

# New Chapter

your writing partner

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## Chemical Kinetics (Part I)

Chemical Kinetics - The branch of chemistry that deals with the study of rate of chemical reaction and the factors affecting the rate of reaction and the mechanism by which reaction proceeds is called chemical kinetics.

### Types of reaction on the basis of reaction rate:-

Very slow reaction

Ex:- Rusting of Iron,  
Setting of cement  
etc.

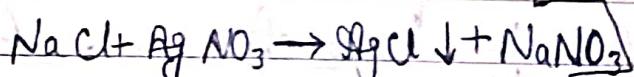
\* It is very difficult to measure the rate of these reactions.

Very fast reaction

Ionic reactions are very fast reaction due to strong force of attraction

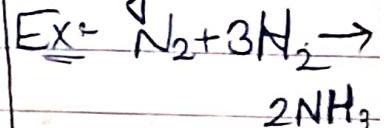
between opposite charged ions.

Ex:- Precipitation reaction, neutralization reaction, etc.



Moderate speed reaction

The reaction which takes place with moderate speed so there rate can be measured easily.



In these reaction since these reactions completed very fast so it is almost impossible to determine the rate of reaction.

## ~~Topic~~ Rate of Chemical Reaction

\* The change in concentration of a reactant or a product per unit time is called rate of chemical reaction.

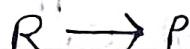
OR

The rate of ~~in~~ decrease in concentration of reactant or rate of increase in concentration of product is called rate of chemical reaction.

~~Rate of reaction~~

$$\text{Rate of reaction} = \frac{\text{change in conc. of any reactant or product}}{\text{change in Time}}$$

Let us consider a reaction



$$\text{Rate of reaction (for reactant)} = -\frac{\Delta [R]}{\Delta t} = \frac{[P_2] - [P_1]}{t_2 - t_1}$$

$$\text{Rate of Product} = \frac{\Delta [P]}{\Delta t} = \frac{[P_2] - [P_1]}{t_2 - t_1}$$

$$\text{Rate of Reaction} = -\frac{\Delta [R]}{\Delta t} = \frac{\Delta [P]}{\Delta t}$$

Rate of reaction is always positive

Significance of -ve sign in reactant:-

As the reaction progress the concen. of reactant decreases therefore  $\Delta[R]$  will be negative but as the reaction is always +ve so rate of -ve is placed to make rate of reaction +ve

Unit of rate of reaction :-

Rate of reaction = change in concentration  
Time interval

$$= \frac{\text{mol L}^{-1}}{\text{sec}} \Rightarrow \text{mol L}^{-1}\text{s}^{-1}$$

or

$$\boxed{\text{M s}^{-1}}$$
  
$$\boxed{\text{mol}^{-1} \text{time}^{-1}}$$

For Gaseous reaction :-

Rate of reaction = change in pressure  
Time interval

$$= \frac{\text{atm}}{\text{Sec}}$$

$$= \text{atm sec}^{-1}$$

or

$$\boxed{\text{atm time}^{-1}}$$

## Expressing the rate of reaction in terms of Reactants and Products

①



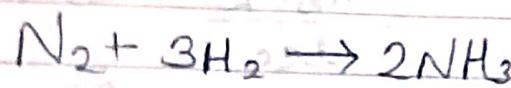
$$\text{Rate of disappearance of X} = -\frac{\Delta[\text{X}]}{\Delta t}$$

$$\text{Rate of disappearance of Y} = -\frac{\Delta[\text{Y}]}{\Delta t}$$

$$\text{Rate of formation of Z} = +\frac{\Delta[\text{Z}]}{\Delta t}$$

$$\boxed{\text{Rate of reaction} = -\frac{\Delta[\text{X}]}{\Delta t} = -\frac{\Delta[\text{Y}]}{\Delta t} = +\frac{\Delta[\text{Z}]}{\Delta t}}$$

②



$$\text{Rate of disappearance of N}_2 = -\frac{\Delta[\text{N}_2]}{\Delta t}$$

$$\text{Rate of disappearance of H}_2 = -\frac{\Delta[\text{H}_2]}{\Delta t}$$

$$\text{Rate of formation of NH}_3 = +\frac{\Delta[\text{NH}_3]}{\Delta t}$$

$$\boxed{\text{Rate of reaction} = -\frac{\Delta[\text{N}_2]}{\Delta t} = -\frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t} = \frac{1}{2} \frac{\Delta[\text{NH}_3]}{\Delta t}}$$

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$$-\frac{\Delta [\text{N}_2]}{\Delta t} = -\frac{1}{3} \frac{\Delta [\text{H}_2]}{\Delta t}$$

$$-\frac{\Delta [\text{H}_2]}{\Delta t} = 3X - \frac{\Delta [\text{N}_2]}{\Delta t}$$

Rate of dissapp. of  $\text{H}_2$  = 3 Time of greater of dissapp. of  $\text{N}_2$

$$\frac{\partial P}{\partial t} = - \frac{\partial P}{\partial x} = - \frac{\partial P}{\partial R} = \frac{\partial P}{\partial t}$$

