CHEMISTRY

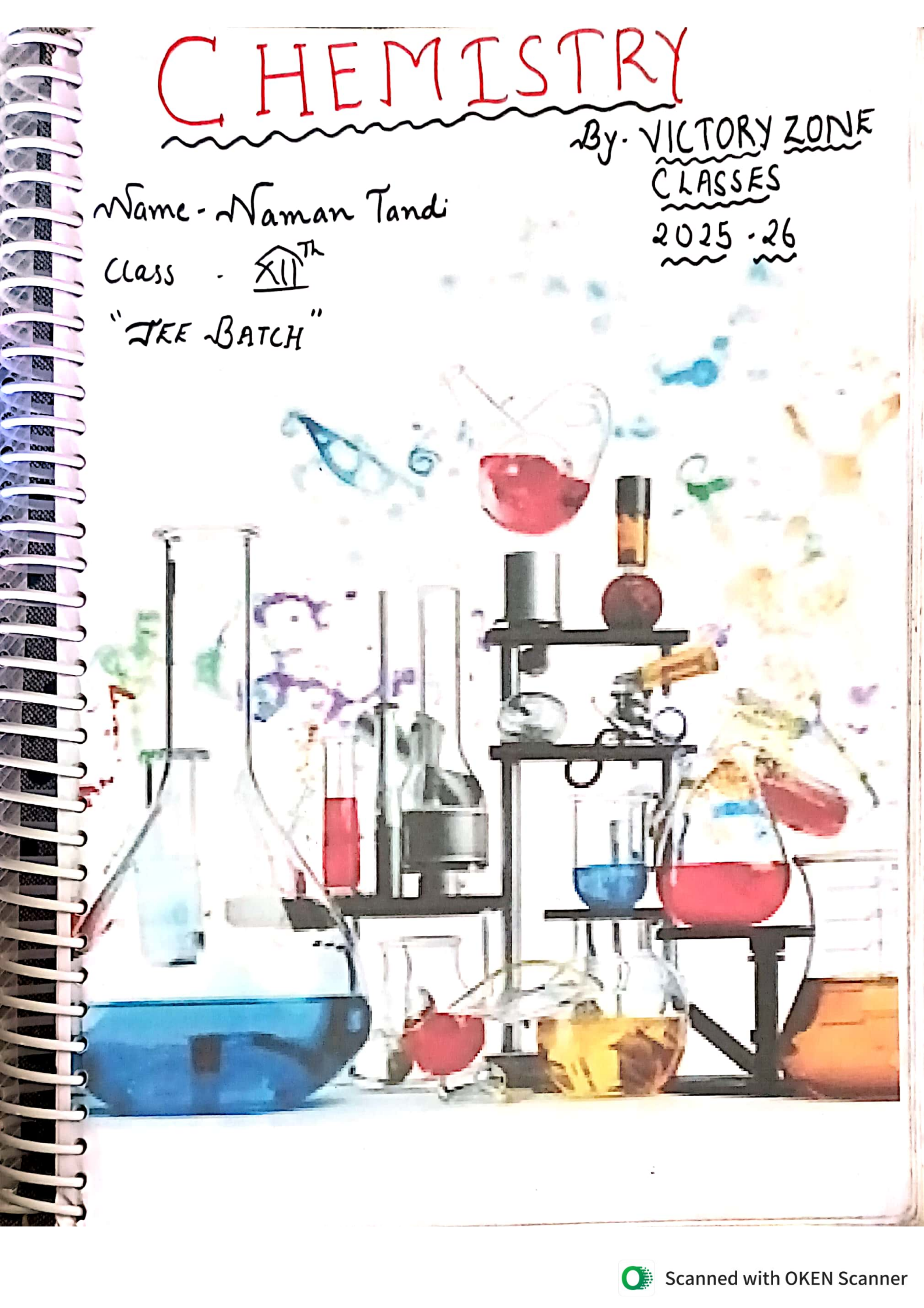
By- VICTORY ZONE CLASSES

2025-26

Name - Naman Tandi

Class - XIIth

"JEE BATCH"



