

Question	Answer	Mark	Guidance
3 (a)	W ; Z ; X ; W ;	4	Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks
3 (a) (ii)	<p>1 some <u>ATP</u> used to (actively) transport pyruvate (into the mitochondrion) ;</p> <p>2 some <u>ATP</u> used to (actively) transport <math>H^{(+)}</math> from (reduced) NAD, formed in glycolysis / into the mitochondrion ;</p> <p>3 some energy released in ETC, is not used to transport <math>H^{+}</math> (across inner membrane) / is released as heat ;</p> <p>4 not all the <math>H^{+}</math> movement (back across membrane), is used to generate ATP / is through ATP synth(et)ase ;</p> <p>5 not all the, reduced NAD / red NAD / NADH, is used to feed into the ETC ;</p>	2 max	<p>IGNORE ref to phosphorylation of glucose as this is taken into account in estimate.</p> <p>2 DO NOT CREDIT transport of (reduced) NAD</p> <p>3 ACCEPT in context of oxidative phosphorylation</p> <p>4 ACCEPT ref to <math>H^{+}</math> leaking (back into matrix or out into cytoplasm) resulting in less ATP generated</p> <p>5 CREDIT use of (some of) the red NAD for other purpose</p>

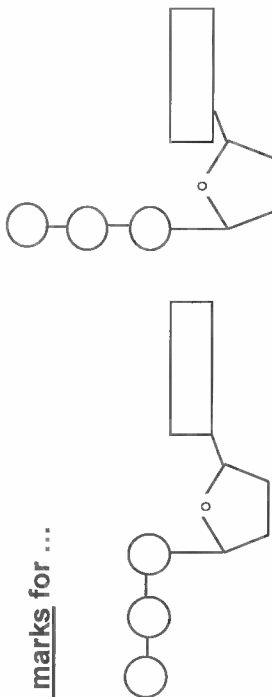
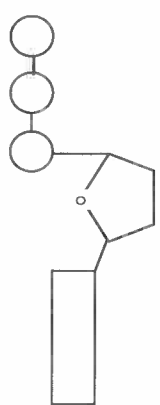
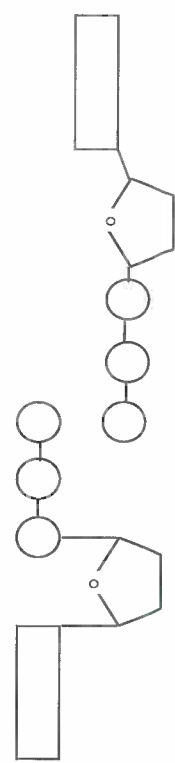
Question	Answer	Mark	Guidance
3 (b)	<p><i>in anaerobic respiration</i></p> <ul style="list-style-type: none"> <li>1 glycolysis / conversion of glucose into pyruvate , occurs ;</li> <li>2 produces 2 molecules of ATP (net) ;</li> <li>3 (only) substrate level phosphorylation (occurs) ;</li> <li>4 oxygen not available as final electron acceptor ;</li> <li>5 pyruvate / ethanal , used to regenerate NAD for glycolysis (to continue) ;</li> <li>6 (Krebs cycle and) electron transport chain / chemiosmosis / oxidative phosphorylation , do not occur ;</li> </ul>	<p>4 max</p>	<ul style="list-style-type: none"> <li>2 IGNORE little / less / not much</li> <li>4 CREDIT oxygen is available as the final electron acceptor in aerobic IGNORE ref to hydrogen acceptor</li> <li>5 pyruvate refers to lactate pathway, ethanal refers to fermentation</li> <li>6 ETC (etc.) <i>only</i> occur(s) in aerobic</li> </ul>
QWC ;		1	<p>Award if 3 of the following terms have been used in a correct context with correct spelling:</p> <ul style="list-style-type: none"> <li>glycolysis</li> <li>pyruvate</li> <li>substrate level phosphorylation</li> <li>oxygen</li> <li>electron acceptor</li> <li>chemiosmosis / chemiosmotic</li> <li>oxidative phosphorylation</li> </ul> <p>Please insert a QWC symbol next to the pencil icon, followed by a tick (✓) if QWC has been awarded or a cross (✗) if QWC has not been awarded. You should use the green dot to identify the QWC terms that you are crediting.</p>
	Total	11	