Time derivative

short rate = change in current

of short rate  
called instant amount that  
moment of time is  
at a particular  
short rate is measured  
when the rate of

instant amount  
short rate

$$\frac{\partial V}{\partial t} = \frac{\partial V}{\partial R} - \frac{\partial V}{\partial P} = \frac{\partial V}{\partial x}$$

Time derivative

shortage rate = change in current

of short rate  
called amount of short rate of  
instantaneous if it is  
at a long time  
short rate in measured  
from the rate of

instant amount  
short rate

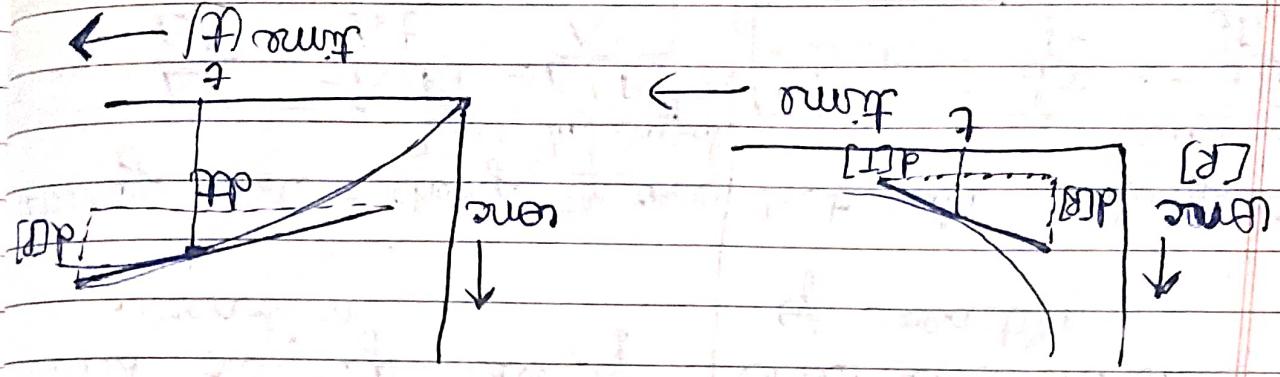
These are 2 types of short rates

types of short rates

$$= 1.25 \times 10^{-4} \text{ million L-sec}$$

$$= \frac{1}{4} \times 5 \times 10^{-4}$$

upper boundary is



In order to determine the rate of change of current at a given time to the same current at a given time of second current at any instant of time a formula is obtained

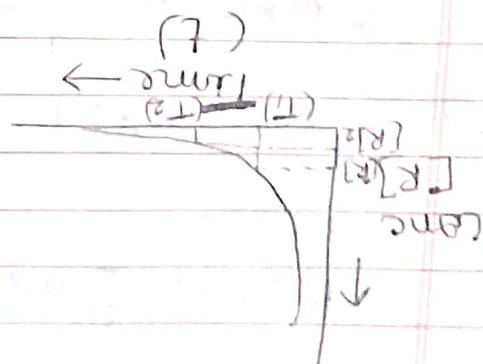
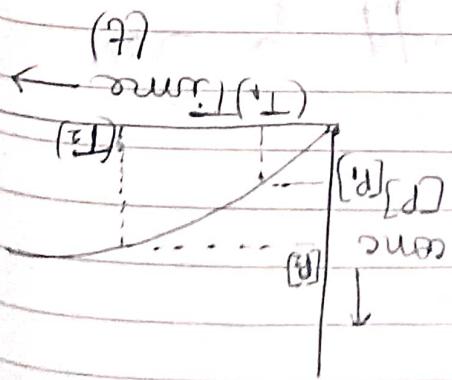
Graphical • Representation of transformation of function

$$\frac{I_1 - I_2}{t_1 - t_2}$$

$$g_{av} = - \left\{ \frac{I_2 - I_1}{t_2 - t_1} \right\}$$

$$g_{av} = \frac{\Delta I}{\Delta t}$$

$$g_{av} = - \frac{\Delta R}{\Delta t}$$



Graphical gradient -

Graphical calculation of average rate

Reason - Because greater the concentration of reactants  
the rate of reaction increases with increase  
in concentration of reactants  
so that the reaction will proceed faster.

### (I) Concentration of Reactants -

Factors affecting the rate of reaction -

• Time -  
The reaction does not give exact rate of reaction because it depends on the concentration of reactants. which depends on time.

### Limitation of averaging rate -

$$\text{Slope of tangent} = \frac{\Delta y}{\Delta x}$$

$$\text{Slope of tangent} = \frac{\Delta y}{\Delta x}$$

$$\text{Rate} = -\frac{\Delta y}{\Delta x}$$

$$\text{Rate} = \tan \theta$$

$$\frac{\Delta P}{\Delta t}$$

$$\text{Rate} = \frac{d[P]}{dt}$$

$$\text{Rate} = -\frac{d[R]}{dt}$$

Glassware from liquid and materials that

### ③ Nature of Reactions

Reaction mechanism depends on the nature of catalyst which affects the rate of reaction by decreasing the activation energy.