VICTORY ZONE CHEMISTRY CLASSES

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CHAPTER SCHEDULE

CHEMICAL KINETICS

6 MAY 2025 TO 1 JUNE 2025

S. NO	CLASS DETAIL	TOPICS DETAILS	CHECK LIST
1.	LECTURE NO. 1	INTRODUCTION OF RATE OF REACTION RATE OF APPERANCE & DISAPPERANCE 10Q	
2.	LECTURE NO. 2	RATE LAW, RATE CONSTANT THEORY	
3.	LECTURE NO. 3	RATE LAW 20Q	
4.	LECTURE NO. 4	MOLECULARITY OF REACTION, PSEUDO FIRST ORDER REACTION, COMPLEX REACTION	
5.	LECTURE NO. 5	COMPLEX REACTION 20Q	
6.	LECTURE NO. 6	INTEGRATED RATE EQUATION ZERO OREDR, FIRST ORDER	
7.	LECTURE NO. 7	INTEGRATED RATE EQUATION ZERO OREDR, FIRST ORDER GRAPH & 30Q	
8.	LECTURE NO. 8	INTEGRATED RATE EQUATION ZERO OREDR, FIRST ORDER GRAPH & 30Q	
9.	LECTURE NO. 9	ARRHENIUS EQUATION	
10.	LECTURE NO. 10	ACTIVATION ENERGY CONCEPT, CATALYTIC PROPERTIES	
11.	LECTURE NO. 11	RELATIONSHIP K & T 20Q	
12.	LECTURE NO. 12	BOARDS PYQS DISCUSSION	
13.	LECTURE NO. 13	RELATIONSHIP K & T 20Q	
14.	LECTURE NO. 14	SELF ANALYSIS PAPER IN CLASS	
15.	TEST NO. 3	31/05/2025 MCQS 30Q MM:120 (YOUR MARKS)	
16.	TEST NO. 4	01/06/2025 THEORY 16Q MM:30 (YOUR MARKS)	
17.	HOME WORK	NUMBER OF QUESTION DONE BY YOUR SELF	
18.	HOME WORK	NCERT BOOK READING & BACK QUESTIONS	

6/05/2025

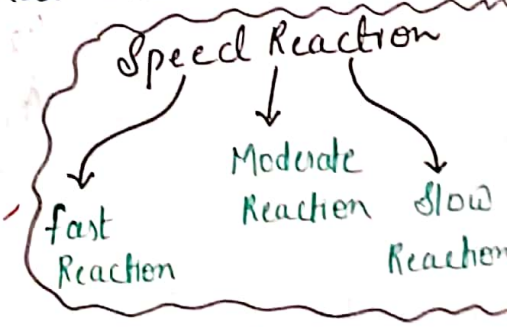
UNIT = 3

CHEMICAL KINETICS

" A Branch of Chemistry which deals with rate of reaction and factor affecting rate of reaction."
(परिभाषा होगी)

In this chapter we will a study about Feasable Reaction

In this Reaction $\Delta G < 0$ [-ve] that means Reaction is Spontainous Reaction.



