dilation of arterioles / eq} ;</li> <li>3. {vasoconstriction / eq} of shunt vessels / eq ;</li> <li>4. more blood to capillaries / eq ;</li> <li>5. idea of more heat lost ;</li> <li>6. via radiation ;</li> </ol>	<b>(4)</b>

Question Number	Answer	Mark
<b>5(c)(i)</b>	<ol style="list-style-type: none"> <li>1. {in the knee / behind the knee cap} / {cross- shaped / two ligaments} ;</li> <li>2. (connective tissue that) connects bone to bone / eq ;</li> </ol>	<b>(2)</b>



Question Number	Answer	Mark
<b>5(c)(ii)</b>	<ol style="list-style-type: none"><li>1. idea of smaller incision reduces chance of infection / eq ;</li><li>2. idea of smaller incision reduces recovery time ;</li><li>3. idea of smaller incision reduces likelihood of osteoarthritis / knee joint replacement later / eq ;</li><li>4. idea of smaller incision so less scar tissue / eq ;</li><li>5. idea of smaller incision so less blood loss / eq ;</li><li>6. idea of smaller incision so less pain / eq ;</li><li>7. use of local anaesthetic means less (associated) risk / eq ;</li><li>8. idea of cheaper related to fewer staff needed ;</li></ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>6(a)</b>	<ol style="list-style-type: none"> <li>1. reference to {restriction enzyme / endonuclease} ;</li> <li>2. to cut gene out of animal DNA ;</li> <li>3. idea of amplification using DNA polymerase (in PCR) ;</li> <li>4. (enzymes) open plasmid ;</li> <li>5. (same endonuclease) to produce 'sticky ends' /description / at selected base sequence ;</li> <li>6. H bonds formed between bases at 'sticky ends' ;</li> <li>7. ligase ;</li> <li>8. to join gene to plasmid / eq ;</li> <li>9. reference to {phosphodiester / eq} bond ;</li> </ol>	<b>(5)</b>

Question Number	Answer	Mark
<b>6(b)</b>	<ol style="list-style-type: none"> <li>1. (small) {circle /eq} of DNA ;</li> <li>2. containing bacterial (survival) genes and {protein / animal} gene ;</li> <li>3. marker gene / description given ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>6(c)</b>	<ol style="list-style-type: none"> <li>1. idea of easier to manage growth e.g. do not need sterile conditions ;</li> <li>2. idea that it is safer (than bacteria) ;</li> <li>3. idea of more protein can be made /eq ;</li> <li>4. bacteria may not have correct amino acids to make protein / eq ;</li> <li>5. idea that it could produce edible drugs ;</li> <li>6. idea that plants have introns/bacteria do not so gene does not need modifying ;</li> <li>7. idea that it is cheaper ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>6(d)</b>	<ol style="list-style-type: none"> <li>1. idea of gene transfer to other {species / eq} ;</li> <li>2. idea of consequence of transfer e.g. resistance to pesticide / antibiotics, superweeds ;</li> <li>3. idea of possible harmful effects from genes e.g. biochemical changes to substances that could act as allergens, long term effects of consuming ;</li> <li>4. idea that benefit focused on developed countries / converse ;</li> <li>5. idea of risk related to use of viral vectors ;</li> <li>6. idea of effect on organic farmers ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>7 (a)</b>	<ol style="list-style-type: none"> <li>1. idea that less {food /eq} required to deliver energy requirement ;</li> <li>2. (so) more likely to have extra food not respired / {extra/surplus} energy ;</li> <li>3. which could be laid down in body as fat / eq ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>7 (b)</b>	<p>Any two from:</p> <ol style="list-style-type: none"> <li>1. ADP</li> <li>2. Pi / inorganic phosphate</li> <li>3. pyruvate / pyruvic acid / lactate</li> <li>4. fatty acids</li> <li>5. NAD / eq</li> <li>6. acetyl CoA / eq</li> <li>7. water ; ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>7 (c)</b>	<ol style="list-style-type: none"> <li>1. many {alpha / eq} glucose monomers ;</li> <li>2. joined by glycosidic bonds ;</li> <li>3. detail of glycosidic bonds e.g. 1-4 ;</li> <li>4. reference to side branches present / 1-6 glycosidic bonds ;</li> </ol>	<b>(3)</b>

