# CONCEPT MAP

## CHEMICAL KINETICS

The branch of chemistry dealing with the study of rate of reaction, mechanism and factors affecting rate of reaction is known as chemical kinetics.

### Rate of Reaction

It is defined as the change in concentration of any one of the reactants and products per unit time.

**Average rate and instantaneous rate:** The rate measured over a long time interval is called average rate and the rate measured for an infinitesimally small time interval is called instantaneous rate.

**Rate Constant :** It is equal to the rate of reaction when the concentration of each of the reactants is unity.

**Factors affecting rate of reaction:**
1. Concentration of reactants
2. Medium
3. Catalyst
4. Surface area
5. Effect of temperature

### Order and Molecularity of Reaction

**Order of reaction:** It is defined as the sum of the powers of the concentration terms in the rate law.
For a given reaction,
$mA + nB \rightarrow$ Product
rate $= k[A]^m [B]^n$
$\therefore$ order of reaction $= m + n$
It can be zero order, first order and so on.
It can also be fractional.

**Molecularity of reaction:** It is defined as the number of molecules of reactant taking part in a chemical reaction.
It can be 1, 2, 3... but can neither be zero or fractional.

### Integrated Rate Equation

**For zero order:**

$$k = \frac{1}{t}\{[A_0] - [A]\}$$

**For first order:**

$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$

**For $n^{th}$ order:**

$$k = \frac{1}{t(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right]$$

where
$k$ = rate constant
$a$, $[A_0]$ = initial concentration
$[A]$ = final concentration
$n$ = order of reaction
$x$ = concentration of reactant decomposed in time $t$.

### Half Life Period

Time during which the concentration of a reactant is reduced to half of its initial concentration.

### Temperature Dependence of Rate of Reaction

**Collision theory :**
$\therefore k = pZe^{-E_a/RT}$
where
$p$ = steric factor
$Z$ = collision frequency

**Concept of activation energy :** The excess energy which must be supplied to the reactants to undergo chemical reactions is called activation energy ($E_a$).
$E_a = E$ (threshold) $- E$ (reactants)

**Arrhenius equation :** Arrhenius proposed a quantitative relationship between rate constant and temperature as

$$k = Ae^{-E_a/RT}$$

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$