PROTEINS: AS ENZYMES

1. a) An active site is a crack or hollow on the surface of the enzyme that a substrate can fit into and bind to, and then undergo a reaction.

   b) (i) Only molecules of exactly the right shape can fit into an active site.

   (ii) The binding between the substrate and the enzyme relies on attractions between groups in the substrate and particular side-groups in the protein chain which are sticking out into the active site. This might be an ionic part of the substrate being attracted to something ionic in the side-group of the protein, or an OH group being attracted to something in a side-group which can hydrogen bond, and so on. So not only must the substrate have the right shape to fit the active site, but it must also have groups that can form intermolecular attractions in exactly the right places to match corresponding groups in the protein chain.

   c) An enzyme can only work with a limited number of substrates. These have to be able to fit the active site, and have the right arrangement of groups so that they can bind to the active site.

   d) The enzyme (E) and substrate (S) combine reversibly to give a complex (E-S) which splits to give the enzyme again and the products of the reaction (P).

2. a) A cofactor is a non-protein substance which is associated with the enzyme and is necessary before the enzyme will work.

   b) A prosthetic group is permanently joined to the enzyme in the active site. (The Chemguide page gives zinc in carbonic anhydrase and haem in catalase as examples.)

   A coenzyme is a separate molecule which attaches itself to the active site alongside the substrate, and the reaction involves both of them. When they leave the active site, both are changed. The changed coenzyme will be converted back to its original form somewhere else in the cell.