Model Answers: Medium

1

The correct answer is **D** as **glucose** is the **dependent variable** and is being **produced** by the reaction, therefore it is not necessary to control its abundance.

A, **B** and **C** are all control variables.

The relationship between enzyme availability and rate of reaction will only remain **linear** provided there is **sufficient substrate**. If substrate was not in excess, then it will become the **limiting factor** and the graph will plateau (hence B was ensuring sufficient maltose availability)

2

The correct answer is **A** as the competitive inhibitor would reduce the number of active sites available on enzyme Z. Therefore, the rate that intermediate 2 was turned into end product would reduce and there would be a built up of intermediate 2.

- **B** is incorrect as competitive inhibitors do not denature enzymes
- **C** is incorrect as there still would be end product formed – it would just be at a lower rate
- **D** is incorrect as enzyme X functioning would be unaffected

3

The correct answer is **A** as points E and R both have higher substrate kinetic energy than point W. Kinetic energy always increases with increasing temperature, however, at high temperatures the rate of reaction will slow due to denaturing of the enzyme.

4

The correct answer is **A** as the K_m is equal to ½ V_{max}. V_{max} in this situation was 60, so ½ V_{max} would be 30, which correlates to 50g of substrate

V_{max} is the **rate of reaction** when the enzyme is **saturated** with substrate (i.e. it is the maximum rate of reaction). The relationship between rate of reaction and concentration of substrate depends on the **affinity** of the enzyme for its substrate. This is expressed as the K_m (Michaelis constant) of the enzyme, an inverse measure of affinity. The K_m is the **concentration of substrate** which permits the enzyme to reach half V_{max}. An enzyme with a **high K_m** has a **low affinity** for its substrate (therefore requires a **greater concentration** of substrate to achieve V_{max})

5

The correct answer is **C** as the type of enzyme immobilisation is the variable being changed in the experiment (therefore is the **independent** variable).

- **B** is the dependent variable (as this is what is being measured)
- **A** and **D** are both control variables (factors that need to be kept the same in order to ensure a fair test)

6

The correct answer is **C** as, while a competitive inhibitor will lower the **rate of reaction** (by occupying some of the available active sites), the **amount of product** will still end up being similar to without the inhibitor

- **A** can't be correct as the amount of product produced is greater than Z (and there was no additional substrate added)
- **B** can't be correct as the rate of reaction is faster than Z
- **D** can't be correct as there is no reaction occurring initially and there ends up being less overall product then Z (it should eventually reach the same level at Z)

7

The correct answer is **D** as insufficient substrate between Y and Z is what causes the rate of reaction to plateau (i.e. the substrate availability is now the limiting factor). If there was sufficient substrate the rate would continue to increase in a linear relationship

- **A** can't be correct as between Y and Z substrate is limiting
- **B** can't be correct as between Y and Z substrate is limiting
- **C** can't be correct as between X and Y enzyme is limiting (hence why increase in enzyme cause a corresponding increase in rate)

8

The correct answer is **C** as the rate of reaction curve for X has the widest base (i.e. the widest range of pH's where the enzyme is still functional). The enzyme can function between pH 1 and ~pH 8.

- **A** is false as, at its optimum pH, enzyme Y has the fastest rate
- **B** is false as, from around pH 4 to pH 8, both enzyme X and Y are functional
- **D** is false as enzyme Z has a functional active site across the narrowest range of pH's

9

The correct answer is **B** as at point X there will be more enzyme/substrate complexes being formed. At Y there is no more **product** being produced, so the substrate has already all been converted into product (so there will be no more **enzyme/substrate complexes** formed).

- **A** is true as this is early on in the reaction, so most substrate has not yet been converted into product
- **C** is true as at this point the rate of reaction has stopped, therefore no more substrate is available
- **D** is true as at Y the concentration of product plateaus, therefore, there is no more reaction between Y and Z and no enzyme/substrate complexes at either point

10

The correct answer is **C** as at point Z, both reactions have plateaued, therefore there is no remaining substrate to be converted into product and thus no **enzyme/substrate complexes** are being formed

- **A** and **B** are true as at point X, the **enzyme availability** is the **limiting factor**, therefore the additional substrate does not result in more enzyme/substrate complexes being formed
- **D** is true as at point Y the concentration of product plateaus, therefore indicating no more enzyme/substrate complexes being formed