According to Speed of Reaction,

Reaction are of 3 Types :-

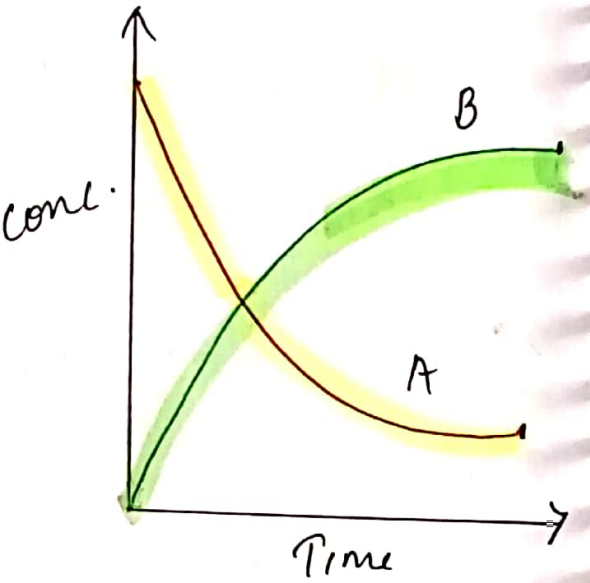
fast Reaction	Moderate Reaction	Slow Reaction
Very Very fast Example :- Neutrilisation • $NaOH + HCl \rightarrow NaCl + H_2O$	very or Moderate Speed. Example :- curding of Milk.	Very very slow. Example - Rusting of Iron

→ Rate of Reaction

"The Change in concentration of Reactant or Product with respect to time that is called Rate of Reaction."

$$A \longrightarrow B$$

	A_0	B_0
At $t = 0$	100%	0%
$t = t_1 = t_1$	A_1	B_1
$t = t_2$	A_2	B_2
$t = t_3$	A_3	B_3



