

Question			Answer	Mark	Guidance
1	(a)		(works) outside cells ;	1	<b>ACCEPT</b> secreted / AW , from cells <b>ACCEPT</b> works in named extracellular environment e.g. digestive tract <b>IGNORE</b> doesn't work in cells
1	(b)	(i)	time / time taken ;	1	<b>Mark the first answer.</b> If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = <b>0 marks</b>  <b>ACCEPT</b> 'how long it took ...'

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1	(b)	(ii)	<p><i>linear part of the graph means...</i></p> <p>1 <u>more</u> (successful) collisions with (amylase) <u>active site</u> (at increasing starch concentration) ; <b>ora</b></p> <p>2 <u>more</u> ESC (at increasing starch concentration) ; <b>ora</b></p> <p>3 so more product formation in a <u>given time</u> (at increasing starch concentration) ; <b>ora</b></p> <p><i>curve / plateau , means...</i></p> <p>4 all / most , <u>active sites</u> (of amylase) are occupied ;</p> <p>5 enzyme / amylase , working , at / near, maximum rate / <math>V_{max}</math> ;</p> <p>6 (so) further increase in starch concentration has no effect (on rate) ;</p> <p>7 enzyme <u>concentration</u> , is / becomes , <u>limiting</u> factor ;</p>	5 max	<p><b>ACCEPT</b> glucose / maltose for product throughout  <b>ACCEPT</b> substrate for starch throughout</p> <p>1 <b>ACCEPT</b> few(er) active sites occupied at low starch concentrations</p> <p>2 <b>ACCEPT</b> ESC formed more easily</p> <p>3 <b>AWARD</b> only if linked to the context of marking points 1 or 2 e.g. 'more product formation in a given time because of more collisions with the enzyme' gets mp3 but not mp1 because active site not mentioned  3 <b>IGNORE</b> <u>rate</u> as this is a description of graph</p> <p>4 <b>ACCEPT</b> all active sites are full of substrate</p> <p>5 <b>ACCEPT</b> enzyme at full capacity</p> <p>6 Must link to 4 or 5  6 <b>AWARD</b> only if mp 4 or 5 given  6 <b>DO NOT CREDIT</b> rate decreases</p> <p>7 <b>ACCEPT</b> the increasing part of the graph is because starch <u>concentration</u> is the <u>limiting</u> factor</p>

Question			Answer	Mark	Guidance
1	(b)	(iii)	<p>1 (so) charges in active site do not change ; <b>ora</b></p> <p>2 (so) hydrogen / ionic , bonds unaffected ; <b>ora</b></p> <p>3 (so) tertiary structure / 3D shape / active site , unaltered ; <b>ora</b></p> <p>4 (so) enzyme / tertiary structure , does not <u>denature</u> ; <b>ora</b></p> <p>5 (so) substrate , fits / is complementary shape to , <u>active site</u> ; <b>ora</b></p> <p>6 so the results are <u>valid</u> / as the <u>rate</u> (of reaction) will vary if pH varies / so that only one (independent) variable is changed ;</p>	3 max	<p>The mark points refer to a constant pH preventing damage to the enzyme. <b>CREDIT</b> throughout the appropriate marking point for an answer that describes what would happen if the pH changed.</p> <p><b>2 DO NOT CREDIT</b> peptide / disulphide , bonds break</p> <p><b>2 DO NOT CREDIT</b> in context of heat / vibration</p> <p><b>2 IGNORE</b> hydrophobic / hydrophilic</p> <p><b>3 IGNORE</b> ref to denaturing active site</p> <p><b>3 IGNORE</b> tertiary structure breaks</p> <p><b>3 ACCEPT</b> tertiary structure affected</p> <p><b>3</b> Cannot be inferred from mp5 – must be stated</p> <p><b>4 IGNORE</b> ref to denaturing active site</p> <p><b>4 DO NOT CREDIT</b> kill / die</p> <p><b>5 IGNORE</b> enters / binds with</p> <p><b>6 IGNORE</b> fair test / reliable / accurate</p>