### ④ Process of Catalyst / Application

The process of catalyst application is as follows:

1. The main reaction is carried out in a reactor.
2. The catalyst is added to the reactor.
3. The reaction mixture is separated from the catalyst.
4. The catalyst is recovered and reused.

### ⑤ Surface area of Reactants

The surface area of reactants increases due to dispersion forces between atoms.

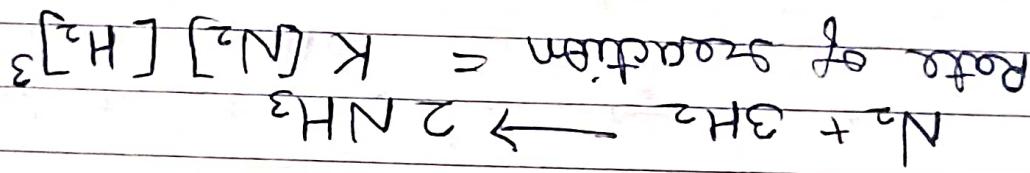
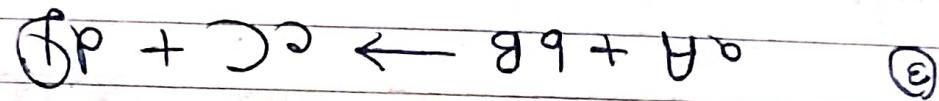
The surface area of reactants increases due to dispersion forces between atoms, and due to the presence of radicals in the reaction mixture.

### ⑥ Temperature

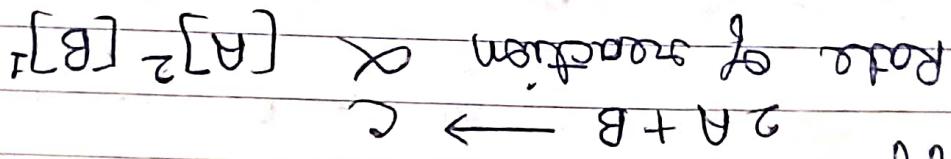
The temperature of the reaction mixture increases with increasing kinetic energy of particles.

~~Rate of reaction = Rate constant  $\times$  concentration of reactants~~

$$\text{Rate of reaction} = K [A]^a [B]^b$$



$$\text{Rate of reaction} = K [A]^2 [B]$$



coefficient

the product equal to the number of each reactant. and each term is raised to the power of concentration of reactant in which it is present. The product of all the terms is the rate of chemical reaction of this reaction at the given condition.

Effect of temperature - Increasing temperature and pressure.

Effect of concentration - Increase in concentration of reactants.

Effect of catalyst - Increase in the rate of reaction.

Effect of inhibitor - Decrease in the rate of reaction.

Ans

change with time for a reaction  
 \* The value of  $k$  for a reaction  
 different reaction have different value of  $k$ .  
 every reaction has a definite rate.  
 \* Catalyst the value of  $k$  high but  
 will be the rate of reaction  
 and faster will be the reaction  
 of the reaction of reaction  
 Rate constant is the measure of  
 characteristics of rate, constant  
 mainly.

$$\boxed{\text{Rate of reaction} = k}$$

$$[\text{B}] = \text{L mol/L}$$

$$\text{Rate of reaction} = k [\text{A}]^a [\text{B}]^b$$



$$\text{Definition of } k:$$

Rate constant  
(specific reaction)  
Rate constant for a  
given reaction equals to  
the ratio of reaction whom  
concentration of reactant is taken  
as unity.

④ Effectiveness of reaction and rate constant.

The unit of k depends upon the  
order of reaction & its magnitude.

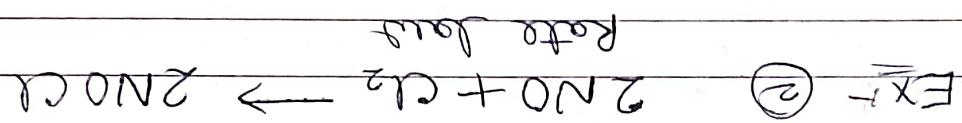
In increasing the concentration of the

rate of reaction.  
at depends upon the  
concentration of reactants.

Rate of reaction  
depends on change in concentration  
of reactant and form  
of product for unit time

CAES unit is mole L<sup>-1</sup>

Rate of dissociation =  $k[N_2O]^3 [Cl]$

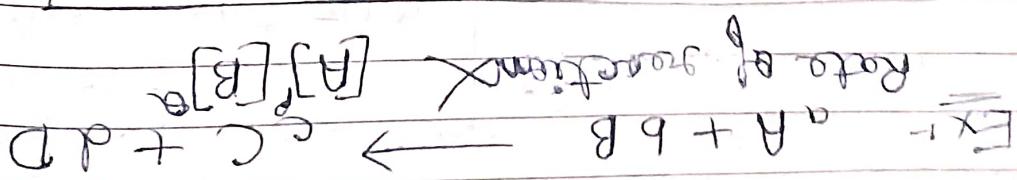


Rate law may not.