* Rate of Reaction / ror / ROR / rate / r

$$r = \frac{\text{change in Concentration}}{\text{change in time}}$$

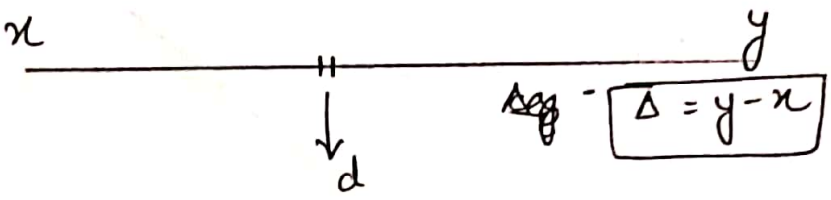
$$r = \frac{\Delta[\ ]}{\Delta t}$$

Concentration / Molarity / [ ] / C

$[\ ] = \frac{\text{mole}}{\text{volume}}$

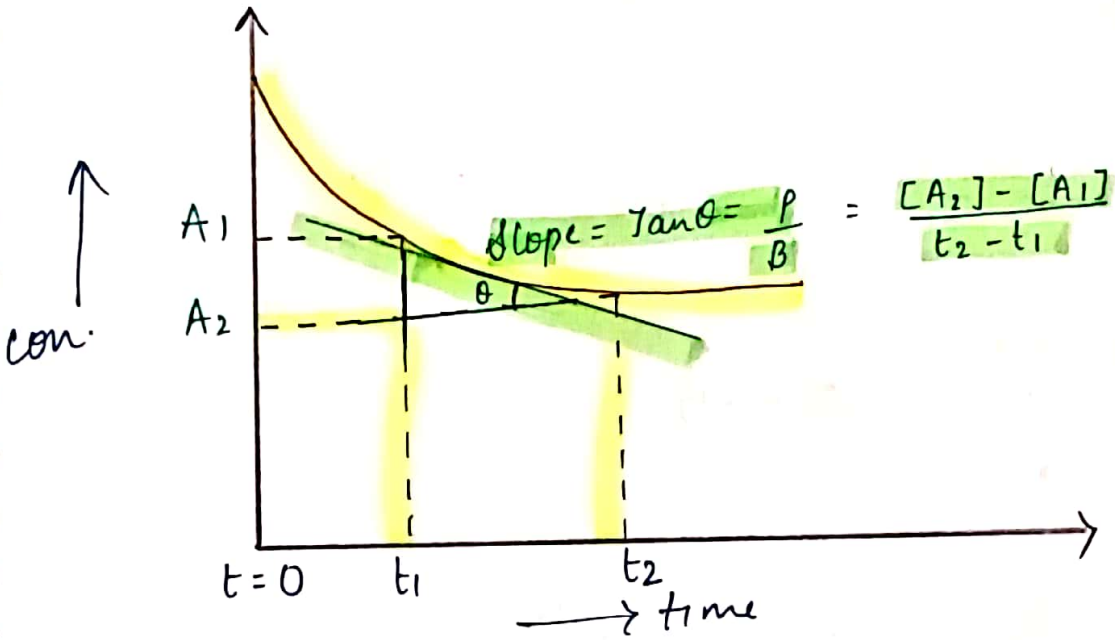
Δ chang = final - intial

$\lim_{t \to 0} \Delta \to d$ ↓ instanious



Graph $A \to B$

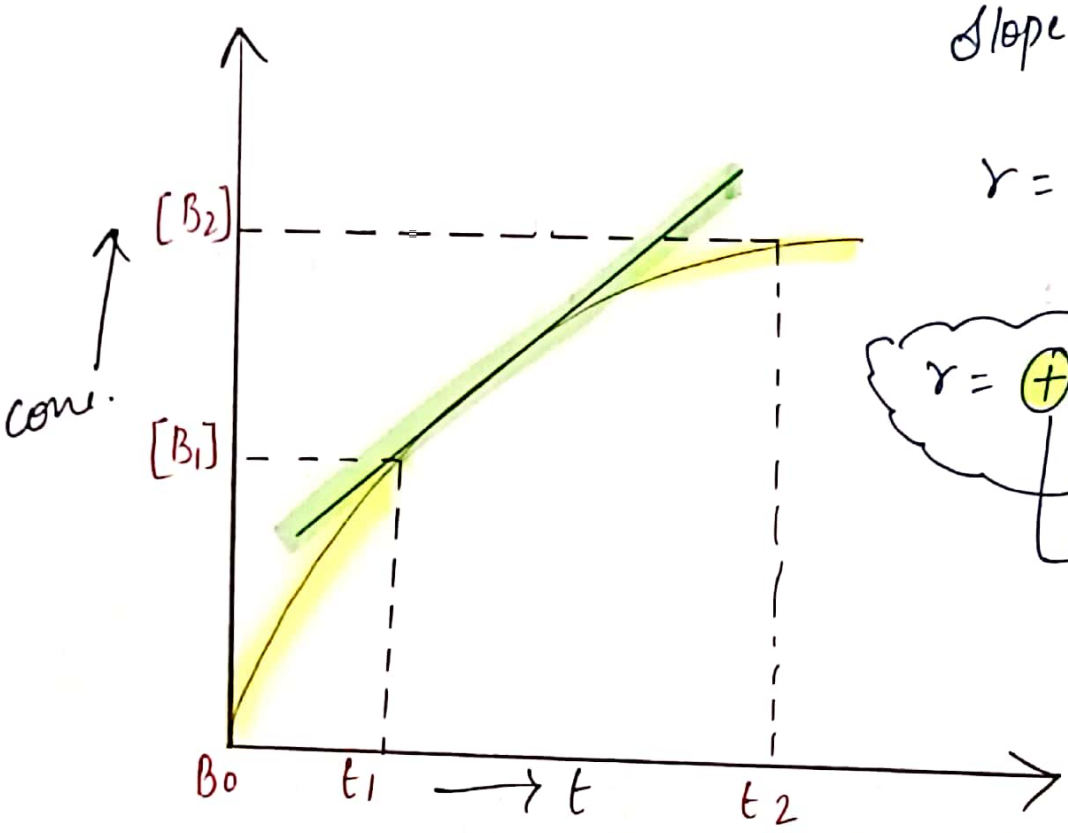
Reactant



γ → rate of Reaction

$\gamma = -\frac{\Delta[A]}{\Delta t}$ [-ve means reactant]

