Enzymes

structural outlines of enzymes:-

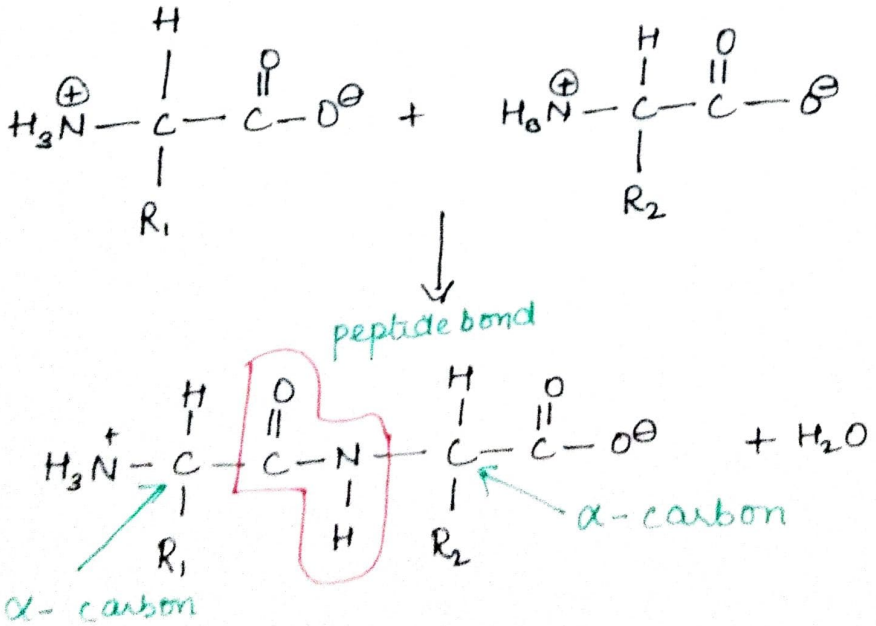
Proteins are special type of polypeptides made of primarily 20 different specific amino acids.

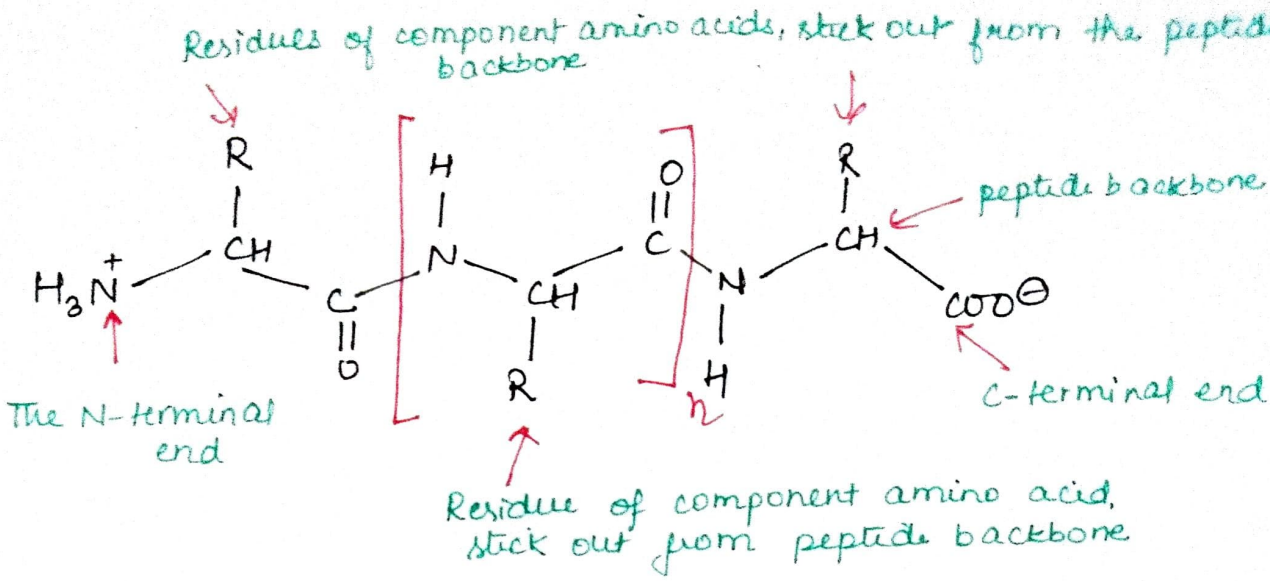
Proteins are large molecules with molecular weights from 6000 to more than 1,00,000 (from nearly 50 to more than 8000 amino acid per molecule).

Peptides are polymers of amino acid. The bond formed between the carbon atom of the carbonyl group of a carboxylic acid and nitrogen atom of an amino group is called amide ~~group~~ bond.

When this bond is in amino acids are called peptide bonds.

The peptides are amphoteric and acts as zwitterion.





Primary structure shows the amino acid sequence

Enzymes:-

→ The enzymes are highly effective catalysts and enhance the rate of reaction by a factor of $10^5 - 10^7$ times.

→ The substrate is tightly bound in the active site to form an ES complex.

→ Like other catalyst, an enzyme lowers the activation energy for the reaction and enhances the reaction rate. The equilibrium of a reaction is not effected by the enzyme.

→ The energy used for enzymatic rate enhancement is largely derived from weak interactions like hydrogen bonding, ionic interactions and hydrophobic interactions. The active sites provides these interactions and thus stablize the transition state.

→ The general acid base catalysis, covalent catalysis and metal ion catalysis help to provide a lower energy path.

→ The binding energy helps to lower the entropy of the substrate can bring about the conformational change in the enzyme to bring about the induced fit.