Question	Answer	Mark	Guidance										
5 (a) (i)	<p>1 (as the temperature increases) the <u>respiration rate</u> increases ;</p> <p>2 <u>respiration rate</u> doubles with a 10°C temperature increase ;</p> <p>3 <b>comparative figures with correct units</b> (units once for respiration and once for temperature) in the context of either mp ;</p>	2 max	<p>Only credit answers that refer to an increase in temperature – no ora</p> <p>1 Clear statement required – cannot be inferred from figures quoted.</p> <p>ACCEPT positive correlation between temperature and respiration rate</p> <p>IGNORE ref to directly proportional</p> <p>2 Clear statement required – cannot be inferred from figures quoted.</p> <p>CREDIT <math>Q_{10} = 2</math></p> <p>3 e.g. • between 0 and 20°C the respiration goes from 17 to 69 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup> • between 5 and 10°C the rate changes by 13 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup> e.g. • between 0 and 10°C the rate goes from 17 to 34 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup> • between 10 and 20°C the respiration goes from 34 to 69 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup></p> <table border="1" data-bbox="1098 215 1166 981"> <tr> <td>0 °C</td> <td>5 °C</td> <td>10 °C</td> <td>15 °C</td> <td>20 °C</td> </tr> <tr> <td>17</td> <td>21</td> <td>34</td> <td>44</td> <td>69</td> </tr> </table> <p>Note: 'between 0 and 20°C the respiration rate increased from 17 to 69 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup>' = 2 marks (mps 1 &amp; 3)</p> <p>But 'at 0 °C the respiration is 17 mg CO<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup>' and at 20°C it is 69' = 1 mark (mp 3)</p>	0 °C	5 °C	10 °C	15 °C	20 °C	17	21	34	44	69
0 °C	5 °C	10 °C	15 °C	20 °C									
17	21	34	44	69									

Question	Answer	Mark	Guidance
5 (a) (ii)	<p>1 <i>best conditions are low(er) temperatures because respiration <u>rate</u> low ;</i></p> <p>2 <math>0^{\circ}\text{C}</math> / freezing , could be / is , best ;</p> <p>3 <i>idea that <math>0^{\circ}\text{C}</math> might be too low as (the food cells) might be damaged at <math>0^{\circ}\text{C}</math> ;</i></p> <p>4 <i>idea that for some (named) food(s) (storage) temperature doesn't seem to matter ;</i></p> <p>5 <i>idea that data is incomplete for , potato / parsnip , so , only limited / no , conclusions can be made ;</i></p> <p>6 <i>idea that if product needs to ripen during storage then a higher temperature (not above <math>20^{\circ}\text{C}</math>) will be ideal ;</i></p>	2 max	<p>1 <math>5^{\circ}\text{C}</math> or below <b>IGNORE</b> statements that simply describe a trend</p> <p>3 <b>ACCEPT</b> ref to freezing instead of <math>0^{\circ}\text{C}</math></p> <p>4 <b>NOT</b> asparagus, blackberry or cauliflower</p> <p>6 <b>IGNORE</b> ref to ethene</p> <p><b>Note:</b> '<math>0^{\circ}\text{C}</math> is best as the respiration rate is low' = <b>2 marks</b> (mps 1 &amp; 2)</p>
5 (a) (iii)	<p>1 onion ;</p> <p>2 has low(est) respiration <u>rate</u> ;</p> <p>3 across all temperatures (in the investigation / up to <math>20^{\circ}\text{C}</math>) or temperature has , the least / little , effect on respiration <u>rate</u> ;</p> <p>4 can be , stored / kept , at , higher temperatures / room temperature / at <math>20^{\circ}\text{C}</math> ;</p>	3	<p>1 <b>DO NOT CREDIT</b> if an additional suggestion is made</p> <p>3 <b>DO NOT CREDIT</b> 'temperature has no effect on respiration rate'</p> <p>4 <b>CREDIT</b> <i>idea that no need to store in fridge</i></p>

Question	Answer	Mark	Guidance
5 (a) (iv)	asparagus <b>and</b> has a high respiration <u>rate</u> across all temperatures / has the highest respiration <u>rate</u> (of the foods) ;	1	Both parts of the mark point required for the mark to be awarded  <b>DO NOT CREDIT</b> 'asparagus' without a supporting reason  <b>ACCEPT</b> 'has a high respiration rate even at low temperature(s)'
5 (b) (i)	1 <i>idea that</i> parasites have little access to oxygen ;  2 (inaccessible because) little oxygen dissolved in plasma / oxygen not very soluble (in plasma) ;  3 (inaccessible because) <i>idea that</i> oxygen is , combined with haemoglobin / contained in red blood cells ;  4 <i>idea that</i> haemoglobin has greater affinity for oxygen than parasite (pigment) ;	2 max	<b>1 DO NOT CREDIT</b> 'no oxygen accessible' clearly stated <b>DO NOT CREDIT</b> in the context of , the mammal respiring anaerobically / deoxygenated blood / temporary lack of oxygen  <b>3 ACCEPT</b> in context of saturation  <b>Note:</b> 'because the oxygen is bound to haemoglobin, the parasite is unable to use it' = <b>2 marks</b> (mps 3 & 1)

