Ongoing revision 14 – cofactors, enzymes, proteins

1. Label the following statements as True or False

a. A coenzyme is unique to only one type of enzyme. *False*

A coenzyme is an organic molecule, that is needed by an enzyme in order to perform its role as a catalyst.
eg NADPH → $NADP^+ + H^-$ this molecule is a coenzyme as it binds to the enzyme and provides a hydride (H^-) to the substrates. Many different enzymes are involved with NADPH

b. An enzyme is unique to the catalysis of only one reaction.

True

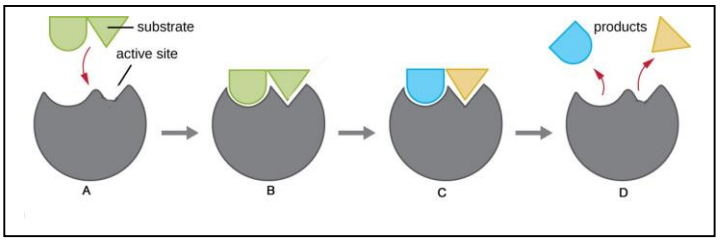
c. Coenzymes do not chemically change during a reaction.

False
Coenzymes can be chemically changed but they quickly undergo another chemical reaction that restores them back to their original state. eg NADPH → $NADP^+ + H^-$

d. All enzymes require a cofactor with which to perform their role.

False.

e. The image on the right represents the lock and key model of how an enzyme interacts with the substrate.

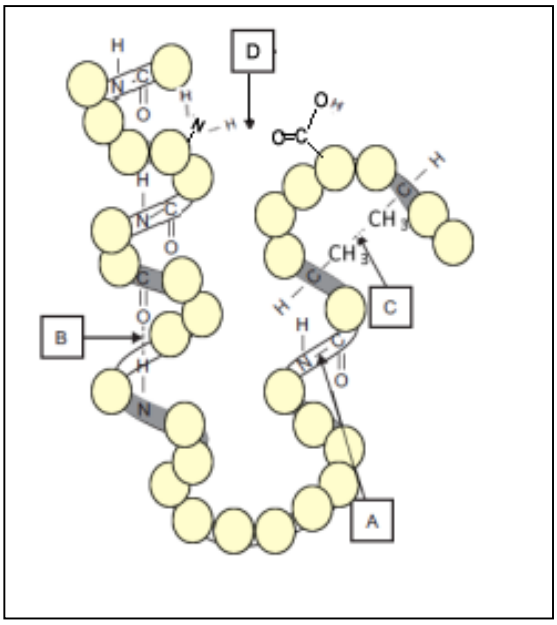


False. The image shows that the active site changes in shape slightly as a result of its interaction with the substrates. This is the induced-fit model
Two models of how enzymes work.
- *Lock and key – the active site is a perfect fit for the substrates and does not change shape during interaction with the substrates*
- *Induced fit – the active site changes slightly to accommodate the substrates.*

f. Off the four images shown in the diagram above, "C" represents the enzyme-substrate complex.
False. B represents the substrate-enzyme complex. It is through this alternate reaction pathway that the enzyme lowers the activation energy for the reaction.

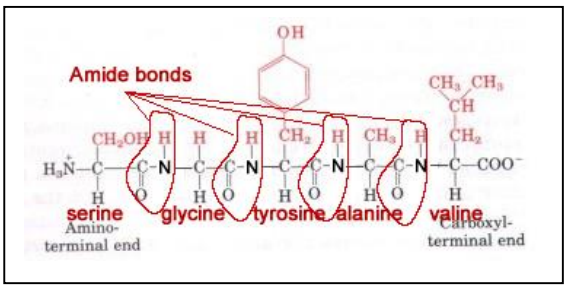
g. Ca^{2+} ions a crucial for some enzymes to catalyse their reactions. Ca^{2+} is considered a coenzyme.
False. Coenzymes are organic molecules where as Ca^{2+} is an inorganic species and is considered as a cofactor rather than a coenzyme. Cofactors can be metal ions or coenzymes.

2. Consider the image on the right of a small peptide. Some of the bonds associated with this peptide are labelled A-D.



   a. Which bond is unlikely to be disrupted by heat or pH change?
      A
   b. Which bond forms the primary structure?
      A
   c. Which bond/s is/are responsible for maintaining the tertiary structure?
      C and D
   d. Alpha helices and beta pleats are part of which structure of the protein and which bond is responsible for this structure?
      Secondary structure . Bond B
   e. Which bonds are likely to be disrupted with a change in pH? *D and B*

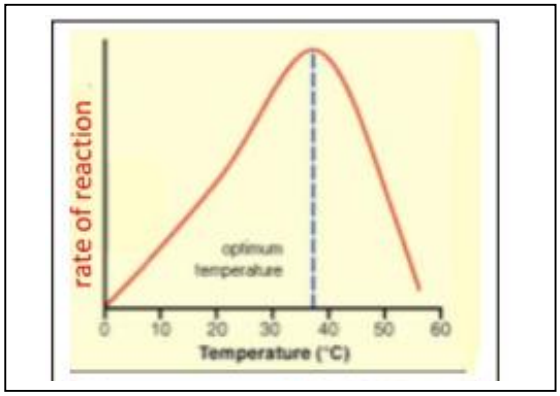
3. Consider the small peptide on the right.



   a. How many different amino acid residues were involved in forming this peptide?
   b. Name each amino acid that formed the peptide.
   c. Circle and name the bonds that constitute the primary structure.
   d. What is the difference in mass between the peptide and the sum of the individual amino acids that formed it?
      72 grams (4 X 18 (formula mass of water given out for every amide link formed))

   e. What word best describes the peptide? Explain your answer.
      i. Tripeptide
      ii. Zwitterion - *A zwitterion is a charged, net neutral molecule with functional groups, of which at least one has a positive and one has a negative charge.*
      iii. Quaternary structure
      iv. Secondary structure.

4. The rate of an enzyme catalysed reaction is shown on the right.



   a. Explain why the rate is slow at temperatures below 30 °C.
   Reactant particles have very little average kinetic energy at low temperatures.
   b. Explain why at temperatures above 40 the rate also decreases.
   The enzyme's secondary and tertiary structure is being compromised at high temperatures as the hydrogen bonds holding the secondary and tertiary structures in place break. The primary structure does not suffer any breakage as covalent bonds are stronger than the relatively weak hydrogen bonds.