A-Level Biology: **w25 11**

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.

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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.

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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.

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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 *context of binding substrate or after product release* less specificity to substrate
3(b)(i)	orange / brown / amber **;** **A** yellow-brown, yellow-orange
3(b)(ii)	*any **three** from*: 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)	*ref. to* breakdown of starch catalysed by the enzyme / reaction in Fig. 3.1 goes in the opposite direction **;** AVP **;** e.g. *ref to* equilibrium shift *ref. to* glucose 1-phosphate has run out decrease in concentration of starch, qualified with *ref. to* iodine solution
3(c)	*any **three** from:* reduction in activity of phosphorylase (at all concentrations) **;** **ora** higher throughout with caffeine V_{max} not reached **;** *ref. to* 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. amphitrite* for attachment sites effectiveness against fouling organisms other than, *A. amphitrite* / 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