Question	Answer	Mark	Guidance
5 (b) (ii)	<p><i>in animals</i> A1 pyruvate is , converted / reduced / to , lactate / lactic acid ;</p> <p>A2 can be reversed as no , atoms lost / other product formed ;</p> <p>A3 lactate dehydrogenase available to reverse the reaction ;</p> <p><i>in yeast</i> Y1 pyruvate converted to ethanol (in 2 steps) and carbon dioxide / CO<sub>2</sub> ;</p> <p>Y2 cannot be reversed as , carbon dioxide is / atoms are , lost ;</p> <p>Y3 (de)carboxylase enzyme cannot reverse the reaction ;</p>	3 max	<p>Only award 3 content marks if A mark(s) <u>plus</u> Y mark(s) awarded</p> <p>A1 Cannot be inferred from awarding of A2 or A3</p> <p>A2 e.g. pyruvate and lactate are both 3C compounds so reaction can be reversed</p> <p>Y1 CREDIT pyruvate decarboxylated to ethanol</p> <p>Y2 e.g. pyruvate is 3C and , ethanol / ethanal , is 2C so reaction cannot be reversed</p>
	<p>QWC – technical terms used appropriately and spelled correctly ;</p>	1	<p>Use of three terms from: pyruvate, lactate, lactate dehydrogenase carbon dioxide, ethanol (de)carboxylase / (de)carboxylation (or derived term)</p> <p>Please insert a QWC symbol next to the pencil icon, followed by a tick (✓) if QWC has been awarded or a cross (x) if QWC has not been awarded You should use the green dot to identify the QWC terms that you are crediting.</p>
Total		14	

Question	Answer	Marks	Guidance
5 (a) (i)	<p>row of 3 phosphates joined to ribose <b>and</b> ribose joined to adenine ;</p> <p>phosphates and adenine shown joined to correct place on ribose</p> <p><b>or</b></p> <p>stated that phosphate(s) joined to carbon 5 <b>and</b> adenine joined to carbon 1 ;</p>	2	<p><b>CREDIT</b> a written description that meets the requirements of the mark point</p> <p><b>IGNORE</b> ribose drawn without an 'O'</p> <p>Phosphates must be attached to a vertical line from ribose</p> <p>Adenine must not be attached to a vertical line from ribose</p> <p><b>2 marks for ...</b></p>  <p><b>ALLOW 2</b> for reverse of above (as long as C atoms not numbered incorrectly) eg</p>  <p><b>1 mark for ...</b> (as implies that adenine is attached to carbon 5)</p>  <p>(as implies that phosphates are attached to carbon 4)</p>

Question	Answer	Marks	Guidance
5 (a) (ii)	hydrolysis ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>  <b>ACCEPT</b> dephosphorylation <b>IGNORE</b> ref to phosphorylation in glycolysis (as, even if addition of phosphate to glucose is explained, this is not the type of reaction)
5 (b) (i)	1 ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
5 (b) (ii)	none ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
5 (b) (iii)	2 / 3 ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	<b>Total</b>	<b>6</b>	

#### Addendum to F214 January 2013 Question Paper

Chemiosmotic theory is a learning outcome of Module 4 of the F214 specification.

The chemiosmotic theory, as presented in the examination paper for F214, January 2013, and the OCR endorsed A2 Heinemann textbook, has been the subject of debate by a group of Academics working in the area of bioenergetics. This group of scientists has stated that the outer mitochondrial membrane does not play a role in oxidative phosphorylation and, hence, in ATP synthesis.

An account of the chemiosmotic theory has been produced by this group to assist with the teaching and learning of this important topic and has been placed on the OCR website <http://www.ocr.org.uk/qualifications/as-a-level-gce-biology-h021-h421/>



Question	Answer	Marks	Guidance
5 (a) (i)	cytoplasm (of cell) ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT cytosol</p>
5 (a) (ii)	<ol style="list-style-type: none"> <li>1 <u>phosphorylation</u> of glucose ;</li> <li>2 so forming <b>hexose (1,6) bisphosphate</b> ;</li> <li>3 (then) splitting into / formation of, <u>two / 2</u>, <b>triose phosphate(s) / TP</b> ;</li> <li>4 (for formation of pyruvate) <b>dehydrogenation / oxidation</b> / formation of reduced NAD ;</li> <li>5 <b>pyruvate</b> produced (from , TP / (3C) intermediate) ;</li> <li>6 total production 4 ATP / net production of 2 ATP ;</li> </ol> <p><b>QWC</b> – technical terms used appropriately <u>and</u> spelled correctly ;</p>	3 max	<p>Marks can be awarded from a <b>diagram</b></p> <ol style="list-style-type: none"> <li>1 <b>DO NOT CREDIT</b> substrate level phosphorylation</li> <li>2 <b>IGNORE</b> glucose-6-phosphate / fructose-6-phosphate <b>CREDIT</b> fructose(-1,6-)bisphosphate <b>ACCEPT</b> hexose biphosphate <b>DO NOT CREDIT</b> hexose diphosphate</li> <li>3 <b>IGNORE</b> hydrolysis <b>DO NOT CREDIT</b> if ATP or NAD or red NAD involved in conversion of hexose bisphosphate to TP</li> <li>4 <b>ACCEPT</b> formation of, NADH<sub>2</sub> / NADH (+H<sup>+</sup>) / red NAD <b>DO NOT CREDIT</b> NADPH<sub>2</sub> / NADPH (+H<sup>+</sup>) <b>DO NOT CREDIT</b> hydrogen ion without electron / H<sub>2</sub></li> <li>6 Needs to be a clear statement</li> </ol>
		1	<p>Use of three terms (including from a flow chart) from:            phosphorylation (or derived term) <b>glucose</b>            hexose (1,6) <b>bisphosphate</b> <b>triose phosphate</b>            dehydrogenation <b>OR</b> oxidation (or derived terms)            pyruvate            Please insert a QWC symbol next to the pencil icon, followed by            a tick (✓) if QWC has been awarded            or a cross (x) if QWC has not been awarded            You should use the green dot to identify the QWC terms that you are crediting.</p>

