

Question 13 (Answer: B)

- Activation energy is measured from the reactants up to the peak of the curve.
- Adding an enzyme lowers that peak, giving the smaller of the two humps.
- So the answer is the single rise from the reactant level to the lower peak.

Question 14 (Answer: A)

- A rigid active site would only fit a substrate that already matched it exactly.
- In the induced-fit model, the substrate binding *changes* the enzyme's shape.
- The active site moulds around the substrate, which is how it comes to fit.

Question 9 (Answer: B)

- The enzyme hydrolyses chitin, so it is a hydrolase acting on a polysaccharide.
- It also *inhibits* another enzyme, so towards that enzyme it acts as an inhibitor, not a catalyst.
- Read the two roles separately – one reaction it speeds up, one it blocks.

Question 13 (Answer: B)

- An enzyme provides an alternative route with a lower activation energy.
- It does not change how much energy the reaction releases overall.
- So the activation energy falls and the energy yield is unchanged.

Question 15 (Answer: C)

- Lock-and-key means the active site is already complementary to the substrate – statement 1 is right.
- A shape *change* on binding is the induced-fit model instead, so statement 2 does not belong here.
- Most of the amino acids are there to hold the tertiary structure that shapes the active site, so statement 3 is right.

Question 13 (Answer: D)

- An extracellular enzyme works outside the cell that made it.
- Digestion in the lumen of the small intestine happens outside the cells, so statement 2 qualifies.
- DNA replication in the nucleus and ATP synthesis in mitochondria are both intracellular.

Question 14 (Answer: B)

- In the induced-fit model the active site is not already the exact shape of the substrate.
- Binding the substrate changes the enzyme's conformation.
- The active site moulds around the substrate; enzymes always *lower* the activation energy.

3(a)	one similarity ; e.g. substrate binds to active site enzyme-substrate complex forms product leaves active site interaction does not alter enzyme for re-use lower activation energy specific to one or very similar substrate(s) interaction can be affected by, action of inhibitors / pH / AW one difference ; e.g. induced-fit ora for lock-and-key active site not fully complementary to substrate change in, conformation / shape, of active site / AW <i>context of binding substrate or after product release</i> less specificity to substrate
3(b)(i)	orange / brown / amber ; A yellow-brown, yellow-orange
3(b)(ii)	<i>any three from:</i> phosphorylase (in extract) catalyses addition of glucose 1-phosphate to starch added to extract ; more starch is synthesised by phosphorylase as time progresses / AW ; iodine solution added to mixture turns a, blue / black / blue-black, colour (in the presence of starch) ; the more starch present in the mixture, the, darker / more intense, the, colour / shade ; the darker the colour (of the positive result) the less light passes through, mixture / sample ; the darker the colour / AW, the higher the absorbance (reading of the colorimeter) ;
3(b)(iii)	<i>ref. to</i> breakdown of starch catalysed by the enzyme / reaction in Fig. 3.1 goes in the opposite direction ; AVP ; e.g. <i>ref. to</i> equilibrium shift <i>ref. to</i> glucose 1-phosphate has run out decrease in concentration of starch, qualified with <i>ref. to</i> iodine solution
3(c)	<i>any three from:</i> reduction in activity of phosphorylase (at all concentrations) ; ora higher throughout with caffeine V _{max} not reached ; <i>ref. to</i> plateau at a (much) lower activity ; calculated K _m value with caffeine is the same as without caffeine ; use of data from the graph to support conclusion ;

3(a)	any three from: to award MPs 2, 3 and 6 there must be reference to shape or conformation at least once in the answer if no reference to shape or conformation in the answer mark to max 2 if lock and key described mark to max 2 from MP4 onwards 1 idea that active site (of inactive enzyme) and substrate are, (only) partially / not, complementary ; 2 as substrate enters active site there is a, change in shape / conformational change, (of active site / enzyme) ; A active site moulds around substrate R substrate changes shape / substrate active site 3 so shape of active site becomes complementary to substrate ; A idea that there is a good fit between active site and substrate 4 enzyme-substrate complex forms ; 5 lowers activation energy ; 6 product(s) leave and, enzyme / active site, returns to original, shape / conformation ; 7 AVP ; e.g. catalytic sites move to be in correct position e.g. detail of lowering activation energy – putting strain on substrate / stress on bonds
3(b)(i)	allow enzyme or subtilisin for immobilised subtilisin A allow attachment for attachment of larvae I comparisons between controls any four from: 1 effective because (much) lower percentage attachment with, the enzyme / AW, compared with the control(s) / AW ; ora for (both) controls 2 any comparison between 24 and 48 hrs in the same experimental tank (1 to 4) ; e.g. tank 2 only one showing decrease at 48 hours 3 any comparison between any two different tanks (1 to 4 or any experimental with control) at either 24 or 48 hours ; e.g. less attachment in tank 2 than in the others at 48 hours 4 48 hours is a short period of time / may not be effective after a few days ; 5 not 100% effective ; 6 (generally) becomes less effective at 48 hours (with exception of tank 2) ; 7 immobilised enzyme, not stable / detached from surface ; 8 ref. to no trend with increasing subtilisin concentration ; 9 no repeats so data may not be valid / AW ; 10 AVP ;
3(b)(ii)	I ref. to cost any two from: 1 density / concentration of, enzyme / subtilisin A / polymer ; A way of attaching enzyme to polymer 2 type of polymer ; 3 check that all organisms are removed from ships before applying, enzyme / polymer ; 4 way to fix polymer to surfaces of ships / material used to make surface of ships ; 5 number of larvae put into tanks / experiment carried out at time of year when larvae are in sea water ; A idea that different places have different numbers of larvae 6 length of time before taking measurements ; 7 length of time, enzyme / anti-fouling agent, remains active ; A ref. to stability of immobilised enzyme 8 idea of any interaction with other, fouling / marine, organisms ; A 'affect' as an interaction e.g. that could, graze / decompose, subtilisin A / polymer that could compete with A. <i>amphitrite</i> for attachment sites effectiveness against fouling organisms other than, A. <i>amphitrite</i> / barnacles subtilisin A / product of enzyme, may be, toxic / harmful, to marine organisms 9 effect of immersion in sea water on, enzyme / polymer (not in artificial sea water) ; 10 effect of different types of sea water, e.g. salt content / mineral content / roughness ; A different, concentrations of sea water / salinities 11 effect of marine pollutants / something in sea water, as enzyme inhibitors ; 12 AVP ; e.g. ref. to surface area of ship exposed to sea water types of antifouling agents present in the seawater