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

Question			Answer	Mark	Guidance
1	(b)	(ii)		5 max	**ACCEPT** glucose / maltose for product throughout **ACCEPT** substrate for starch throughout
			linear part of the graph means…		
			1 more (successful) collisions with (amylase) active site (at increasing starch concentration) **; ora**		**1 ACCEPT** few(er) active sites occupied at low starch concentrations
			2 more ESC (at increasing starch concentration) **; ora**		**2 ACCEPT** ESC formed more easily
			3 so more product formation in a given time (at increasing starch concentration) **; ora**		**3 AWARD** 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 IGNORE *rate*** as this is a description of graph
			curve / plateau , means…		
			4 all / most , active sites (of amylase) are occupied **;**		**4 ACCEPT** all active sites are full of substrate
			5 enzyme / amylase , working , at / near, maximum rate / V_{max} **;**		**5 ACCEPT** enzyme at full capacity
			6 (so) further increase in starch concentration has no effect (on rate) **;**		**6** Must link to **4** or **5** **6 AWARD** only if mp 4 or 5 given **6 DO NOT CREDIT** rate decreases
			7 enzyme concentration , is / becomes , limiting factor **;**		**7 ACCEPT** the increasing part of the graph is because starch concentration is the limiting factor

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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td>(iv)</td><td>temperature (of the reaction mixture) ;
enzyme / amylase , concentration ;

(total) volume of (reaction) solution ;

concentration of , cofactors / chloride ions / Cl^- ;</td><td>2 max</td><td>Mark the first answer on each prompt line. If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = 0 marks
DO NOT CREDIT substrate / starch , concentration
(as this is the independent variable)

DO NOT CREDIT amount

ACCEPT volume of enzyme solution
DO NOT CREDIT amount

ACCEPT concentration of coenzymes

IGNORE time / agitation / inhibitors</td></tr>
<tr><td>1</td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>Amylose</th><th>Cellulose</th></tr>
<tr><td>coiled</td><td>no coiling</td></tr>
<tr><td>(contains) α / alpha / A / a ,-glucose</td><td>(contains) β / beta / B / b , -glucose</td></tr>
<tr><td>α / alpha / A / a 1-4 glycosidic bonds</td><td>β / 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>
</table>
;
;
;
;
;
</td><td>3</td><td>Mark the first 3 responses
AWARD 1 mark for each correct row irrespective of boxes
Three correct rows of responses written within the same box can be awarded 3 points.

ACCEPT every second one is flipped

ACCEPT fibres / microfibrils / fibrils / macrofibrils
DO NOT CREDIT myofibrils
ACCEPT grains

ACCEPT ‘(cross)links’ as AW for ‘bonds’</td></tr>
</table>

Question			Answer	Mark	Guidance
1	(c)	(ii)	(tensile) strength / strong **;** (H) bonds / links , can form (between adjacent fibrils) **;** insoluble **;**	2 max	**ACCEPT** mechanical strength **IGNORE** fibrous / rigid **ACCEPT** fibres / microfibrils / fibrils / macrofibrils **IGNORE** refs to bonding with water **IGNORE** ionic / myofibrils **ACCEPT** crosslinks **DO NOT CREDIT** peptide / covalent / glycosidic / disulfide etc
			Total	**17**	

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

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

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

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

Question			Answer	Marks	Guidance
	(c)	(i)	different, amino acids / amino acid sequence / primary structure **;** different, (named feature of) secondary / (named feature of) tertiary / quaternary, structure **;**	2	**ACCEPT** 'different R groups present' **ACCEPT** e.g. more α-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 **IGNORE** 3D **IGNORE** 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	**IGNORE** 'different gene sequence' **IGNORE** mutation **ACCEPT** different triplet / codon **ACCEPT** 'number of bases / nucleotides' **ACCEPT** 'different numbers of A or T / C or G' **ACCEPT** 'more adenines' etc **ACCEPT** 'mRNA will be different' **IGNORE** chromosome
	(d)	(i)	enzyme could have potential / future , application **;** any example of potential application **;**	1 max	**IGNORE** refs to enzyme being useful to the Antarctic fish **IGNORE** genetic resource or any ref to biodiversity **ACCEPT** 'could be of use to humans' eg medical use, low temperature washing powder, scientific research

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