Question	Answer	Marks	Guidance
5. (b)	<p>W ethanal ;</p> <p>X carbon dioxide / CO<sub>2</sub> ;</p> <p>Y reduced NAD ;</p> <p>Z NAD<sup>(+)</sup> ;</p>	4	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>W</b> Correct spelling only <b>DO NOT CREDIT</b> ethanol</p> <p><b>X</b> <b>DO NOT CREDIT</b> CO<sub>2</sub> / CO</p> <p><b>Y</b> <b>ACCEPT</b> NADH<sub>2</sub> / NADH<sup>(+)</sup> (+H<sup>+</sup>) / red NAD <b>DO NOT CREDIT</b> NADPH<sub>2</sub> / NADPH<sup>(+)</sup> (+H<sup>+</sup>) / red NADP</p> <p><b>Z</b> <b>DO NOT CREDIT</b> NADP</p>
5. (c) (i)	<p>1 A / alkaline , produced less alcohol (than the control) at all times ;</p> <p>2 V / <i>Vateria</i> , produced less alcohol (than the control) , at 30 <b>and</b> 45 <b>and</b> 60 hours / from 30 hours / after 15 hours</p> <p>or V / <i>Vateria</i> had the same alcohol as the control at 15 hours ;</p> <p>3 C / <i>Careya</i> , produced less alcohol (than the control) at 30 <b>and</b> 45 hours</p> <p>or C / <i>Careya</i> , produced more alcohol (than the control) at 15 <b>and</b> 60 hours ;</p>	2	<p><b>CREDIT</b> ora for all mark points</p> <p>ora e.g. control always produced more alcohol than A</p>

Question	Answer	Marks	Guidance
5 (c) (ii)	<p>at 60 hours</p> <p>V has fewer yeast cells (which would ferment the sugar) or C has more yeast cells ;</p> <p>only a small number of bacteria in V are , fermenting the sugar / producing alcohol or the , type / species , of bacteria in V are not , fermenting the sugar / producing alcohol or most / all / type of , bacteria in C are , fermenting the sugar / producing alcohol ;</p>	1	<p>IGNORE ref to a compound inhibiting production of alcohol in V Must be clear statements, not implied by the use of figs</p> <p>IGNORE 'V has fewer bacteria' without ref to fermentation</p> <p>IGNORE 'C has more bacteria' without ref to fermentation</p>
5 (c) (iii)	<p>A / (weak) alkaline (solution) ;</p> <p>(A has the least contamination as) it has very few bacteria <b>and</b> little alcohol ;</p>	2	<p>ONLY CREDIT in context of treatment A</p>
	<b>Total</b>	<b>14</b>	

Question	Expected Answers	Marks	Additional Guidance												
1 (a)	<p data-bbox="271 1444 303 1859"><b>Award 1 mark per correct row</b></p> <table border="1" data-bbox="399 1064 1061 1836"> <tr> <td data-bbox="486 1579 678 1836"><i>name of hydrogen acceptor after glycolysis</i></td> <td data-bbox="399 1321 486 1579">mammal</td> <td data-bbox="399 1064 486 1321">yeast</td> <td data-bbox="486 1064 518 1108">;</td> </tr> <tr> <td data-bbox="678 1579 837 1836"><i>is CO<sub>2</sub> produced?</i></td> <td data-bbox="678 1321 837 1579">no / ✗ / none / no molecules</td> <td data-bbox="678 1064 837 1321">yes / ✓ / some / one molecule</td> <td data-bbox="758 1064 790 1108">;</td> </tr> <tr> <td data-bbox="837 1579 1061 1836"><i>name of final product</i></td> <td data-bbox="837 1321 1061 1579">lactate</td> <td data-bbox="837 1064 1061 1321">ethanol</td> <td data-bbox="949 1064 981 1108">;</td> </tr> </table>	<i>name of hydrogen acceptor after glycolysis</i>	mammal	yeast	;	<i>is CO<sub>2</sub> produced?</i>	no / ✗ / none / no molecules	yes / ✓ / some / one molecule	;	<i>name of final product</i>	lactate	ethanol	;	<b>3</b>	<p data-bbox="271 179 375 896"><b>Mark the first answer in each box.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p data-bbox="406 179 470 896"><b>ACCEPT</b> phonetic spelling <b>except</b> for ethanal and ethanol</p> <p data-bbox="518 179 654 896"><b>ACCEPT</b> pyruvic acid (instead of pyruvate)  <b>ACCEPT</b> acetaldehyde (instead of ethanal)  <b>IGNORE</b> formulae  The spelling of ethanal must be unambiguous</p> <p data-bbox="734 179 805 896"><b>ACCEPT</b> 2 molecules for yeast  (from 1 glucose molecule)</p> <p data-bbox="877 179 1045 896"><b>ACCEPT</b> lactic acid (instead of lactate)  <b>ACCEPT</b> ethyl alcohol (instead of ethanol)  <b>IGNORE</b> alcohol  <b>IGNORE</b> formulae  The spelling of ethanol must be unambiguous</p>
<i>name of hydrogen acceptor after glycolysis</i>	mammal	yeast	;												
<i>is CO<sub>2</sub> produced?</i>	no / ✗ / none / no molecules	yes / ✓ / some / one molecule	;												
<i>name of final product</i>	lactate	ethanol	;												