for Product



$$\text{Slope} = \tan\theta = \frac{P}{B}$$

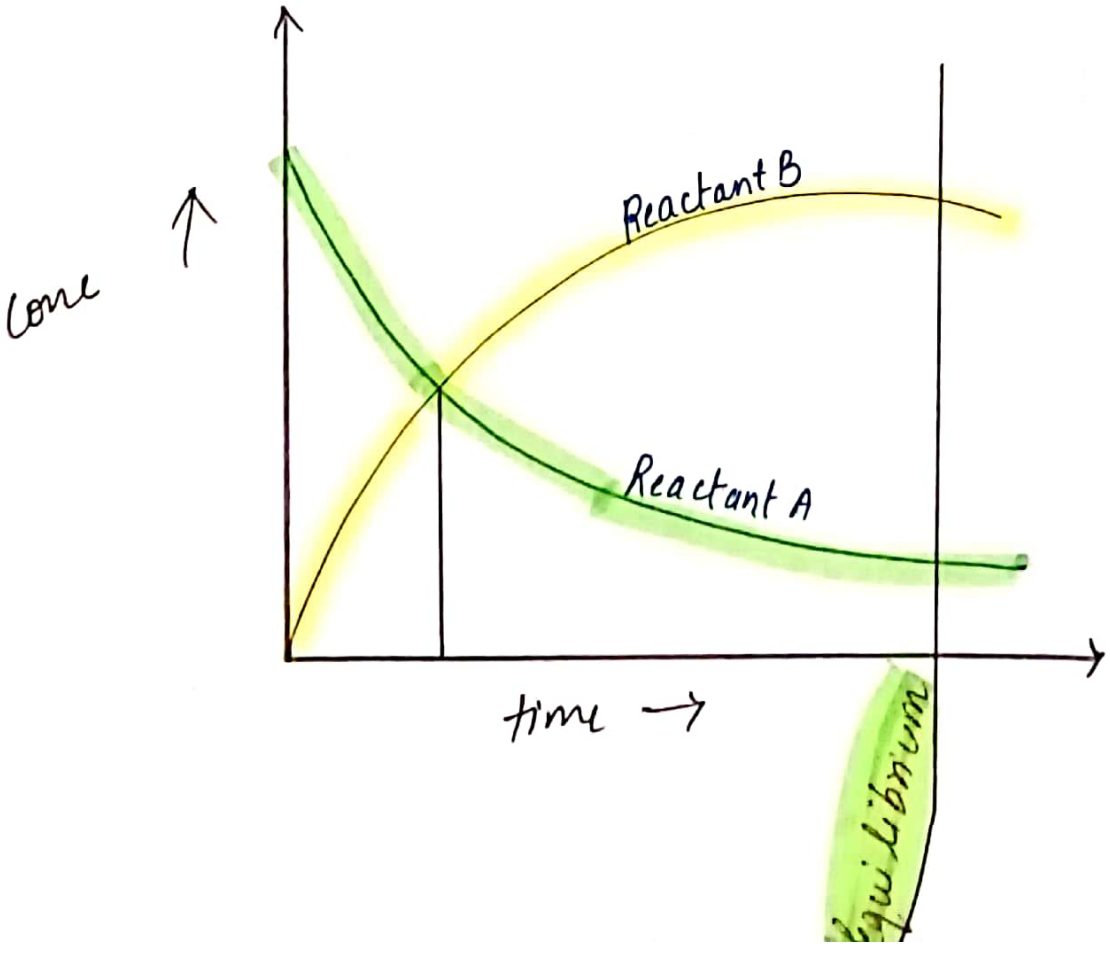
$$r = \frac{B_2 - B_1}{t_2 - t_1}$$

$$r = (+)\frac{\Delta[B]}{\Delta t}$$

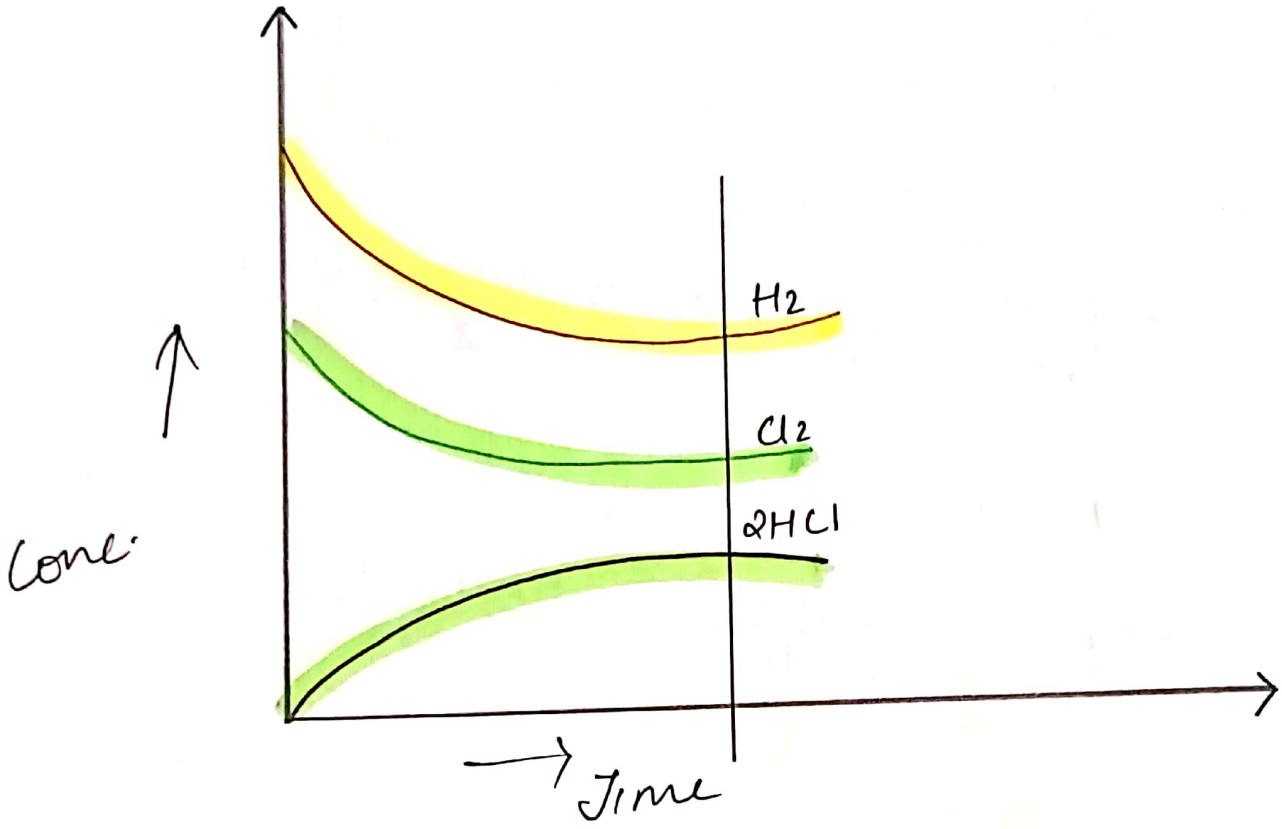
→ Jam Product.

Combine Graph

$A \rightarrow B$



Example - $H_2 + Cl_2 \rightarrow 2HCl$



Rate of Reaction

① $A \rightarrow B$

$$r = -\frac{\Delta[A]}{\Delta t} = +\frac{\Delta[B]}{\Delta t}$$

② $2A \rightarrow 4B$

$$r = \frac{-1}{2}\frac{\Delta[A]}{\Delta t} = +\frac{1}{4}\frac{\Delta[B]}{\Delta t}$$

Instanious

$3A \rightarrow 5B$ $\quad r = -\frac{1}{3}\frac{d[A]}{dt} = +\frac{1}{5}\frac{d[B]}{dt}$

