CHEMISTRY STUDY MATERIALS FOR CLASS 12
(NCERT BASED NOTES OF CHAPTER -04)

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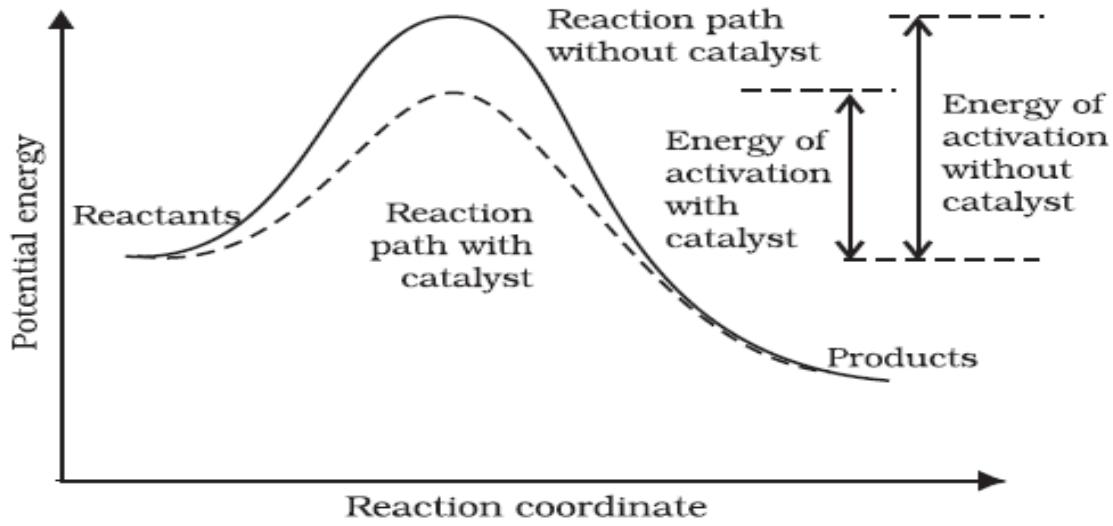
4. CHEMICAL KINETICS

Effect of Catalyst

A catalyst is a substance which alters the rate of a reaction without itself undergoing any permanent chemical change. The action of the catalyst can be explained by *intermediate complex theory*. According to this theory, a catalyst participates in a chemical reaction by forming an intermediate complex. This is unstable and decomposes to yield products and the catalyst.



A catalyst increases the rate of a chemical reaction by providing an alternate pathway or reaction mechanism by reducing the activation energy between reactants and products.

The important characteristics of a catalyst are:

1. A small amount of the catalyst can catalyse a large amount of reactants.
2. A catalyst does not alter Gibbs energy, ΔG of a reaction. It catalyses the spontaneous reactions but does not catalyse non-spontaneous reactions.
3. A catalyst does not change the equilibrium constant of a reaction, but it helps to attain the equilibrium faster by increasing the rate of both forward as well as the backward reactions.

Collision Theory

This theory was developed by Max Trautz and William Lewis. It is based on kinetic theory of gases. According to this theory, the reactant molecules are assumed to be hard spheres and reaction is occurred when molecules collide with each other.

The number of collisions per second per unit volume of the reaction mixture is known as collision frequency (Z).

Another factor which affects the rate of chemical reactions is activation energy. For a bimolecular elementary reaction

$$A + B \rightarrow \text{Products}$$

Rate of reaction can be expressed as

$$\text{Rate } (r) = Z_{AB}\, e^{-Ea/RT}$$

Where Z_{AB} represents the collision frequency of reactants, A and B and $e^{-Ea/RT}$ represents the fraction of molecules with energies equal to or greater than *E*a. Comparing with Arrhenius equation, we can see that *A* is related to collision frequency.

A third factor which affects the rate of a chemical reaction is the proper orientation. To account for this, a factor *P* called the *probability or steric factor* is introduced. So the above equation becomes:

$$\text{Rate } (r) = PZ_{AB}\, e^{-Ea/RT}$$

Thus, in collision theory activation energy and proper orientation of the molecules together determine the criteria for an effective collision and hence the rate of a chemical reaction.

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