Question	Expected Answers	Marks	Additional Guidance
1 (b)	<p>1 <i>idea that</i> ATP produced / energy released ;</p> <p>2 <i>idea that</i> recycles NAD / NAD can be used again ;</p> <p>3 allows , <b>glycolysis</b> / description of glycolysis , to take place / to continue ;</p>	<p>1 max</p> <p>4</p>	<p><b>IGNORE</b> ref to specific metabolic reactions other than glycolysis (mp 3)</p> <p><b>IGNORE</b> ref to respiration without oxygen</p> <p>1 <b>DO NOT CREDIT</b> this mark point with any ref to energy , generated / produced / made [eg energy made in the form of ATP = 0 ATP (energy) is produced = 0]</p> <p>2 <b>ACCEPT</b> 'reoxidises red NAD' (as implies recycling) <b>CREDIT</b> NADH / NADH<sup>+</sup> / NADH<sub>2</sub> for red NAD <b>DO NOT CREDIT</b> 'oxidises red NAD' without further qualification</p> <p>3 If glycolysis used as a term, the spelling of 'glyco' must be correct.</p>
	<b>TOTAL</b>	<b>4</b>	

Question	Expected Answers	Marks	Additional Guidance
3 (a) (i)	<p><b>W</b> glycolysis ;</p> <p><b>X</b> Calvin cycle / light-independent stage (of photosynthesis) ;</p> <p><b>Y</b> Krebs cycle ;</p>	3	<p><b>Mark the first answer for each letter.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>W</b> : <b>CREDIT</b> glycolytic pathway  <b>ACCEPT</b> phonetic spelling but must have 'glycol'  <b>IGNORE</b> respiration</p> <p><b>X</b> <b>IGNORE</b> dark reaction / photosynthesis  <b>ACCEPT</b> phonetic spelling</p> <p><b>Y</b> <b>ACCEPT</b> citric acid cycle / TCA cycle / (tri)carboxylic acid cycle  <b>ACCEPT</b> phonetic spelling  <b>IGNORE</b> respiration / link reaction</p>
3 (a) (ii)	<p><b>1</b> take place in different , parts / organelles , of the cell  <b>or</b>  compartmentalisation / reactions separated by membranes ;</p> <p><b>2</b> W / glycolysis , in cytoplasm ;</p> <p><b>3</b> X / Calvin cycle , in , chloroplast / stroma (of chloroplast) ;</p> <p><b>4</b> Y / Krebs cycle , in , mitochondrion / matrix (of mitochondrion) ;</p> <p><b>5</b> AVP ;</p>	3 max	<p><b>1</b> Must be a clear statement and not implied from others.  <b>DO NOT CREDIT</b> different parts of the leaf  <b>DO NOT CREDIT</b> no interference between pathways (as rephrasing the Q)</p> <p><b>2</b></p> <p><b>3</b> <b>DO NOT CREDIT</b> if thylakoid / membranes stated or implied</p> <p><b>4</b> <b>DO NOT CREDIT</b> if cristae / membranes stated or implied</p> <p><b>5</b> eg • different enzymes for each pathway  • different conditions for each pathway</p>

Question	Expected Answers	Marks	Additional Guidance
3 (a) (iii)	X ;  W and Y ;	2	<p>IGNORE names. The question has asked for letters.</p> <p><i>photosynthesis</i>  <b>Mark the first answer.</b> If the answer is correct and an additional letter is given then = <b>0 marks</b></p> <p><i>aerobic respiration</i>  <b>Mark the first two answers.</b> If these answers are correct and an additional letter (ie 3<sup>rd</sup> etc) is given then = <b>0 marks</b></p> <p><b>Both letters required for this mark, in any order.</b></p>
3 (a) (iv)	ATP / adenosine triphosphate ; water / H <sub>2</sub> O ; (oxidised) NAD / FAD ;	2	<p>If any answer(s) incorrect then <b>Max 1</b></p> <p>IGNORE energy / heat          IGNORE numbers</p> <p>eg oxygen (x) and ATP (✓) and water = max 1          oxygen (x) and energy (<i>ignore</i>) = 0          ATP (✓) and energy (<i>ignore</i>) and H<sub>2</sub>O (✓) = 2          reduced NAD (x) and ATP (✓) and energy (<i>ignore</i>) and H<sub>2</sub>O = max 1</p>