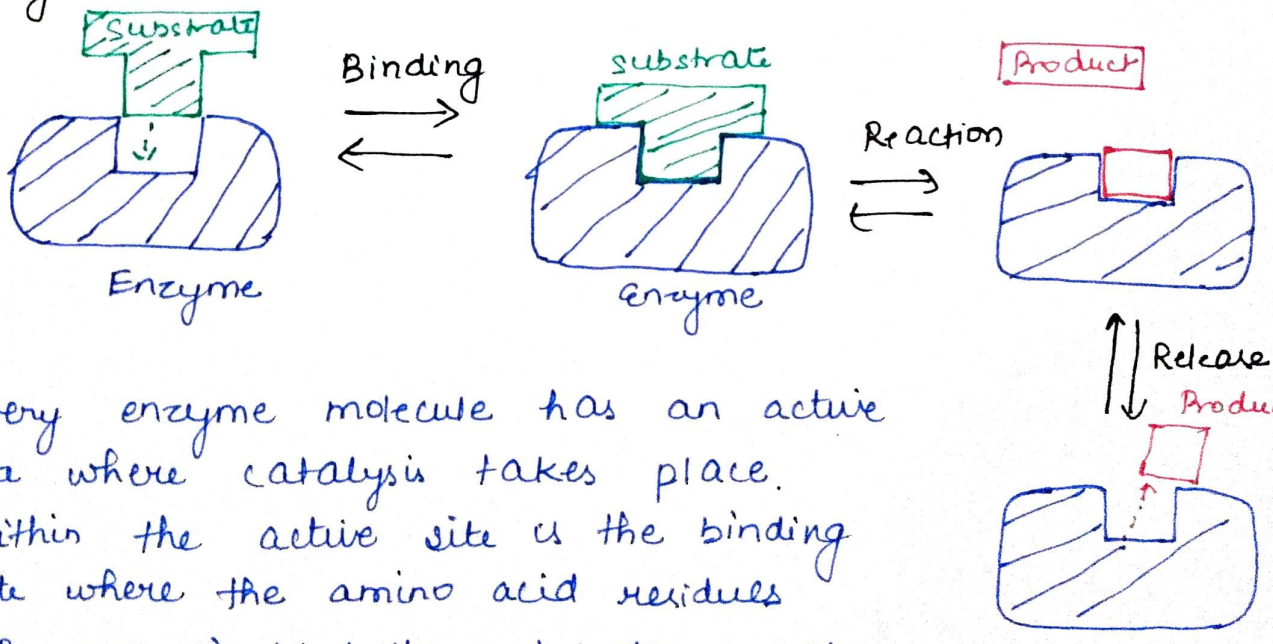
→ Binding energy also explains the specificity of enzyme to their substrates.

→ Like all catalysts enzymes are not consumed and neither permanently altered as a consequence of their involvement in reaction.

→ In contrast to other catalysts used in the synthetic chemistry laboratory, enzymes are highly specific both for the reaction catalyzed and for a single substrate or for a small set of closely related substrates.

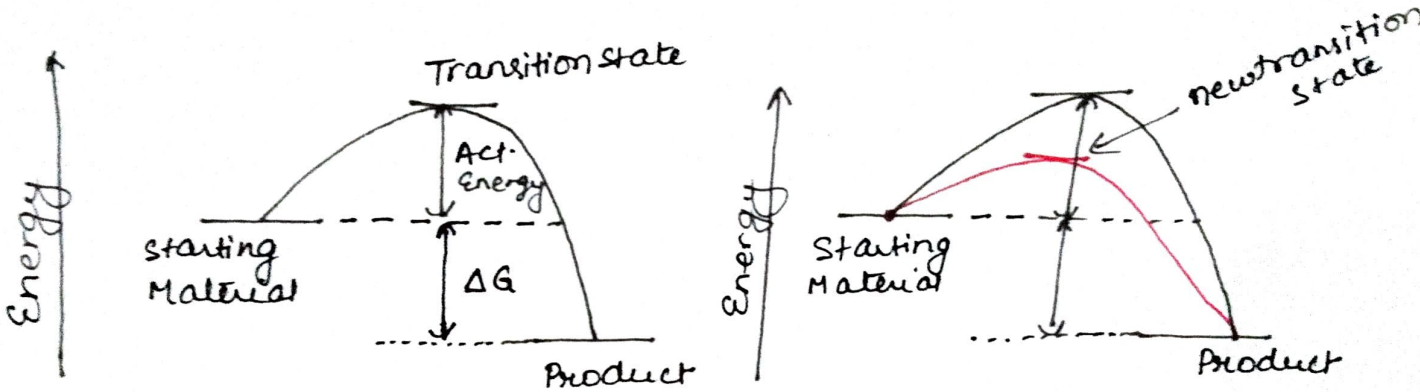
→ Enzymes are also stereospecific catalysts and therefore specifically catalyze the reaction of one enantiomer of the compound i.e. D- but not the L-sugars and L- amino acid but not the D-.

Enzyme Substrate reaction:-



Every enzyme molecule has an active site where catalysis takes place. Within the active site is the binding site where the amino acid residues (R- groups) bind the substrate in the proper position of the reaction.

→ This is similar to proper positioning of reactant molecules in intramolecular reactions. This binding involves hydrogen bonding, electrostatic interactions etc. These favourable interactions with amino acids residues present in the active site stabilize the transition state and as a direct result of this stabilization, the activation energy of the reaction is lowered and the rate of reaction is enhanced.



Lowering of activation energy in the presence of catalyst.

Functions of catalyst:-

→ Catalysts provide surface or environment for the reaction
→ Catalysts brings reactants close together for the reaction to occur.
→ Catalysts help to position reactant correctly so that transition state configurations are attained easily. It stabilizes the transition state.
→ Catalysts weakens bonds.
→ Catalysts may participate in the mechanism, as, e.g., in the case of nucleophilic catalyst.