

* characteristics of 2nd Order Reaction:-

(1) Half life period ($t_{1/2}$)

from 2nd order rate expression —

$$k = \frac{1}{t} \times \frac{x}{a(a-x)}$$

We put $x = a/2$ when $t = t_{1/2}$

$$k = \frac{1}{t_{1/2}} \times \frac{a/2}{a(a-a/2)}$$

$$\therefore t_{1/2} = \frac{1}{k} \frac{a/2}{a \times a/2}$$

$$t_{1/2} = \frac{1}{k} \times \frac{1}{a}$$

$$\therefore t_{1/2} \propto \frac{1}{a}$$

The half life period of 2nd order reaction is inversely proportional to the initial concentration.

② Unit :-

Unit of 2nd Order Reaction -

From 2nd order rate expression -

$$k = \frac{1}{t} \times \frac{a}{a(a-x)}$$

$$k = \frac{1}{t} \times \frac{\text{Conc}^2}{\text{Conc}^2 \times \text{Conc}^2}$$

$$k = \frac{1}{\text{sec}} \times \frac{1}{\text{Conc}^2}$$

$$k = \frac{1}{\text{sec}} \times \frac{1}{\text{mol/l}}$$

$k = \text{litre mol}^{-1} \text{sec}^{-1}$

③ 2nd order reaction becomes 1st order reaction if the concentration of one of the reactant is too high -

from 2nd order rate expression -

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

let $a \gg b$

$$a-b \approx a$$

$$a-x \approx a$$

then,

$$k = \frac{2.303}{t(a)} \log \frac{b \cdot a}{a(b-x)}$$

$$K \cdot a = \frac{2.303}{t} \log \frac{b}{(b-x)}$$

$$K' = \frac{2.303}{t} \log \frac{b}{(b-x)}$$

This expression is the rate constant of 1st order reaction.

④ Examples of 2nd Order reaction :-

(1) Soapification of Ester -



Ethyl acetate Sodium hydroxide

(2). Decomposition of acetaldehyde -



Acetaldehyde Methane

(3).