Question	Expected Answers	Marks	Additional Guidance
3 (b)	<p>1 NAD / FAD / NADP, can, accept hydrogen / accept H / be reduced ;</p> <p>2 reduced, NAD / FAD, supplies / carries, electrons, to the electron transport chain / for oxidative phosphorylation ;</p> <p>3 reduced, NAD / FAD, supplies / carries, hydrogen ions for, chemiosmosis / oxidative phosphorylation ;</p> <p>4 reduced NADP, supplies / carries, hydrogen to, light independent stage / Calvin cycle / X ;</p> <p>5 coenzyme A / CoA, carries, <u>acetate</u> / <u>ethanoate</u> / <u>acetyl group</u>, to, Krebs cycle / Y ;</p> <p>6 AVP ;</p>	3 max	<p>1 <b>DO NOT CREDIT</b> hydrogen ions / protons, unless there is an electron as well <b>DO NOT CREDIT</b> accepts hydrogen molecules / H<sub>2</sub> <b>CREDIT</b> equation showing the reduction <b>ACCEPT</b> eg NAD converted to NADH <b>IGNORE</b> 'carries hydrogen'</p> <p>2 Must refer to <i>reduced</i> NAD <b>or reduced</b> FAD <b>or</b> NADH / NADH<sup>+</sup> / NADH<sub>2</sub> / FADH / FADH<sup>+</sup> / FADH<sub>2</sub></p> <p>3 Must refer to <i>reduced</i> NAD <b>or reduced</b> FAD <b>or</b> NADH / NADH<sup>+</sup> / NADH<sub>2</sub> / FADH / FADH<sup>+</sup> / FADH<sub>2</sub></p> <p>4 Must refer to <i>reduced</i> NADP <b>or</b> NADPH / NADPH<sup>+</sup> / NADPH<sub>2</sub></p> <p>5 <b>DO NOT CREDIT</b> acetyl CoA carries acetate</p> <p>6 eg • co-enzyme(s) / cytochrome(s), transfer / accept and release, electrons along the electron transport chain • can be, recycled / oxidised <b>and</b> reduced</p>
	<b>TOTAL</b>	<b>13</b>	



Question		Answer	Marks	Guidance
4	(a)	(i)	1	<p>link reaction <b>and</b> Krebs cycle ;</p> <p><b>Mark the first 2 answers.</b> If they are correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p>
4	(a)	(ii)	1	<p>oxidative phosphorylation ;</p> <p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>ACCEPT</b> electron transport chain / electron transport system / electron carrier chain <b>IGNORE</b> chemiosmosis <b>DO NOT CREDIT</b> photorespiration</p>
4	(b)	(i)	1	<p>1 <b>IGNORE</b> ref to mass / weight</p>
		(ii)	2 max	<p>2 <b>IGNORE</b> ref to mass / weight must refer to A / soaked / germinating <b>and/or</b> B / dry / dormant</p> <p>3 <b>CREDIT</b> idea that with the presence of beads the volume of gas would be the same</p>

Question	Answer	Marks	Guidance
4 (b) (ii)	<p>1 (determined by) finding difference in volume between (30) soaked, seeds / peas and (30) dry, seeds / peas ;</p> <p>2 the difference represents the volume of glass beads required</p> <p>or</p> <p>add the quantity of glass beads necessary to make the volumes (of respirometer contents) equal ;</p> <p>3 calculate / knowing, volume of 1 bead to determine number of beads equivalent to volume required ;</p>		<p><b>ACCEPT</b> ref to mass/weight instead of volume throughout (ii) as an error carried forward (ecf)</p> <p><b>3 CREDIT</b> any suitable <i>method</i> of determining the volume of beads required</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>• displacement</li> <li>• put soaked peas in tube and measure volume; mark; then put dry peas in and add glass beads into tube and top up to mark</li> </ul>
4 (c) (i)	0.014 ; ;	2 max	<p>Correct answer = 2 marks, even if no working</p> <p>If answer incorrect, not rounded correctly or given to more than 3 dp then</p> <p><b>ALLOW</b> 1 mark for seeing</p> <ul style="list-style-type: none"> <li>• <math>\frac{0.27}{20}</math></li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• 0.0135</li> </ul> <p>Only if there is no answer on the dotted answer line, should you look for the answer in the working or in the appropriate place in the table.</p>

Question	Answer	Marks	Guidance
4 (c) (ii)	at, <i>higher temperature</i> / 25°C increased <u>kinetic</u> energy ; (named respiratory) enzymes / decarboxylases / dehydrogenases , involved ;		<b>CREDIT</b> ora for lower temperature <b>IGNORE</b> more collisions / ESCs Needs a clear statement that they are involved in <u>respiration</u> <b>IGNORE</b> (named) co-enzymes
4 (c) (iii)	1 reactions require aqueous medium / reactions need to take place in water / reactions need to take place in solution ; 2 enzymes and substrates can move (to collide) in soaked seeds or movement (of reactants) , prevented / limited , in dry seeds ; 3 soaked seeds need more , ATP / energy or dry seeds need less , ATP / energy ; 4 for , protein synthesis / mitosis / other (named) metabolic reaction ;	<b>2</b>	<b>ACCEPT</b> 'germinating' for 'soaked', 'peas' for 'seeds', 'dormant' for 'dry' throughout <b>1 IGNORE</b> ref to reactants dissolving <b>2 IGNORE</b> ref to ESC as the mp is for the idea of mobility <b>3 DO NOT CREDIT</b> 'no' ATP / energy <b>4 CREDIT</b> soaked peas have increased metabolism <b>IGNORE</b> growth / respiration <b>DO NOT CREDIT</b> ref to photosynthesis
	<b>Total</b>	<b>2 max</b> <b>12</b>	

