CHEMICAL KINETICS

RATE OF RXN

for : $aA + bB \longrightarrow xX + yY$

$$rate = \frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{x}\frac{d[X]}{dt} = \frac{1}{y}\frac{d[Y]}{dt}$$

INSTANTANEOUS RATE

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

AVERAGE RATE

$$rate = \frac{-\Delta R}{\Delta t} = \frac{-([R_2] - [R_1])}{t_2 - t_1}$$

Reaction	Unit of Rate Constant (K)
Zero Order	$mol\ L^{-1}S^{-1}$
First Order	S^{-1}
Second Order	$mol^{-1}\ LS^{-1}$

ORDER OF REACTION

Sum of powers of concentration of reactants in the rate law.

$aA + bB \longrightarrow Product$

$rate = k[A]^x [B]^y$

$order = x + y$

Order of a reaction may be whole number or a fraction.

MOLECULARITY

- Number of reacting species taking party in an elementary reaction
- It cannot be zero or a fraction.
  Molecularity = a + b

$$aA + bB \rightleftharpoons cC + dD$$

RATE CONSTANT UNIT FOR NTH ORDER REACTION

$$K = mol^{1-n}\ Litre^{n-1}\ sec^{-1}$$

RATE EXPRESSION
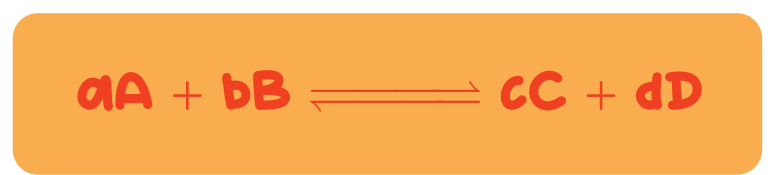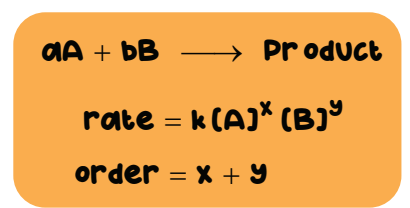
$$rate \propto A]^x [B]^y$$

RATE CONSTANT

$$rate = K[A]^x[B]^y$$

EFFECTIVE COLLISION

Molecular collide with sufficient kinetic energy and proper orientation

A chemical reaction occurs when molecules collide with sufficient energy.

COLLISION FREQUENCY

Number of collisions per unit volume of reaction mixture.

COLLISION THEORY

FOR BIMOLECULAR REACTION

$rate = PZ_{AB}e^{Ea/RT}$
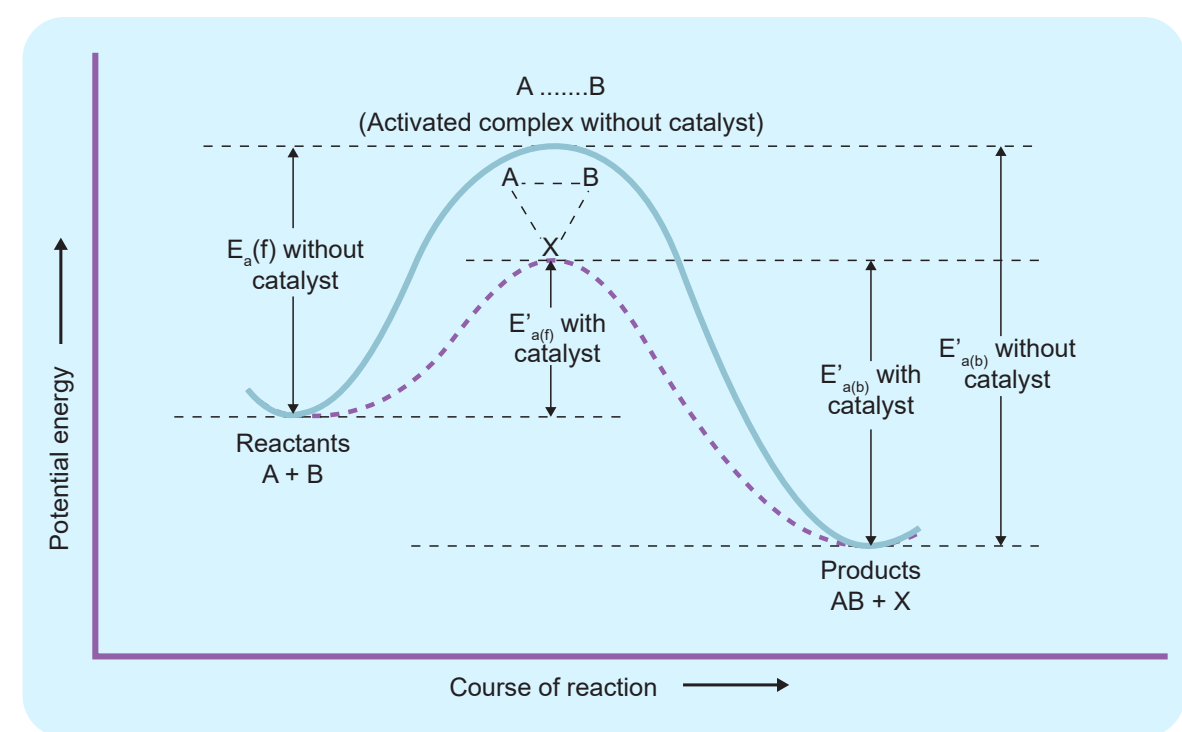
$P \rightarrow$ steric factor

$Z_{AB} \rightarrow$ collisio frequency

INTEGRATED RATE EQUATION

Reaction	Differential rate law	Integrated rate law	Half life
Zero Order	$\frac{d[R]}{dt} = -K$	$Kt = [R]_0 - [R]$	$t_{1/2} = \frac{[R]_0}{2K}$
First Order	$\frac{d[R]}{dt} = -K[R]$	$Kt = ln\left(\frac{[R]_0}{[R]}\right)$	$t_{1/2} = \frac{0.693}{K}$

Radioactive decay are first order reaction.

ZERO ORDER
slope = -K

FIRST ORDER
slope = -K

Half life of nth order reaction
$$t_{1/2} \propto [R_0]^{1-N}$$

PSEUDO FIRST ORDER REACTION

- are not truely first order reaction but in certain conditions behaves like those.
- hydrolysis of ethyl acetate in acidic medium.

FACTORS INFLUENCING RATE

CONCENTRATION
Higher the concentration of reactants. faster is the rate reaction.

TEMPERATURE
Rate of reaction increases with increase in temperature.

SURFACE AREA
Greater is the surface area. faster is the reaction rate.

PRESENCE OF CATALYST
Rate of reaction increases in presence of a catalyst.

ARRHENIUS EQUATION

slope = $\frac{-K}{R}$

$ln A$

$$log\left(\frac{K_1}{K_2}\right) = \frac{E_a}{2.303}\left[\frac{T_1 - T_2}{T_1 T_2}\right]$$

$$K = Ae^{-Ea/RT}$$

$$ln\,k = ln\,A - \frac{E_a}{RT}$$

A ....B
(Activated complex without catalyst)

A --- B

$E_a(f)$ without catalyst

$E'_{a(f)}$ with catalyst

$E'_{a(b)}$ with catalyst

$E'_{a(b)}$ without catalyst

Reactants A + B

Products AB + X

Potential energy

Course of reaction