* characterstics 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 $t = t_{1/2}$

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

$$\text{or} \quad t_{1/2} = \frac{1}{K} \frac{a/2}{a \times a/2}$$

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

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

The half life period of 2nd order reaction is inversily proportional to the initial Concentration.

(2) Unit :-

Unit of 2nd Order Reaction —

From 2nd Order rate expression —

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

$$K = \frac{1}{t} \times \frac{Conc^1}{Conc^1 \times Conc^1}$$

$$K = \frac{1}{sec} \times \frac{1}{Conc^1}$$

$$K = \frac{1}{sec} \times \frac{1}{mol/L}$$

K = litre mol^{-1} 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 $a \gg b$

$a - b \simeq a$

$a - x \simeq a$

then,

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

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

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

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

(4) Examples of 2nd Order reaction :-

(1) Soaponification of Ester –

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$$

Ethyl acetate — Sodium hydroxide

(2). Decomposition of acetaldehyde –

$$2\,CH_3CHO \longrightarrow 2CH_4 + 2CO$$

Acetaldehyde — Methane

(3).