Question	Answer	Marks	Guidance
3 (a)	crista(e) / inner mitochondrial membrane ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p><b>ACCEPT</b> thylakoid membrane / lamella(e) (of chloroplast)</p>
3 (b) (i)	A has more stain than B <u>and</u> C has none ;	1	<p>All 3 seeds must be mentioned</p> <p>Staining ref. could relate to area or intensity of stain.</p> <p><b>DO NOT CREDIT</b> implication that C has any staining</p> <p><b>ACCEPT</b> 'shading' instead of 'staining'</p> <p><b>IGNORE</b> ref to presence or absence of TTC (as it is present in all regions of all seedlings and it is the <i>staining</i> that is important)</p>
3 (b) (ii)	<ol style="list-style-type: none"> <li>1 idea that shaded areas in A are respiring ;</li> <li>2 idea that 22°C is suitable temperature for respiration ;</li> <li>3 reduced , NAD / FAD / coenzymes , produced in , glycolysis / link reaction / Krebs cycle ;</li> <li>4 lots of / more , electron transfer (to TTC) / (oxidative) phosphorylation / chemiosmosis ;</li> </ol>	2 max	<p>1 <b>ACCEPT</b> a description of the respiring area(s) eg the outer regions of the seed are respiring</p> <p>3 <b>ACCEPT</b> NADH / NADH<sup>+</sup> / NADH + H<sup>+</sup> / NADH<sub>2</sub> / FADH / FADH<sup>+</sup> / FADH + H<sup>+</sup> / FADH<sub>2</sub></p>

Question	Answer	Marks	Guidance
3 (b) (iii)	(named stage of) respiration uses, enzymes / proteins in ETC / electron carriers ;  <i>group B</i> not enough <u>kinetic</u> energy for , ESC formation / substrates and enzymes to collide (successfully) ;  <i>group C</i> enzymes / proteins in ETC / electron carriers , denatured by , high temperature / (almost) boiling water ;	2 max	<b>IGNORE</b> coenzymes  <i>Note that a statement reading:</i> ‘the respiratory enzymes are denatured by 90°C in C’ = 2 marks (mps 1 and 3)
3 (c) (i)	ethanal ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks  <b>ACCEPT</b> acetaldehyde <b>IGNORE</b> formulae (as name asked for in Q)
3 (c) (ii)	ethanal ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks  <b>ACCEPT</b> acetaldehyde <b>IGNORE</b> formulae (as name asked for in Q)

Question	Answer	Marks	Guidance
3 (c) (iii)	ethanol <u>and</u> carbon dioxide ;	1	<p>Mark the first 2 answers. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT formulae            IGNORE alcohol unless specified as 'ethyl alcohol'            IGNORE (oxidised) NAD            DO NOT CREDIT NADP / reduced NAD / ATP</p>
3 (c) (iv)	<p>1 releases NAD , to accept more H / to be reduced again / so glycolysis can continue</p> <p>or</p> <p>allows (some) ATP to be generated (in glycolysis) ;</p> <p>2 (some ATP available) for named cellular process ;</p> <p>3 AVP ;</p>	2 max	<p>1 the idea that cells can still respire is not quite enough</p> <p>2 eg</p> <ul style="list-style-type: none"> <li>• active transport</li> <li>• endocytosis / exocytosis / pinocytosis</li> <li>• mitosis / meiosis</li> <li>• protein synthesis</li> <li>• DNA replication</li> <li>• Calvin cycle / light-independent stage of photosynthesis</li> </ul> <p>3 eg</p> <ul style="list-style-type: none"> <li>• stated situation where oxygen is in short supply (e.g. waterlogging / compacted soil / roots situated very deep in soil)</li> </ul> <p>IGNORE can respire in low oxygen conditions (as stated in Q)</p>
<b>Total</b>		<b>11</b>	

Question	Expected Answer	Mark	Additional Guidance
1 (a) (i)	<p>X adenine ;</p> <p>Y ribose ;</p> <p>Z (tri / 3) phosphate(s) ;</p>	3	<p>Mark the first answer for each letter. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>X IGNORE nitrogenous base / base / A DO NOT CREDIT adenosine</p> <p>Y IGNORE pentose / sugar DO NOT CREDIT ribulose / hexose</p> <p>Z IGNORE chemical formulae (as Q asks for name) DO NOT CREDIT phosphorus / phosphoryl (PO)</p>