Qu.1 $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$

$$r = -\frac{d[H_2]}{dt} - \frac{d[Cl_2]}{dt} = +\frac{1}{2}\frac{d[HCl]}{dt}$$

Qu.2 $N_2(g) + 2O_2 \rightarrow 2NO_2$

$$r = -\frac{d[N_2]}{dt} - \frac{1}{2}\frac{d[O_2]}{dt} = +\frac{1}{2}\frac{d[NO_2]}{dt}$$

Qu.3 $N_2 + 3H_2 \rightarrow 2NH_3$

$$r = -\frac{d[N_2]}{dt} - \frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

8/05/2025

Rate of Reaction

$$\text{Average} = \mp \frac{\text{Change in concentration}}{\text{change in time}} = \mp \frac{\Delta[\ ]}{\Delta t}$$

$$\text{Instantaniows} = \mp \frac{\text{Change in concentration}}{\text{change in time}} = \mp \frac{d[\ ]}{dt}$$

25 Stars

$$5Br^-_{(aq)} + BrO_3^-{}_{(aq)} + 6H^+_{(aq)} \longrightarrow 3Br_{2(aq)} + 3H_2O_{(l)}$$

Average Rate $= -\frac{1}{5}\frac{\Delta[Br^-]}{\Delta t} = -\frac{\Delta[BrO_3^-]}{\Delta t} = -\frac{1}{6}\frac{\Delta[H^+]}{\Delta t} = +\frac{1}{3}\frac{\Delta[Br_2]}{\Delta t}$

$= +\frac{1}{3}\frac{\Delta[H_2O]}{\Delta t}$

Instantaneous Reaction :-

$$-\frac{1}{5}\frac{d[Br^-]}{dt} = -\frac{d[BrO_3]}{dt} = -\frac{1}{6}\frac{d[H^+]}{dt} = +\frac{1}{3}\frac{d[Br_2]}{dt}$$

$$= +\frac{1}{3}\frac{d[H_2O]}{dt}$$

$\Delta \rightarrow$ अंतर $d \rightarrow$ differentiation

$$2A \longrightarrow 4B$$

$$r = -\frac{1}{2}\frac{[A]}{dt} = +\frac{1}{4}\frac{d[B]}{dt}$$

50 stars

Rate of Appearance → product

$+\frac{d}{dt}$

Rate of Disappearance → Reactant

$-\frac{d}{dt}$

rate of appearance of $B = +\frac{d}{dt}[B]$

rate of disappearance of $C = -\frac{d}{dt}[C]$

rate of appearance of $N = +\frac{d[N]}{dt}$

$\frac{2A}{x\,r} + \frac{4B}{x\,r} \longrightarrow \frac{9C}{x\,r}$

(1) Rate of Reaction :- $r = -\frac{1}{2}\frac{d[A]}{dt} = -\frac{1}{4}\frac{d[B]}{dt} = +\frac{1}{9}\frac{d[C]}{dt}$

(2) Rate of Disappearance A = $2r$

(3) Rate of Disappearance of B = $4r$

(4) Rate of Disappearance of C = $9r$

Qu. 1) $3C + 4B \rightarrow 8D$

[At Product, rate = rate / coefficient]

rate of appearance of $D = \frac{80}{8} = 10$

rate of disappearance of $B = 4 \times 10 = 40$

rate of disappearance of $C = 3 \times 10 = 30$

DPP - (2)

Qu. 1)

$$2N_2O_5 \rightarrow 4NO_2 + O_2$$

$$\frac{\text{Change in concentration of } NO_2}{\text{Change in time}} = \frac{1.6 \times 10^{-2} M}{4 \text{ sec}} =$$

rate of formation of $NO_2 = 0.4 \times 10^{-2} = 4 \times 10^{-3} MS^{-1}$

Qu. 2)

$$2HI \rightarrow H_2 + I_2$$

Opt (2) $= -\frac{1}{2}\frac{d[HI]}{dt} = \frac{d[H_2]}{dt} = \frac{d[I_2]}{dt}$

Qu. 3)

$$+\frac{1}{2}\frac{\Delta[C]}{\Delta t} = +\frac{1}{3}\frac{\Delta[D]}{\Delta t}$$