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	(b) (iv)	<p>temperature (of the reaction mixture) ; enzyme / amylase , concentration ;</p> <p>(total) volume of (reaction) <u>solution</u> ;</p> <p>concentration of , cofactors / chloride ions / Cl<sup>-</sup> ;</p>	2 max	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = <b>0 marks</b> <b>DO NOT CREDIT</b> substrate / starch , concentration (as this is the independent variable)</p> <p><b>DO NOT CREDIT</b> amount</p> <p><b>ACCEPT</b> volume of enzyme solution <b>DO NOT CREDIT</b> amount</p> <p><b>ACCEPT</b> concentration of coenzymes</p> <p><b>IGNORE</b> time / agitation / inhibitors</p>														
1	(c) (i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Amylose</th> <th style="width: 50%; text-align: center;">Cellulose</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><i>coiled</i></td> <td style="text-align: center;"><i>no coiling</i></td> </tr> <tr> <td>(contains) <math>\alpha</math> / alpha / A / a , -glucose</td> <td>(contains) <math>\beta</math> / beta / B / b , -glucose ;</td> </tr> <tr> <td><math>\alpha</math> / alpha / A / a 1-4 glycosidic bonds</td> <td><math>\beta</math> / beta / B / b 1-4 glycosidic bonds ;</td> </tr> <tr> <td>all , monomers / AW , in same orientation</td> <td>alternate monomers at , 180° / AW , to each other ;</td> </tr> <tr> <td>granular / not fibrous</td> <td>fibrous / not granular ;</td> </tr> <tr> <td>H bonds within molecule / no (H) bonds (between molecules)</td> <td>(H) bonds between adjacent molecules ;</td> </tr> </tbody> </table>	Amylose	Cellulose	<i>coiled</i>	<i>no coiling</i>	(contains) $\alpha$ / alpha / A / a , -glucose	(contains) $\beta$ / beta / B / b , -glucose ;	$\alpha$ / alpha / A / a 1-4 glycosidic bonds	$\beta$ / beta / B / b 1-4 glycosidic bonds ;	all , monomers / AW , in same orientation	alternate monomers at , 180° / AW , to each other ;	granular / not fibrous	fibrous / not granular ;	H bonds within molecule / no (H) bonds (between molecules)	(H) bonds between adjacent molecules ;	3	<p><b>Mark the first 3 responses</b> <b>AWARD</b> 1 mark for each correct row irrespective of boxes Three correct rows of responses written within the same box can be awarded 3 points.</p> <p><b>ACCEPT</b> every second one is flipped</p> <p><b>ACCEPT</b> fibres / microfibrils / fibrils / macrofibrils <b>DO NOT CREDIT</b> myofibrils <b>ACCEPT</b> grains</p> <p><b>ACCEPT</b> '(cross)links' as AW for 'bonds'</p>
Amylose	Cellulose																	
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1	(c)	(ii)	(tensile) strength / strong ;  (H) bonds / links , can form (between adjacent fibrils) ;  insoluble ;	2 max	<b>ACCEPT</b> mechanical strength <b>IGNORE</b> fibrous / rigid  <b>ACCEPT</b> fibres / microfibrils / fibrils / macrofibrils <b>IGNORE</b> refs to bonding with water <b>IGNORE</b> ionic / myofibrils <b>ACCEPT</b> crosslinks <b>DO NOT CREDIT</b> peptide / covalent / glycosidic / disulfide etc
			<b>Total</b>	<b>17</b>	

