## Mechanism of the reaction.

- The study of reaction pathway or mechanism of a reaction is very important aspect of kinetics of reaction.
- In some reactions, intermediates formed which accumulate during the early period of the reaction, reach to the maximum concentration and then react and give the final products.
- The necessary condition for a mechanism is that it must lead to the correct law.

## (1) Reaction involving first order consecutive reactions

(i) In such reactions, the reactions form a stable intermediate compound before they are finally converted into the products.

(ii) For example, reactants (R) are first converted to intermediate (I) which is then converted to product (P) as

 $R \xrightarrow{k_1} I \xrightarrow{k_2} P$ ; Therefore, the reaction takes place in two steps, both of which are first order i.e.,

Step I:  $R \xrightarrow{k_1} I$ 

Step II :  $I \xrightarrow{k_2} P$ 



This means that *I* is produced by step I and consumed by step II. In these reactions, each stage will have its own rate and rate constant the reactant concentration will always decrease and product concentration will always increase as shown in fig.

(2) **Reaction involving slow step:** When a reaction occurs by a sequence of steps and one of the step is slow, then the rate determining step is the slow step. For example in the reaction

 $R \xrightarrow{k_1} I; I \xrightarrow{k_2} P$ , if  $k_1 \ll k_2$  then I is converted into products as soon as it is formed, we can say that

$$\frac{-d[R]}{dt} = \frac{d[P]}{dt} = k_1[R]$$

(3) **Parallel reactions:** In such type of reactions the reactants are more reactive, which may have different orders of the reactions taking place simultaneously. For example, in a system

containing  $NO_2$  and  $SO_2$ ,  $NO_2$  is consumed in the following two reactions,  $2NO_2 \xrightarrow{k_1} N_2O_4$ ;  $NO_2 + SO_2 \xrightarrow{k_2} NO + SO_3$ 

The rate of disappearance of  $NO_2$  will be sum of the rates of the two reactions *i.e.*,

$$-\frac{d[NO_2]}{dt} = 2k_1[NO_2]^2 + k_2[NO_2][SO_2]$$