Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) **A** and structure (of **A**) is complementary to that of the active site;	**1**	You must be able to explain how enzymes act.
(b) idea that non-competitive inhibitor (**C**) binds at a site that is not the active site; binding causes a change in the shape of the active site; substrate is no longer able to bind to the active site;	**3**	Make sure that you know the different effects of competitive and non-competitive inhibition of enzymes.
(c) (i) peptide;	**1**	Peptide bonds hold amino acids together. Do not confuse them with disulfide bridges, hydrogen or ionic forces which maintain the secondary, tertiary and quaternary structure of a protein.
(ii) idea that amino acid chain folds/ tertiary structure; named bond holding tertiary structure, e.g. ionic/disulfide/hydrogen;	**2**	Do not confuse peptide bonds with disulfide bridges, hydrogen or ionic forces which maintain the secondary, tertiary and quaternary structure of a protein.
2 (a) (i) substances/molecules have more (kinetic) energy/moving faster (*reject vibrate*); increased collisions/enzyme substrate complexes formed;	**2**	Explain changes in rate of reaction in terms of collisions between substrate and enzyme and activation energy. Any factor that increases collisions or lowers the activation energy of the enzyme reaction or reduces the energy needed for the reaction will speed up the reaction.
(ii) causes denaturation/tertiary structure/ shape change; hydrogen/ionic bonds break; shape of active site changed; substrate no longer binds/not complementary to active site;	**3**	
(b) all substrate changed into product/reaction is complete; same amount of product formed; same initial substrate concentration;	**2**	
3 (a) lowers activation energy; relevant mechanism, e.g. brings molecules close together/reaction in smaller steps/ change in charge distribution/proton donation or acceptance/induced fit ensuring substrates brought in correct sequence; including relevant reference to active site;	**3**	

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(b) (i) 48, 56–58, 51–54 (*all correct*);	**1**	
(ii) description – increase up to 48/optimum (*allow ECF from* (i)); decrease above 48/optimum (*allow ECF from* **(i)**); explanation of increase – increased KE/move faster; therefore more collisions/more enzyme–substrate complexes formed with active site; explanation of decrease – denaturation/3D structure changed/ tertiary structure changed; detail, e.g. breaking of hydrogen/sulfur bonds (*reject peptide bonds*); shape of active site changed; substrate no longer fits;	**6 max**	Plan out your answer to make sure you cover every part of the question. Write your answer in full sentences. ECF means error carried forward. If you made a mistake in interpreting the graph, you will not lose marks for repeating the same mistake. For example, if you had the optimum temperature as 38 instead of 48 and you wrote increase up to 38, you would get a mark in **(ii)** even though the number was incorrect. This means that you do not lose more than 1 mark for one mistake. Do not confuse the bonds. Hydrogen and sulfur bonds hold the molecule in shape, peptide bonds join amino acids together.
4 (a) maximum rate at which enzyme can combine with substrate/form enzyme–substrate complexes/substrate no longer limiting/enzyme is a limiting factor;	**2**	The enzymes or their active sites are not used up.
(b) inhibitor attaches to enzyme away from the active site; changes shape of active site; prevents formation of enzyme–substrate complex;	**2**	
(c) 26.32% (*accept 26% or 26.3%*);	**2 max**	The maximum rate is the highest rate on the graph. Without inhibitor the rate is 7.6 arbitrary units. With inhibitor the rate is 5.6 arbitrary units. The percentage decrease in rate = (decrease in rate/maximum rate) × 100, i.e. ((7.6 – 5.6)/7.6) × 100. You will gain 1 mark for knowing the principle and 1 mark for the correct answer.
(d) curve below top curve (without inhibitor) joining to top curve/ continues to increase to end of *x*-axis	**1**	You must start your curve at the origin. It must not go above the curve shown for the reaction without the inhibitor.