Question		Answer		Marks	Guidance
2	(a)		enzymes ;	1	<b>IGNORE</b> protein / catalysts <b>ACCEPT</b> enzymic
2	(b)	(i)	<p>1 similar, shape / structure ;</p> <p>2 example of similarity ;</p> <p>3 both , will fit into / complementary (shape) to / bind to / bond to , <u>active site</u> (of alcohol dehydrogenase ) ;</p>	3	<p>1 <b>IGNORE</b> same shape 1 <b>ACCEPT</b> 'ethanol same shape as part of DEG'</p> <p>2 <b>IGNORE</b> they contain C, H and O 2 <b>IGNORE</b> the end is the same 2 <b>ACCEPT</b> e.g. they both have OH 2 <b>ACCEPT</b> similar parts identified on diagram if they are clearly indicating an example of similarity</p> <p>3 <b>ACCEPT</b> implication of both 3 <b>IGNORE</b> attach / enter 3 <b>IGNORE</b> both will form ESC (with alcohol dehydrogenase)</p>
2	(b)	(ii)	<p>1 (ethanol) <u>competes</u> with DEG ; <b>ora</b></p> <p>2 (when at high(er) concentration) ethanol more likely to , collide with / bind to / bond to , active site ; <b>ora</b></p> <p>3 less , DEG breakdown / toxic product ; <b>ora</b></p>	3	<p>1 <b>ACCEPT</b> ethanol / DEG , is , a <u>competitive</u> inhibitor</p> <p>2 <b>ACCEPT</b> 'ethanol more likely to form ESC' 2 <b>ACCEPT</b> implication of 'more likely' from context 2 <b>IGNORE</b> attach / enter</p> <p>3 <b>ACCEPT</b> DEG product is diluted 3 <b>ACCEPT</b> no DEG breakdown</p> <p><b>IGNORE</b> 'you will drink less of it'</p>
<b>Total</b>				<b>7</b>	

Question			Answer	Marks	Guidance
3	(a)	(	A <u>substrate</u> ; B <u>active site</u> ;	2	<b>Mark the first answer on each prompt line.</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> .
		(ii)	<i>idea of</i> simple representation of the , process / structure <b>or</b> <i>idea of</i> showing people how it works ;	1	<b>Examples of acceptable responses</b> 'to make the process easy to understand' 'it is a visual representation' <b>IGNORE</b> 'because you don't know exactly what is happening' <b>IGNORE</b> ' because that's the way it works' <b>IGNORE</b> 'because it is still unproven'
		(iii)	supported by , more evidence / new research / more work ;  <i>idea of</i> fitting evidence more closely (than lock & key) ;	1 max	<b>ACCEPT</b> example, e.g. X-ray crystallography  <b>ACCEPT</b> e.g. 'it has <u>now</u> been found that the enzyme shape changes during the reaction' <b>IGNORE</b> responses in terms of 'because that is how it happens'. Answers must refer to evidence. <b>ACCEPT</b> 'in the lock and key model the lock changes rather than the key'

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	(b) (i)	<p>1 enzyme / LDH , concentration / volume ;</p> <p>2 substrate / lactate, concentration / volume ;</p> <p>3 time ;</p> <p>4 <i>idea that fish should be as closely related as possible ;</i></p> <p>5 pH ;</p>	3 max	<p><b>Mark the first answer on each prompt line.</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>1 IGNORE</b> 'amount / number'</p> <p><b>2 IGNORE</b> 'amount / number'</p> <p><b>2 IGNORE</b> 'reactants'</p> <p><b>1 or 2 CREDIT</b> 'volume / concentration , of solution' once if no reference to enzyme <b>or</b> substrate</p> <p><b>4 ACCEPT</b> e.g. 'same type of fish'</p> <p><b>4 IGNORE</b> size / age / sex</p>
	(ii)	L ;	1	<p><b>Do not award mark if more than one letter given.</b></p> <p><b>ACCEPT</b> lactate and water at all temperatures</p>