It may be equal to  $a$  and  $b$ .  
the rate may exponentially.  
In rate law expression found  $a$

rate law expression

Rate of dissociation =  $k[A]^a [B]^b$



Rate of dissociation is directly proportional to the sum of the concentration of each product and each reactant.  
Rate of dissociation is directly proportional to the dissociation of each reactant.  
Rate of dissociation is directly proportional to the sum of the concentration of each product and each reactant.  
Rate of dissociation is directly proportional to the concentration of each reactant.

Rate equation -

Rate law (Rate law expression) -

$\text{Rate of reaction} = k[A]^p[B]^q$   
 $\text{Rate law}$   
 $A + B \rightarrow C + D$   
 The sum of the reactants  
 is called order of reaction.  
 If the reaction is elementary, then  
 the number of reactants  
 taking part is called  
 molecularity of reaction.  
 The number of reactants  
 taking part in a reaction  
 determines the order of reaction.  
 The molecularity of reaction  
 is the sum of the  
 coefficients of reactants in the  
 balanced equation.

Order of reaction  
 molecularity of reaction  
 and order of reaction.

Order of reaction  
 molecularity of reaction  
 and order of reaction.

Elementary reaction  
 reaction in which only one step  
 takes place in a reaction  
 mechanism of reaction.

Complex Reaction

Elementary reaction  
 reaction in which more than one step  
 takes place in a reaction  
 mechanism and complex

Rate of reaction  
 $H_2 + I_2 \rightarrow 2HI$   
 (in mole/liter)  
 $P_2O_5 + Cl_2 \rightarrow PCl_5$   
 (in mole/liter)

The number of reactants  
 taking part in a reaction  
 determines the order of reaction.  
 The molecularity of reaction  
 is the sum of the  
 coefficients of reactants in the  
 balanced equation.

Elementary Reaction

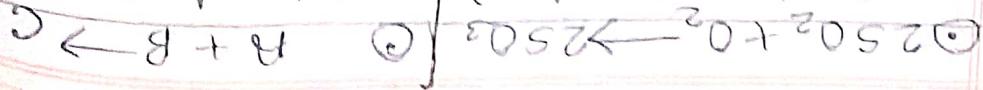
Elementary reaction

Rate of reaction =  $K[A]^x[B]^y$

Ans

Rate of reaction =  $K[A]^x[B]^y$

Rate of reaction =  $K[A]^x[B]^y$



Rate of reaction =  $K[A]^x[B]^y$

(for equilibrium)

at equilibrium

W.A.R.

$$K = \frac{1}{S_1 - S_2}$$

$$K = \frac{\text{Rate}}{\text{[A]}^2}$$

$$K = \frac{\text{Rate}}{\text{[A]}^2} = \frac{\text{Rate}}{\text{[L]}^2}$$

$$\text{Rate} = K[\text{A}]^2$$

For first order reaction

$$\text{Unit of } K = \text{mol L}^{-1} \text{s}^{-1}$$

$$\text{Rate} = K$$

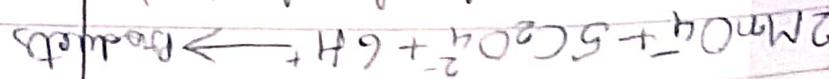
$$\text{Rate} = K[\text{A}]^n$$

For zero order reaction

$A \rightarrow \text{Product}$

Unit of rate constant:

(no unit)



addition  
as well as complex  
applicable to elementary  
and addition of reaction

use concentration  
of each step complex  
the molecularity of  
reaction

(3)

Fast 2nd order reaction

$$Rate = k[A]^2$$

$$k = \frac{Rate}{[A]^2}$$

$$k = \frac{Rate}{[A]^2}$$

$$k = \frac{Rate}{[A]^2}$$

(4)

Fast 3rd order reaction

$$Rate = k[A]^3$$

$$k = \frac{Rate}{[A]^3}$$

$$k = \frac{Rate}{[A]^3}$$

$$(mol L^{-1})^3$$

$$k = \frac{Rate}{[A]^2}$$

$$k = \frac{Rate}{[A]^2}$$

$$K = \text{atm}^{1-n} S^{-1}$$

$$K = \frac{\text{atm}^n}{\text{atm} S^{-1}}$$

$$K = \frac{\text{Rate}}{[A]^n}$$

$$\text{Rate} = K [A]^n$$

~~we use mole fraction instead of concentration~~

$$K = \text{mole}^{1-n} L^{n-1} S^{-1}$$

$$K = \frac{\text{mole}^{1-n}}{\text{mole}^{n-1} L^{-1}}$$

$$K = \frac{\text{Rate}}{[A]^n}$$

$$\text{Rate} = K [A]^n$$

(5)  $F_{\text{eq}}, n_{\text{th}}$  Quid?

$$Rate \propto K [N_2O_5]$$

$$\boxed{\text{Order of reaction} = 1}$$

Determination of order of reaction :- Order of reaction can be determined by following methods.

- 1) By graphical method.
- 2) By empirical rate, method
- 3) By integrated rate law method

By Graphical method :- In this method order of reaction is determined by plotting a graph between rate of reaction and conc. of reactant.

