Model Answers: Easy

1

The correct answer is **C** because:

- Only **competitive** inhibitors bind to the **active** site (non-competitive inhibitors bind to the **allosteric** site)
    - an **allosteric site** is a site on the enzyme that is not its active site where inhibitors can bind and disruption the enzymatic reaction
- Both competitive and non-competitive **inhibitors** cause a change in the tertiary structure
- competitive inhibitors bind to the active site (through induced fit)
- non-competitive inhibitors bind to the allosteric site and cause a conformational change in the tertiary structure
- Both competitive and non-competitive inhibitors will decrease the enzyme's activity.

2

The correct answer is **B** as this is the typical shape of a **rate of reaction** graph in response to increasing **temperature**.

- There is a **gradual** increase in rate of reaction as temperature increases (as the particles will have more **kinetic energy** and therefore more successful **collisions**).
- This increase occurs up until the optimum temperature (in this case between 80 and 110°)
- Then the rate of reaction declines steeply (usually significantly steeper that the increase in rate prior to optimum temperature). The reason for the steep decline is that the enzymes have been **denatured** by the **high kinetic energy** (i.e. the bonds have been broken in their structure) and the shape of the **active site** is no longer **complementary** to the substrate

3

The correct answer is **B** as

- **competitive inhibitors** bind to the **active site** of an enzyme and **compete** with the substrate for binding
- increasing **substrate** concentration decreases the chance that a **competitive inhibitor** will bind to an enzyme. Essentially, the effectiveness of the competitive inhibitor will be decreased, and therefore the rate of reaction will be increased.

Competitive inhibitors are influenced more by substrate concentration than non-competitive inhibitors as they bind to the same place on the enzyme (the active site). Reactions with non-competitive inhibitors present will never be

able to reach the same initial rate of reaction as without the inhibitor, whereas reactions with competitive inhibitors can (at high substrate concentrations).

4

The correct answer is **C** because:

- any type of inhibitor will reduce the initial rate of reaction (so 1 is correct).
- the induced fit model explains how the active site undergoes a shape change on binding with the substrate - the same is true for when it binds with a competitive inhibitor to form an enzyme / inhibitor complex.
- with a non-competitive inhibitor, the shape of the active site is also changed while the enzyme / inhibitor complex is formed – the inhibitor is bound to the allosteric site (a site separate from the active site) and which causes a shape change in the active site (so 2 is correct).
- there are two types of inhibition competitive and non-competitive (so 3 is correct). Inhibitors will never lead to an increase in the V_{max}, although a competitive inhibitor in excess substrate may reach the same V_{max} (so 4 is incorrect)

5

The correct answer is **D** because:

- Raising the stomach pH above 2.5 would put the pepsin outside of its optimum pH range (1.5 - 2.5) and ionic bonds in the tertiary structure would start to break - so **A** is true
- Raising the stomach temperature above 42°C would put the pepsin outside of its optimum temperature range (37°C - 42°C) and bonds in the tertiary structure would start to break, especially hydrogen bonds - so **B** is true
- As with the first point, raising the stomach pH above 2.5 would put the pepsin outside of its optimum pH range (1.5 - 2.5) and ionic bonds in the tertiary structure would start to break - so **C** is true
- Temperatures below 37°C would result in less enzyme/substrate complexes being formed due to substrate and enzymes having less kinetic energy – so **D** is not true

6

The correct answer is **A** as

- competitive inhibitors bind to the **active site** (hence the name competitive – they are competing with the substrate to bind).
- increasing substrate concentration will **reduce** the effect of the inhibition
- this is because the amount of substrate will be greater than the amount of inhibitor and therefore more likely to bind to the enzyme's **active site**

D would be the answer for a **non-competitive inhibitor** as these are inhibitors that bind to an allosteric site (i.e. an area of the enzyme that is not the active site) and, accordingly, are not impacted by changes in substrate concentration

7

The correct answer is **A** as the $\mathbf{V_{max}}$ is 60 (this is where the line plateaus). Therefore, the ½ V_{max} must be 30 and this corresponds to 50g of substrate (when read off the graph).

8

The correct answer is **C** as enzymes would **not** be present in the milk because they are immobilised. This means they remain bound to the **alginate beads** and do not end up in the milk with the other products.

- **A** is correct as glucose and galactose are the products arising from the hydrolysis of lactose
- **B** is correct as monosaccharides are sweeter than disaccharides and easier to digest as they can be absorbed directly into the bloodstream
- **D** is correct as both normal milk and lactose-free milk will look the same due to the disaccharides and monosaccharides being dissolved

9

The correct answer is **C** as

- this graph shows the effect of increasing substrate concentration on the rate of enzyme reaction.
- between point X and point Y, increasing the **amount of substrate** causes a corresponding increase in the **rate of reaction**.
- However, between point Y and point Z increasing substrate concentration no longer causes an increase in the reaction rate. This is because all the **active sites** on the enzyme are occupied and therefore, increasing the amount of substrate has no effect - the **enzyme concentration** is now the **limiting factor**

- **A** is incorrect as the graph shows no information about the effect of temperature
- **B** is incorrect as, between point X and point Z increasing the amount of substrate causes a corresponding increase in the rate of reaction - this therefore means that the substrate concentration must be the limiting factor
- **D** is incorrect as between point Y and point Z increasing the amount of substrate has no effect on the rate of reaction, therefore substrate can't be the limiting factor

10

The correct answer is **D** as the area under the rate of reaction curves for enzyme X and Y overlap. This means there is a range of pH where both enzymes work and therefore both have functional active sites

- **A** is true as the rate of reaction curve at its optimum is higher than the other two at their respective optimum temperature
- **B** and **C** are true as the rate of reaction curves for enzyme Y and Z + X and Z have no overlap. This means there is no pH where they both work and therefore no pH where they both have a functional active site