Chemical kinetics

⇒ Effect of Temp. on rate of rex^n:-

The rate of rex^n increases with increase in temperature.

Arrhenius proposed an eq^n that related temp. and rate constant for a rex^n quantitavely

Acc. to Arrhenius Eq^n

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

where,

k = rate constant of the Rex^n

A = Arrhenius Factor/ Frequency factor/pre exponential factor

Ea = Activation Energy (i.e)

R = Universal Gas Constant

T = Temp. in kelvin (absolute scale)

Taking ln both Sides

$\ln k = \ln Ae^{-Ea/RT}$

$\ln k = -Ea/RT + \ln A$

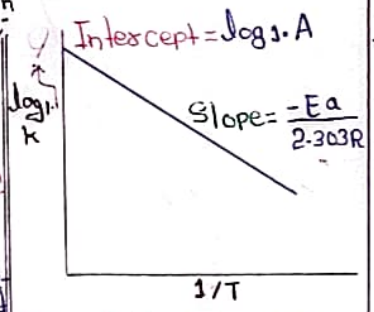
↳ At temp. T_1,

$\ln k_1 = \ln A - \frac{E_1}{RT_1}$ — ①

↳ At temp. T_2,

$\ln k_2 = \ln A - \frac{Ea}{RT_2}$ — ②

Operating ② − ①



$\ln k_2 - \ln k_1 = \frac{Ea}{RT_2} - \frac{Ea}{RT_1}$

$\ln \frac{k_2}{k_1} = \frac{Ea}{R}\left(\frac{T_1 - T_2}{T_2 T_1}\right)$

$2.303 \log \frac{k_2}{k_1} = \frac{Ea}{R}\left(\frac{T_1 - T_2}{T_2 T_1}\right)$

$\log \frac{k_2}{k_1} = \frac{Ea}{2.303R}\left(\frac{T_1 - T_2}{T_2 T_1}\right)$

Where,

Ea → Activation Energy

R → Gas Constant

When one or more substance undergo a change which results in the formation of a new product, called Chemical Reaction.

Chemical kinetics, is the branch of chemistry which deals with the study of rates of Chemical reaction, their mechanism and the conditions in which rates can be altered.

→ On the basis of speed:-

i) **Very Fast Reaction:** Some rex^n such as ionic rex^n occur very fast.

eg. $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

ii) **Very Slow Reaction:** Some rex^n are very slow i.e takes months to years in completion.

eg. Rusting of iron in the presence of air and moisture, formation of coal and Petrolium.

iii) **Moderate Reaction:** Those rex^n which are neither very slow nor very fast but takes place at moderate speed.

eg. inversion of cane sugar.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

(Glucose) (Fructose)

→ ON The Basis of No. of steps:-

Elementary Reaction

The reactions taking place in one step.

Complex Reactions

The reaction taking place in more than one step, and each step is called elementary rex^n/step.

Slowest step is called Rate Determining step.

→ Rate of Chemical Reaction:

It is the change in molar conc^n of species taking part in the Chemical reaction per unit time.

for the reaction $A \rightarrow B$

→ Rate of disappearance of A:

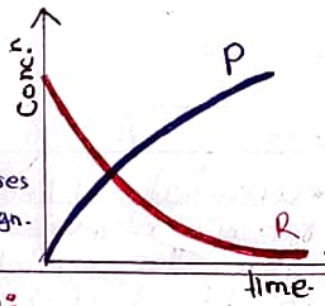
$$\Rightarrow \frac{\text{Decrease in conc}^n \text{ of A}}{\text{Time taken}} = -\frac{\Delta[A]}{\Delta t}$$

→ Rate of disappearance of B:

$$\Rightarrow \frac{\text{Increase in conc}^n \text{ of B}}{\text{Time taken}} = +\frac{\Delta[B]}{\Delta t}$$

NOTE:-

The conc^n of reactant decreases, so it is represt by -ve sign, while the conc^n of product increases so it represented by the sign.



→ Types of Rate of Reaction:

- **Average Rate** ~ Change in molar conc^n of reactant and product at a interval of time.

$R \longrightarrow P$

Avg. Rate of Rex^n $\Rightarrow -\frac{\Delta[R]}{\Delta t} = +\frac{\Delta[P]}{\Delta P}$

- **Instantaneous Rate** ~ Change in molar conc^n of reactant and product at a given instant of time

$R \longrightarrow P$

Inst Rate of Reaction $\Rightarrow -\frac{d[R]}{dt} + \frac{d[P]}{dt}$