\* This method is applicable only when one reactant is taking part in the reaction.

$A \rightarrow \text{Product}$

$$\text{Rate}_1 = K[A]^1$$

$$\text{Rate}_1 \propto [A]$$

For II nd order:-

$$\text{Rate}_2 = K[A]^2$$

$$\text{Rate}_2 \propto [A]^2$$

For III rd order:-

$$\text{Rate}_3 = K[A]^3$$

$$\text{Rate}_3 \propto [A]^3$$

For 0 order:-

$$\text{Rate}_0 = K[A]^0$$

$$\text{Rate}_0 = K$$

i.e. rate of reaction does not depend upon conc. of reactant.

$\text{Rate} \uparrow$

I order

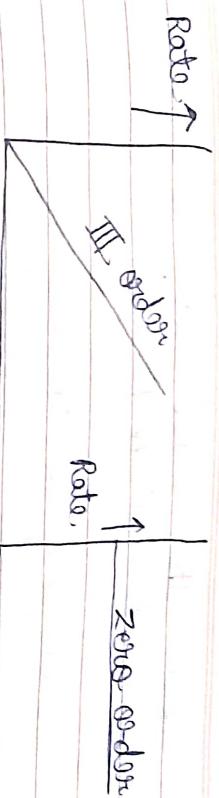
$\text{Rate} \uparrow$

II order

$[A]^1 \rightarrow$

$[A]^2 \rightarrow$

$[\text{conc}]^4 \rightarrow$



### Initial Rate Method :-

- \* This method is used when more than 1 reactant are involved in the reaction.
- \* In this method various initial rates are determined at different initial conc. of reactant.

### Numericals :-

Q ① For the reaction  
 $2\text{NO} + \text{Cl}_2 \rightarrow 2\text{NOCl}$  at 300K

following data are obtained

- i) write rate law for the reaction.
- ii) what is the order of reaction.
- iii) Calculate, the value of rate constant

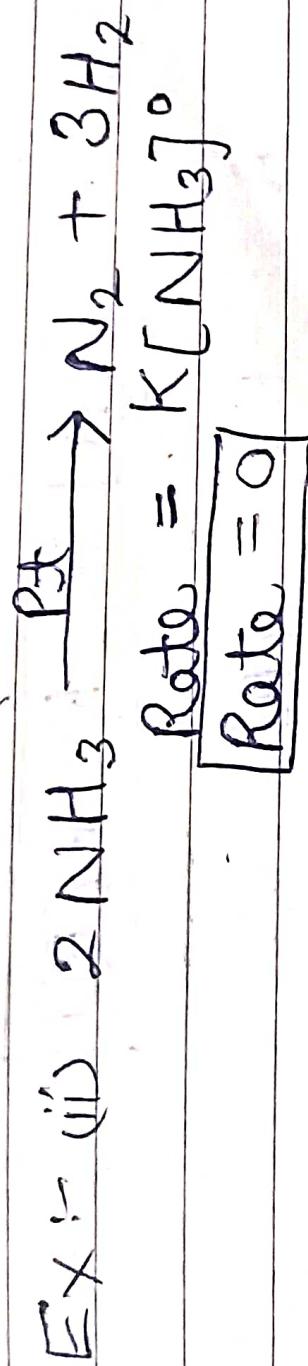
| Experiment | $[\text{NO}]_0$ | $[\text{Cl}_2]_0$ | Initial rate (M/s)   |
|------------|-----------------|-------------------|----------------------|
| 1          | 0.01            | 0.01              | $1.2 \times 10^{-4}$ |
| 2          | 0.01            | 0.02              | $2.4 \times 10^{-4}$ |
| 3          | 0.02            | 0.02              | $9.6 \times 10^{-4}$ |

## Integrated Rate law method (Integrated Rate expression)

Zero order reaction :- The reaction in which rate is independent of conc. of any reactant is called zero order reaction.



$$\text{Rate} = K [\text{H}_2]^0 [\text{Cl}_2]^0$$
$$\boxed{\text{Rate} = K}$$



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Derivation of integrated rate expression for zero order reaction

For zero order reaction

$A \rightarrow$  Product

$$\begin{cases} \text{Rate} = K[A] \\ [\text{Rate}] = K \end{cases}$$

$$\boxed{-\frac{d[A]}{dt} = K} \quad \text{differential rate of reaction}$$

$$d[A] = -K dt$$

on integrating both sides

$$\int d[A] = -K \int dt$$

$$\begin{aligned} [A] &\times \boxed{[A] = -kt + C} && (C \rightarrow \text{Integration Constant}) \\ [A]_t - [A]_0 &= -kt \end{aligned}$$

at time  $t = 0$

$$[A] = [A]_0$$

$T \rightarrow$  Time.

