Bsc. II, Paper — III A

Effect of temperature on reaction rate:—

The rate of reaction is dependent upon on temperature. It is generally seen that every rise of 10K in temperature, reaction rate become double or triple. This is expressed in term of co-efficient which is a ratio of two rate constant differing by a temperature difference 10K. Generally temperature selected are 298K and 308K.

$$\text{Temperature co-efficient} = \frac{\text{rate constant at } 308K}{\text{rate constant at } 298K}$$

On basis of collision theory the reaction rate depends on collision frequency and effective collision.

For effective collision two condition must be essential.

(a) proper orientation (ii) sufficient energy.

As effective collision become doble for 10K rise in temperature from 298K to 308K, the reaction rate become double.

Arrhenius equation for effect of ~~temperature~~ temperature on rate of reaction:—

Arrhenius derived a mathematical expression to give quantitative relation between temperature and rate constant. It is written as

$$K = Ae^{-Ea/RT} \quad \text{—— (i)}$$

Here A = frequency factor
Ea = activation energy.
R = gas constant
T = Temperature (K).

A gives the frequency of collision of reacting molecules.

Taking logarithm on both side of equation (i)

$$\ln K = \ln A - \frac{Ea}{RT} \quad \text{—— (ii)}$$

If value of K at two different temperatures T_1 and T_2 are K_1 and K_2 then eq (ii) can be written as.

$$\ln K_1 = \ln A - \frac{Ea}{RT_1} \quad \text{—— (iii)}$$

and $$\ln K_2 = \ln A - \frac{Ea}{RT_2}$$

substracting eqn (iv) by (iii) we get

$$\ln K_2 - \ln K_1 = \ln A - \frac{E_a}{RT_2} - \ln A + \frac{E_a}{RT_1}$$

$$\Rightarrow \ln K_2 - \ln K_1 = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\Rightarrow \ln \frac{K_2}{K_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right].$$

$$\Rightarrow \ln \frac{K_2}{K_1} = \frac{E_a}{R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\Rightarrow \log \frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right] \quad \text{— (V)}$$

Thus knowing value of K_1 and K_2 at two different temperature T_1 and T_2 energy of activation can be calculated.

equation (ii) can be written as

$$\ln K = -\frac{E_a}{RT} + \ln A \rightarrow \text{(VI)}$$

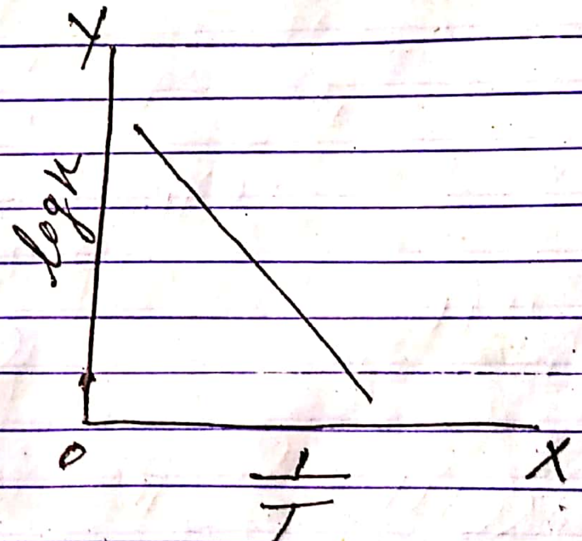
this is equation of straight line.

i.e. $y = mx + c$

~~Thus plot of~~
Taking logarithm base at 10 we get

$$\log K = -\frac{E_a}{2.303RT} + A$$

Thus plot of $\log k$ vs $\frac{1}{T}$, the slop of the line gives value of $-\frac{E_a}{2.303R}$ and As R is constant E_a of the reaction can be calculated.



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