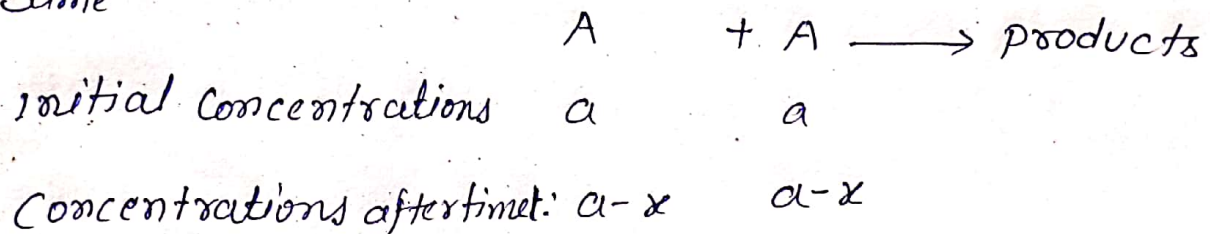


SUBJECT - CHEMISTRY
 CLASS - BSc (Hons) PART - I
 PAPER - II
 GROUP - A
 TOPIC - 2nd order reaction
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2nd order reaction: The reaction in which its rate is determined by the variation of two concentration terms is called 2nd order reaction. There are two cases of 2nd order reactions:

Case 1: When initial concentrations of reactants are the same



Since x moles have been reacted, then rate

$$\frac{dx}{dt} \propto (a-x)(a-x)$$

$$\frac{dx}{dt} = k(a-x)(a-x) \quad \text{or} \quad \frac{dx}{(a-x)^2} = k dt$$

$$\text{Let } z = a-x \quad \therefore dz = -dx$$

$$\therefore \int \frac{dx}{(a-x)^2} = - \int \frac{dz}{z^2} = \int z^{-2} dz = \frac{z^{-2+1}}{-2+1} = z^{-1} = \frac{1}{z} = \frac{1}{a-x}$$

$$\therefore \frac{1}{a-x} = kt + 1$$

$$\text{When } t=0 \quad x=0 \quad \text{then } 1 = \frac{1}{a}$$

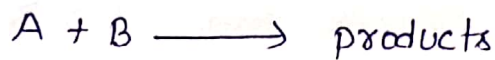
Putting the value of 1 in above equation, we get,

$$\frac{1}{a-x} - \frac{1}{a} = kt$$

or Rate Constant, $k = \frac{1}{t} \cdot \frac{x}{a(a-x)}$

\therefore unit of $k = \frac{1}{\text{Sec}} \cdot \frac{\text{mole/litre}}{\text{mole/litre} \times \text{mole/litre}} = \text{litre mole}^{-1} \text{Sec}^{-1}$

Case II when initial concentrations of reactants are different -



Initial Concentrations a b

Concentrations after time t: a-x b-x

Therefore rate, $\frac{dx}{dt} = k(a-x)(b-x)$: or $\frac{dx}{(a-x)(b-x)} = k dt$

On integration $\frac{-\ln(a-x) - \ln(b-x)}{a-b} = kt + I$

when $t=0, x=0$ then $I = -\ln \frac{a}{b(a-b)}$

Therefore the above equation

$$\frac{-\ln(a-x) - \ln(b-x)}{a-b} = kt - \ln \frac{a}{b(a-b)}$$

or $\frac{2.303}{a-b} \log \frac{b(a-x)}{a(b-x)} = kt$

or Rate Constant, $k = \frac{2.303}{t(a-b)} \log \frac{b(a-x)}{a(b-x)}$