$[A] \rightarrow$  conc. of reactant at time  $t$

$[A]_0 \rightarrow$  conc. of reactant at time  $t = 0$

[initial conc. of reactant]

$$\boxed{\begin{cases} [A]_0 \rightarrow 0 + C \\ C = [A]_0 \end{cases}}$$

$$\boxed{[A] = -kt + [A]_0}$$

$$A = -kt + [A]_0$$

$$Kt = [A]_0 - [A]$$

$$\boxed{K = \frac{[A]_0 - [A]}{t}}$$
 Integrated rate law  
for zero order reaction

$K \rightarrow$  Rate constant for zero order

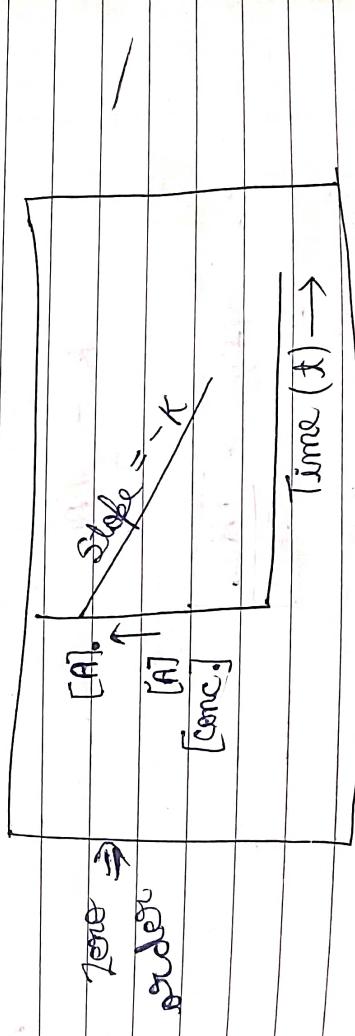
Characteristics of zero order reaction:-

Graph between concentration of reactant and time

$$Kt = [A]_0 - [A]$$

$$Kt = [A]_0 - [A]$$

$$\boxed{[A] = -Kt + [A]_0}$$
$$y = mx + c$$



half life period for zero order reaction. ( $t_{1/2}$ )

The time ~~time~~ period in which a substance remains half of its initial conc. is called half life period.

After half life period

$$t \rightarrow t_{1/2}$$

$$\text{So } [A] = \frac{[A]_0}{2}$$

$$\text{Therefore } K = \frac{[A]_0 - [A]}{t}$$

$$= \frac{[A]_0 - [A]_{1/2}}{t_{1/2}}$$

$$K = \frac{[A]_0}{2 t_{1/2}}$$

$$\boxed{t_{1/2} = \frac{[A]_0}{2K}}$$

$$t_{1/2} = \frac{[A]_0}{2K}$$

$K \rightarrow$  rate constant  
for zero order reaction

$$t_{1/2} \propto [A_0]$$

$\therefore$  Half-life period for zero order reaction is directly proportional to the initial conc. of reactant.

Graph between half life period and initial conc. of reactant for zero order reaction :-

$$t_{1/2} = \frac{[A]_0}{2K}$$

$$\begin{aligned} t_{1/2} &= \frac{1}{2K} [A_0] + 0 \\ y &= mx + c \end{aligned}$$



zero  
order

## 1st order reaction

The reaction in which rate depend upon conc of only one reactant



$$\text{Rate} = k[\text{N}_2\text{O}_5]$$

order of reaction = 1

- ② all radioactive decay is the example of 1st order reaction.

Derivation of Integrate rate law for 1st order reaction

$\text{A} \rightarrow \text{Product}$

Rate law

$$\text{Rate} = k[\text{A}]^1$$

$$\boxed{-\frac{d[\text{A}]}{dt} = k[\text{A}]} \quad \text{Differential rate law for 1st order reaction.}$$

$$\frac{d[\text{A}]}{[\text{A}]} = -k dt$$

on integrating both side

$$\int \frac{d[\text{A}]}{[\text{A}]} = -k \int dt$$

$$\int \frac{dx}{x} = \log x + C$$

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$$\ln \Rightarrow \text{natural log}$$

$\ln \rightarrow \log_{10}$

Multiply by 2.303

$$\int \frac{d[A]}{[A]} = -k \int dt$$

$$\ln [A] = -kt + c \quad \text{(i)}$$

At time  $t = 0$   
 $[A] = [A]_0$

$[A]_0$  = initial conc. of reactant  
 $[A]$  = conc. of reactant at time  $t$ ,

$t$  = Time

$c$  = integrating constant

$$\ln [A]_0 = 0 + c$$
$$c = \ln [A]_0 \quad \text{(ii)}$$

$$\ln [A] = -kt + \ln [A]_0$$

$$kt = \ln [A]_0 - \ln [A]$$

$$k = \frac{1}{t} \ln \frac{[A]_0}{[A]}$$

$$k = 2.303 \log \frac{[A]_0}{[A]} \text{ Integrated rate law}$$

for 1st order reaction

$k \rightarrow$  rate constant for 1<sup>st</sup> order reaction

If initial conc. of reactant is  $a$  and x amount of reactant is consumed at time  $t_1$

$$K = \frac{2.303}{t} \log \frac{a}{a-x}$$

$K$  = rate constant for 1<sup>st</sup> order reaction.