Question Number	Answer	Mark
<b>7 (d)</b>	<ol style="list-style-type: none"> <li>1. more gonadotropins ;</li> <li>2. {use / muscle uptake} of (excess) fatty acids ;</li> <li>3. respired to release (much) energy / increased fat metabolism ;</li> <li>4. idea of reduced requirement to replenish glycogen stores ;</li> </ol>	<b>(3)</b>

Question Number	Answer	Mark
<b>7 (e)</b>	<ol style="list-style-type: none"> <li>1. (slow twitch muscles ) carry out aerobic respiration / full oxidation / eq ;</li> <li>2. which produces more ATP (than anaerobic) / eq ;</li> <li>3. 'energy' not locked up in lactate / eq ;</li> <li>4. idea that it takes longer for lactate levels to build up ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>7 * (f)</b>	<p>QWC – Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> <li>1. <math>\text{Ca}^{2+}</math> leaks out of { cell / <i>cytoplasm</i> / <i>sarcoplasmic reticulum</i> } ;</li> <li>2. idea of change in <math>\text{Ca}^{2+}</math> binding to <i>troponin</i> ;</li> <li>3. causes displacement of <i>tropomyosin</i> / eq ;</li> <li>4. idea of change in number of <i>myosin</i> binding sites exposed ;</li> <li>5. comment on <i>myosin</i> binding to <i>actin</i> ;</li> <li>6. (loss of <math>\text{Ca}^{2+}</math> from cell / cytoplasm) therefore force exerted by muscle is lower than expected</li> </ol> <p>OR (more <math>\text{Ca}^{2+}</math> in cytoplasm) results in less ATP so less muscle contraction ;</p>	<b>(4)</b>

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<b>7 (g)</b>	<table border="1"> <thead> <tr> <th>Process</th> <th>Two nucleic acids involved in the process</th> </tr> </thead> <tbody> <tr> <td>Transcription of the ACE gene</td> <td>DNA &amp; mRNA ;</td> </tr> <tr> <td>Production of ACE at a ribosome</td> <td>Any <b>two</b> from: mRNA, tRNA, rRNA ;</td> </tr> </tbody> </table>	Process	Two nucleic acids involved in the process	Transcription of the ACE gene	DNA & mRNA ;	Production of ACE at a ribosome	Any <b>two</b> from: mRNA, tRNA, rRNA ;	<b>(2)</b>
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<b>7 (h)</b>	<ol style="list-style-type: none"> <li>1. obtain a sample of cells / extract DNA (from cells) ;</li> <li>2. reference to named enzyme ;</li> <li>3. idea of how to increase amount of DNA ;</li> <li>4. reference to electrophoresis ;</li> <li>5. details of electrophoresis ;</li> <li>6. use a {DNA / gene} probe ;</li> <li>7. with a base sequence complementary to that on the {variant / eq} ;</li> <li>8. idea of matching with known variant profile ;</li> </ol>	<b>(4)</b>

Question Number	Answer	Mark
<b>7 (i)</b>	B ;	<b>(1)</b>

Question Number	Answer	Mark
<b>7 (j)</b>	<ol style="list-style-type: none"> <li>1. (higher metabolic rate) means more chemical reactions / eq ;</li> <li>2. more {energy released / ATP used} / eq ;</li> <li>3. (which) releases heat / eq ;</li> <li>4. keeps divers warmer / warm for longer / able to swim without a wetsuit / eq ;</li> </ol>	<b>(3)</b>

Question Number	Answer	Mark
<b>7 (k)</b>	<ol style="list-style-type: none"> <li>1. carbon dioxide due to {deforestation / land cleaning / burning fossil fuels / correct ref to respiration / eq} ;</li> <li>2. methane from {rice fields / anaerobic bacterial action / ruminant fermentation / named ruminant} ;</li> </ol>	<b>(2)</b>

Question Number	Answer	Mark
<b>7 (1)</b>	1. $1.4 \div 37 =$ ; 2. 3.8 (%) ; Correct answer gains both 2 marks	<b>(2)</b>

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