Question	Expected Answer	Mark	Additional Guidance
1	<p>(a) (ii)</p> <p>1 transfers energy / energy 'currency' / releases energy / universal energy molecule / energy intermediate / (immediate) source of energy ;</p> <p>2 phosphate(s) can be removed by <u>hydrolysis</u> ;</p> <p>3 to , release / provide , <u>30kJ</u> (<math>\text{mol}^{-1}</math>) energy ;</p> <p>4 (energy released for) metabolism / appropriate named reaction / appropriate reaction described ;</p> <p>5 ADP can attach a phosphate (forming ATP) during , respiration / photosynthesis ;</p> <p>6 energy released in , small 'packets' (to prevent cell damage) / suitable quantity ;</p>	3 max	<p><b>1 IGNORE</b> contains energy <b>DO NOT CREDIT</b> produce energy</p> <p><b>2</b> <math>\text{ATP} \rightarrow \text{ADP} + \text{P}_{(i)}</math> by <u>hydrolysis</u> or <math>\text{ATP} + \text{H}_2\text{O} \rightarrow \text{ADP} + \text{P}_{(i)}</math> (must include water)</p> <p><b>3 ACCEPT</b> 28 – 32 <u>kJ</u> <b>DO NOT CREDIT</b> produce energy</p> <p><b>4</b> e.g. • muscle contraction • active transport • phosphorylation • glycolysis • during movement binding to proteins to change their shape</p> <p><b>IGNORE</b> respiration / photosynthesis unqualified</p> <p><b>5 CREDIT</b> during, oxidative phosphorylation / chemiosmosis / substrate level phosphorylation / photophosphorylation</p> <p><b>NOTE</b> 'it releases 30kJ of energy when a phosphate is removed by hydrolysis' = 3 marks (mps 3, 1 and 2)</p>



Question	Expected Answer	Mark	Additional Guidance
1	(b) (i)  crista ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>ACCEPT</b> 'cristae' / 'inner mitochondrial membrane' <b>IGNORE</b> 'stalked particles'</p>
1	(b) (ii)  chemiosmosis / oxidative phosphorylation ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>IGNORE</b> description of chemiosmosis [e.g. • 'ATP synthesis' • 'electron flow along electron carriers'] <b>IGNORE</b> 'aerobic respiration' <b>IGNORE</b> 'electron transport chain' alone (as this is not a process)</p>
1	(c) (i)		<p>1 <u>substrate</u> respired changes over time ;</p> <p>2 initially respire (mostly) , glucose / carbohydrate ;</p> <p>3 lower / decrease in / 0.75 , RQ indicates (more) , fat / lipid , as substrate <i>or</i> as time goes by (more) lipid is respired ;</p> <p>4 glucose / carbohydrate , used up / decreases (over time) ;</p> <p>5 protein not likely to be used as substrate / protein only used as a last resort ;</p>
		3 max	<p>1 Needs to be a clear statement and not just names and not inferred from candidate's complete answer</p> <p>2 <b>IGNORE</b> respiring protein</p> <p>3 <b>IGNORE</b> respiring protein</p> <p>5 'Less protein respired' isn't quite enough for this mp</p>

Question	Expected Answer	Mark	Additional Guidance
1	<p>(c) (ii) <i>This is a QWC question</i></p> <ol style="list-style-type: none"> <li>1 peripheral / skin , thermoreceptors / (heat) receptors , stimulated (by decrease in external temp) ;</li> <li>2 (impulses sent to / blood temperature monitored in ) hypothalamus / sensory cortex ;</li> <li>3 vasoconstriction of , arterioles / small arteries , to reduce heat loss ;</li> <li>4 (prevents heat loss by) radiation / conduction / convection ;</li> <li>5 increased , metabolic rate / metabolism / respiration , to generate heat (energy) ;</li> <li>6 (release of) adrenaline / thyroxine ;</li> <li>7 shivering / (involuntary) muscle spasms , to generate heat (energy) ;</li> <li>8 erector / hair , muscles raise , (skin) hair / fur , to trap , air / heat ;</li> <li>9 AVP ;</li> </ol>		<p>Only CREDIT answers that refer to preventing a decrease in body temperature – no ora IGNORE negative feedback (Q only about preventing decrease)</p> <p>3 ACCEPT 'pre-capillary sphincter' instead of 'arterioles' DO NOT CREDIT other blood vessels but allow QWC</p> <p>5 Emphasis needs to be on increase / higher rate / more</p> <p>7 Needs the idea of generating heat not just 'to keep warm</p> <p>9 e.g. ● specific behavioural response (such as huddling / increased exercise / move to find sun) ● involvement of sympathetic nervous system ● reduce sweating / reduce panting / stop panting DO NOT CREDIT 'stop sweating'</p>
	<p>QWC - technical terms used appropriately and spelt correctly ;</p>	4 max	<p>Use of three terms from: peripheral, thermoreceptor(s), hypothalamus, cortex, vasoconstriction, metabolic rate / metabolism, adrenaline, thyroxine, erector radiation / conduction / convection</p> <p>Please insert a QWC symbol next to the mark total bracket, followed by a tick (✓) if QWC has been awarded or a cross (x) if QWC has not been awarded You should use the green dot to identify the QWC terms that you are crediting.</p>
	Total	1	
	Total	[16]	