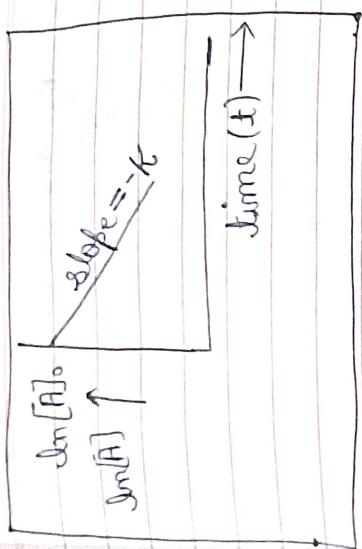
At time  $t_1$  conc. of reactant is

$$K = \frac{2.303}{t_2 - t_1} \log \frac{[A]_1}{[A]_2}$$

Characteristics of 1<sup>st</sup> order reaction

Graph between conc. of reactant and time :-

$$\ln [A] = -Kt + \ln [A]_0$$
$$Y = mx + c$$



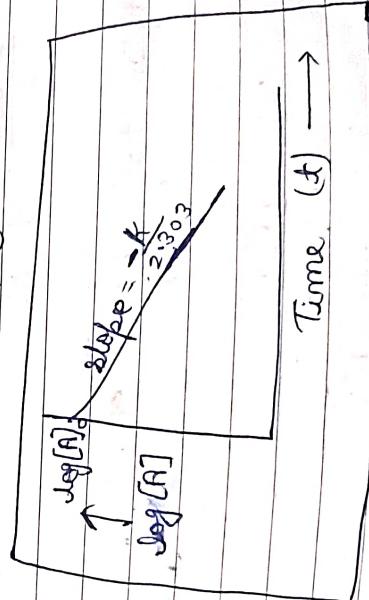
$$K = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

$$\frac{Kt}{2.303} = \log \frac{[A]_0}{[A]}$$

$$\frac{Kt}{2.303} = \log [A]_0 - \log [A]$$

$$\log [A] = -\frac{Kt}{2.303} + \log [A]_0$$

$$y = mx + c$$

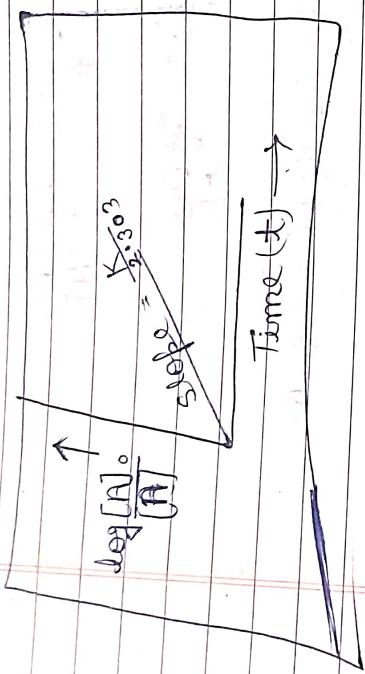


$$\frac{Kt}{2.303} = \frac{\log [A]_0 - \log [A]}{[A]}$$

$$\frac{\log [A]_0}{[A]} - \frac{Kt}{2.303} = 0$$

$$\downarrow$$

$$y = mx + c$$



Half life Period for 1st order reaction

$$K = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

Affter half life

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

$$[A] = \frac{[A]_0}{2}$$

$$K = \frac{2.303}{t_{1/2}} \log \frac{[A]_0}{[A]_{1/2}}$$

$$K = \frac{2.303}{t_{1/2}} \log 2$$

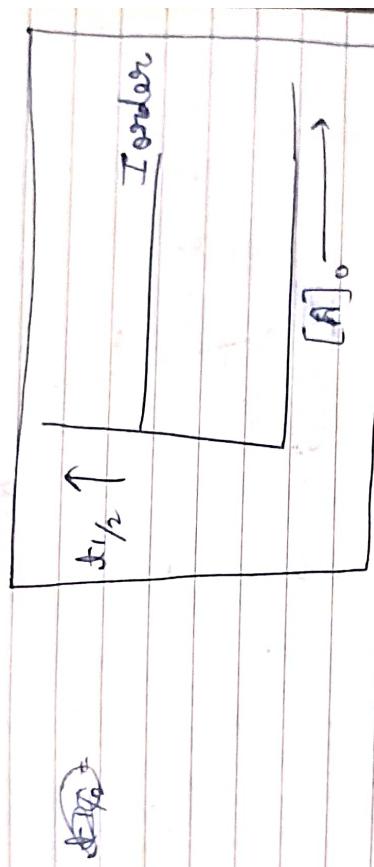
$$\left[ \log 2 = 0.3010 \right]$$

$$K = \frac{2.303}{t_{1/2}} \times 0.3010$$

$$K = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = \frac{0.693}{K}$$

Half life period for  
1 order is  
independent from  
initial conc. of  
reactant.



