+ Arrhenius Equation :-

from Vant hoff's equation –

we know that –

$$\frac{d \ln k}{dt} = \frac{E_a}{RT^2} \quad \text{—— (1)}$$

Where k is the rate constant of temperature T & E_a is activation energy.

On rearranging and intigrating eqn –(1)

$$\int d \ln k = \frac{E_a}{R} \int \frac{dt}{T^2}$$

or $$\ln k = -\frac{E_a}{RT} + \ln A \quad \text{—— (2)}$$

Where, $\ln A$ = Intigration Constant.

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

or $$\ln \frac{k}{A} = e^{-E_a/RT}$$

$$\boxed{K = A e^{-E_a/RT}} \quad \text{—— (3)}$$

The above eqn – (3) is called Arrhenius eqn.

Where, 'A' is called frequency factor or pre-exponential factor.

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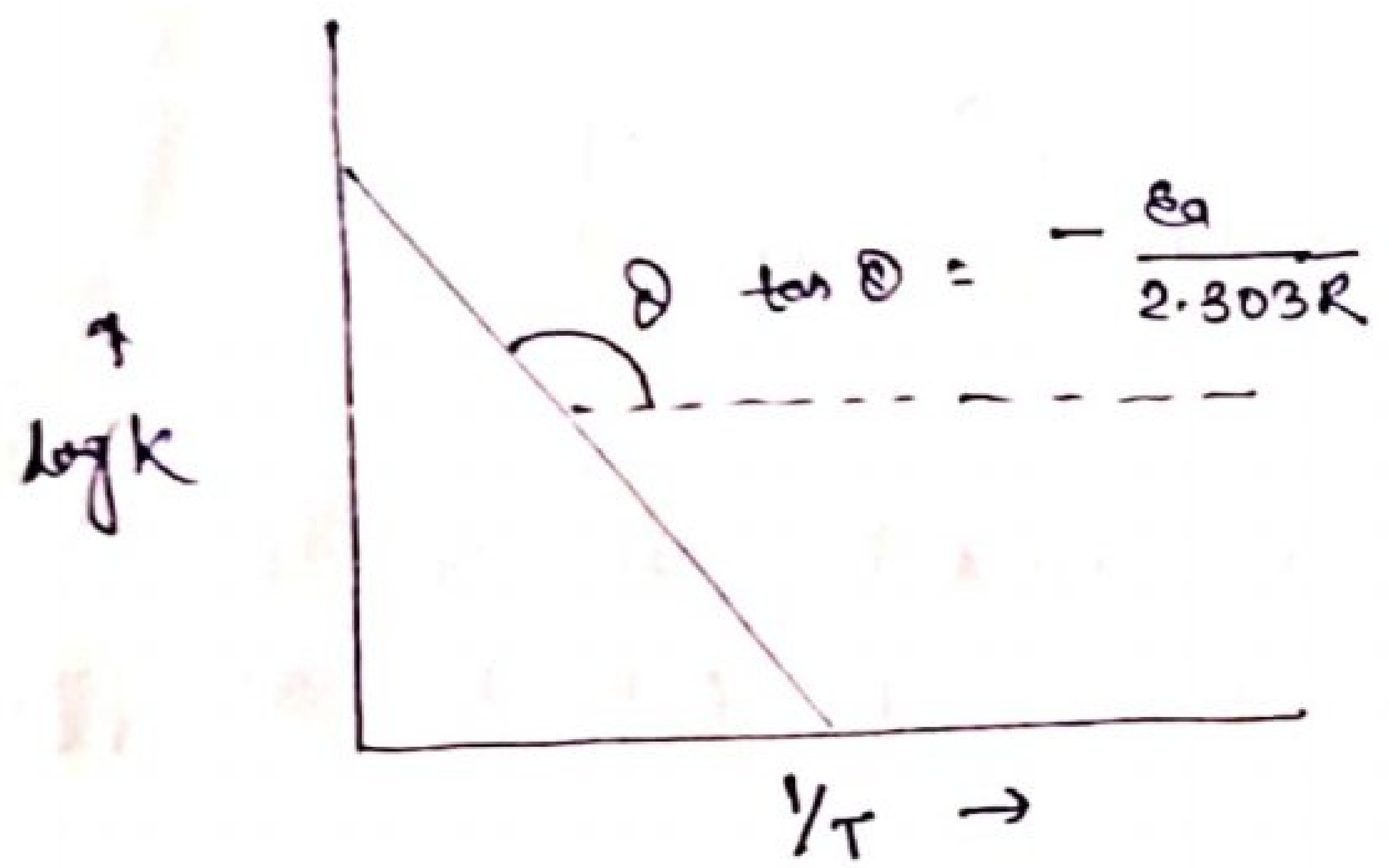
Again,
from eq^s - 2

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

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

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

A plot of $\log K$ Vs $1/T$ will give a straight line. The slope of which is $-\frac{E_a}{2.303 R}$



* Calculation of Activation energy (Ea)

let K_1 and K_2 are the rate constants at temperature T_1 & T_2. let 'Ea' is the activation energy of that reaction then from eq^s - 2

$$\ln K_1 = -\frac{E_a}{RT_1} + \ln A \qquad \text{——— (4)}$$

$$\& \quad \ln K_2 = -\frac{E_a}{RT_2} + \ln A \qquad \text{——— (5)}$$

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on substracting eqⁿ – (5) from eqⁿ – (4)

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

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

$$\Rightarrow 2.303 \log\frac{K_1}{K_2} = \frac{E_a}{R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$

$$\Rightarrow \log\frac{K_1}{K_2} = \frac{E_a}{2.303R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$

$$\Rightarrow \boxed{\log\frac{K_1}{K_2} = \frac{E_a}{2.303R}\left(\frac{T_1 - T_2}{T_2 T_1}\right)}$$

so knowing the values of K_1 & K_2 and T_1, T_2. we can easily calculate the value of Activation energy (E_a).

from

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