Question		Answer	Marks	Guidance
	(iii)	<p><b>1</b> (1°C is) below the <u>optimum</u> temperature / <u>optimum</u> temperature is higher , for this enzyme ;</p> <p><b>2</b> (at 1°C) low <u>kinetic</u> energy / KE , of , enzyme / substrate ;</p> <p><b>3</b> less chance of substrate entering active site / less chance of ESC formation / fewer collisions between substrate and active site ;</p> <p><b>4</b> <i>idea of</i> activation energy harder to reach ;</p>	<b>2 max</b>	<p><b>1 ACCEPT</b> '<u>optimum</u> is 10°C'</p> <p><b>1 IGNORE</b> '1°C is not the <u>optimum</u> temperature'</p> <p><b>1 ACCEPT</b> '1°C is further away from the <u>optimum</u> (than 10°C)'</p> <p><b>2 ACCEPT</b> 'molecules' / 'particles'</p> <p><b>3 ACCEPT</b> 'fewer ESC formed'</p> <p><b>3 ACCEPT</b> 'slower ESC formation'</p> <p><b>3 IGNORE</b> denatured</p> <p><b>4 ACCEPT</b> 'activation energy is greater'</p>
	(iv)	<p><u>easier</u> for / increased chance of , substrate, entering <u>active site</u> ;</p> <p><u>more</u> bonds can form / greater surface area for contact (between active site and substrate) ;</p> <p><u>easier</u> for <u>active site</u> to change <u>shape</u> (as part of induced fit) ;</p> <p>the <u>induced fit</u> , will be easier / AW ;</p>	<b>1</b>	<p>Answers must imply 'easier' or 'quicker'</p> <p><b>ACCEPT</b> 'fitting into' 'joining' 'binding'</p> <p><b>IGNORE</b> refs to 'binding to a larger range of substrates'</p> <p><b>IGNORE</b> refs to ESC</p> <p><b>ACCEPT</b> 'different bonds can form'</p> <p><b>ACCEPT</b> '(named) bonds form more easily'</p> <p><b>DO NOT CREDIT</b> if a candidate thinks that flexibility increases kinetic energy</p>

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	(c) (i)	different, amino acids / amino acid sequence / primary structure ;  different, (named feature of) secondary / (named feature of) tertiary / quaternary, structure ;	2	<b>ACCEPT</b> 'different R groups present'  <b>ACCEPT</b> e.g. more $\alpha$ -helices / different or fewer (named) bonds / (different) prosthetic group / co-factor / ion / co-enzyme / R-groups in different orientation / polypeptide OR chain will fold differently <b>IGNORE</b> 3D <b>IGNORE</b> protein / enzyme , will fold differently
	(ii)	different , base / nucleotide , sequence ;  different , proportion / ratio , of bases / nucleotides ;  different , allele / gene (would code for the polypeptide) ;	2	<b>IGNORE</b> 'different gene sequence' <b>IGNORE</b> mutation <b>ACCEPT</b> different triplet / codon  <b>ACCEPT</b> 'number of bases / nucleotides' <b>ACCEPT</b> 'different numbers of A or T / C or G' <b>ACCEPT</b> 'more adenines' etc  <b>ACCEPT</b> 'mRNA will be different' <b>IGNORE</b> chromosome
	(d) (i)	enzyme could have potential / future , application ;  any example of potential application ;	1 max	<b>IGNORE</b> refs to enzyme being useful to the Antarctic fish <b>IGNORE</b> genetic resource or any ref to biodiversity <b>ACCEPT</b> 'could be of use to humans'  eg medical use, low temperature washing powder, scientific research

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	(ii)	ban fishing (in this area / Antarctic) ;	<b>2 max</b>	<b>1</b> Answers must refer to banning or legislating (and fishing) <b>1 IGNORE</b> 'legislation' unqualified, <b>1 IGNORE</b> less fishing unqualified <b>1 IGNORE</b> 'ban hunting' unqualified  <b>2 ACCEPT</b> refs to net / mesh size <b>2 ACCEPT</b> idea of patrolling / enforcing  <b>3 CREDIT</b> in terms of maintaining fish's food source <b>3 IGNORE</b> 'feeding fish' <b>3 IGNORE</b> refs to 'in National Parks' unqualified <b>3 e.g.</b> 'protect habitat by banning fishing' = 2 marks (mp1 and mp 3)  <b>4 ACCEPT</b> 'in captivity' / AW <b>4 ACCEPT</b> 'fish farming' <b>4 ACCEPT</b> ref to sperm / egg, banks  <b>6 IGNORE</b> education unqualified
	<b>2</b>	<i>idea of quotas / limits on numbers caught ;</i>		
	<b>3</b>	<i>idea of protecting (this) habitat (from drilling etc) ;</i>		
	<b>4</b>	<i>ex situ (conservation) / captive breeding ;</i>		
	<b>5</b>	<i>idea of promoting other species (for eating) ;</i>		
	<b>6</b>	educating people in the fishing industry ;		
<b>Total</b>			<b>18</b>	