~~Half calculation of order of reaction from half life period -~~

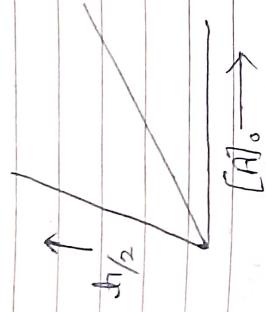
$$t_{1/2} \propto [A]_0^{1-n}$$

$t_{1/2}$  = Half life Period  
 $[A]_0$  = Initial conc. of reactant  
 $n$  = order of reaction.

(1) For zero order reaction

$$n=0$$

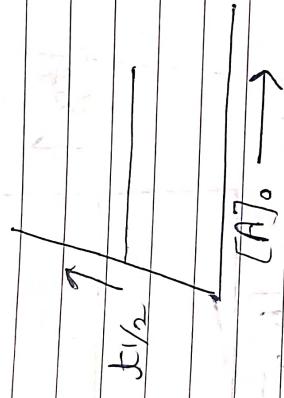
$$t_{1/2} \propto [A]_0'$$



(2) For 1st order reaction

$$n=1$$

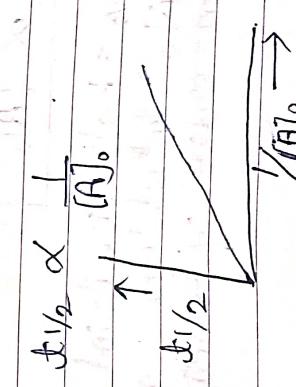
$t_{1/2}$  does not depend upon  $[A]_0$



(3) For 2nd order reaction

$$n=2$$

$$t_{1/2} \propto \frac{1}{[A]_0}$$



Your writing partner

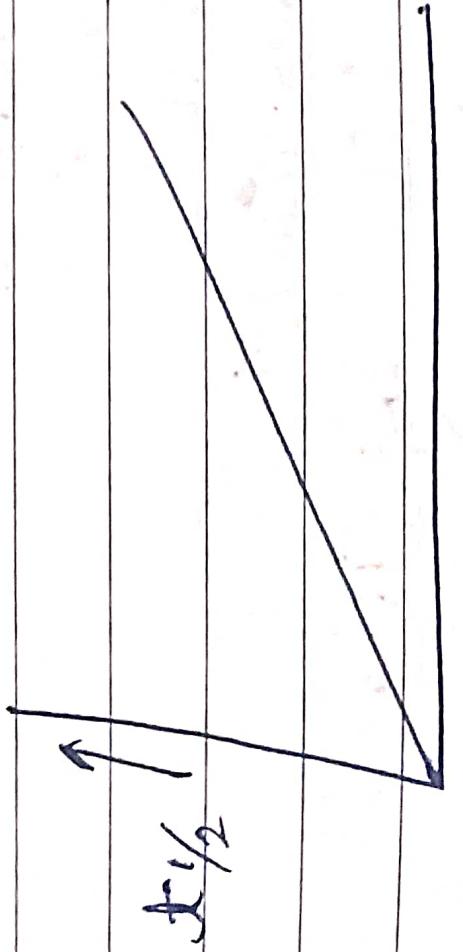
Date \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

(4) For III<sup>rd</sup> order reaction

$$n=3$$

$$t^{1/2} \propto [A]_0^{-2}$$

$$t^{1/2} \propto \frac{1}{[A]^2_0}$$



$$\frac{1}{[A]^2_0}$$

Numerical

$$t = 8.33 \text{ sec}$$

Rate const: for zero order gaseous reaction

For Zero order reaction

$$k = \frac{[A]_0 - [A]}{t}$$

For Gaseous reaction

$$k = \frac{P_0 - P}{t}$$

$P_0$  = Initial Pressure of reactants

$P$  = Pressure of reactant at time  $t$

$t$  = time

$k$  = Rate constant

Half life Period for zero order reaction

$$t_{1/2} = \frac{[A]_0}{2k}$$

$$t_{1/2} = \frac{P_0}{2k}$$

Rate const for 1<sup>st</sup> order

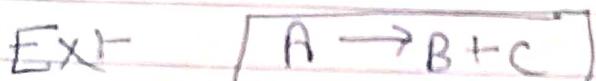
$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$$

For gaseous reaction

$$k = \frac{2.303}{t} \log \frac{p_0}{p}$$

where  $p_0 \rightarrow$  Initial pressure of reactant

$p \rightarrow$  Pressure of reactant at time 't'



Initially  $p_0 \quad 0 \quad 0$

After time 't'  $p_0 - x \quad x \quad x$

Total pressure after time 't'

$$p_t = p_0 + x$$

$$p_t = p_0 + x$$

$$x = p_t - p_0$$

Pressure of reactant after time

$$p = p_0 - x$$

$$p = p_0 - [p_t - p_0]$$

$$K = 1.38 \times 10^{-2} \text{ Sec}^{-1}$$

## Pseudo first order reaction

The reaction which are not of 1<sup>st</sup> order (generally bi-molecular) but under certain condition becomes reaction of 1<sup>st</sup> order are called Pseudo first order reaction.

In these reaction one of the reactants is in excess so that its conc. remain const. and it will not take part in the rate determination.

Ex :- Hydrolysis of ester