On comparing

$$4A + B \rightarrow 2C + 3D$$

Qu.4) $A + 2B \longrightarrow 6C + 2D$

given, rate of disappearance of $A = 2.6 \times 10^{-2}\ Ms^{-1}$

rate of reaction for given equation,

$$r = -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = +\frac{1}{6}\frac{d[C]}{dt} = \frac{1}{2}\frac{d[D]}{dt}$$

$$-\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt}$$

rate of disappearance of $A = -\frac{d[A]}{dt} = 2.6 \times 10^{-2}\ Ms^{-1}$

$\therefore -\frac{1}{2}\frac{d[B]}{dt} = 2.6 \times 10^{-2}\ Ms^{-1}$

$-\frac{d}{dt}[B] = 5.2 \times 10^{-2}\ Ms^{-1}$

[rate of disappearance of $B = 5.2 \times 10^{-2}\ Ms^{-1}$]

Qu.5)

$$BrO_3^- \longrightarrow 3Br_2$$

$$-\frac{d}{dt}[BrO_3^-] = +\frac{1}{3}\frac{d}{dt}[Br_2]$$

Q 7) 50 stars

$N_2 + 3H_2 \longrightarrow 2NH_3$

rate of formation of NH_3 = 0.001 $Kg\ h^{-1}$

↳ rate = $\frac{0.001}{2}$ $Kg\ h^{-1}$

rate of Reaction = $\frac{0.001}{17 \times 2}$ $M\ hr^{-1}$

multiply with H_2 Coefficient = $\frac{3 \times 0.001}{17 \times 2}$ $M\ hr^{-1}$

H_2 के कारण

= $\frac{3 \times 0.001 \times 2}{17 \times 2}$

3 → no. of H_2 because answers in $Kg\ h^{-1}$

0.001 → Given in question

2 → for NO_2 to change rate of Reaction

17 → NH_3 का कारण molar mass because Kg/hr में दिया है

Q8)

(1) $-\frac{1}{3}\frac{d[A]}{dt} = -\frac{d[B]}{dt} = +\frac{d[C]}{dt} = +\frac{d[D]}{dt}$

Q9)

(2) 3×10^{-4} mol $L^{-1} s^{-1}$

10/05/25

Rate law

The Experiment Expression which relates the rate of reaction with concentration of the reactants. The constant of propotionality 'K' is known as rate constant

Or

Rate law is the expression in which reaction rate is given in terms of molar concentration of reactants with each term raised to some power which may or may not be same as the stoichiometric coefficient of the reacting species in a balanced chemical equation.

For Example -

$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$$

" The representations of rate of reaction in terms of concentration of the reactants is known as rate law. It is also called as rate Equation or rate Expression."

→ Rate Constant

The Rate of Reaction at unit concentration of reactant is called Rate Constant or Specific rate of reaction.

$$aA + bB \rightarrow cC + dD$$

$$r = K[A]^a [B]^b$$

As Per Defination for unit $a = 0$, $b = 0$

$$\boxed{r = K}$$

→ Rate of Reaction

→ Rate law

$2A \rightarrow 4B$ $\quad r = K[A]^2$

$5A + 6B \rightarrow 7C$ $\quad r = K[A]^5 [B]^6$

$\frac{1}{2}A + \frac{3}{4}B \rightarrow 6C$ $\quad r = K[A]^{\frac{1}{2}} [B]^{\frac{3}{4}}$

$H_2 + I_2 \rightarrow 2HI$ $\quad r = K[H_2][I_2]$

$N_2 + 3H_2 \rightarrow 2NH_3$ $\quad r = K[N_2][H_2]^3$

* Order of Reaction

The Sum of Power of concentration of reactants in the rate law Expression is known as Order of Reaction.

·) Order of Reaction is an experimental quantity.

·) Order of Reaction may be positive, negative, zero, fractionetc.

* Unit of K

① for Zero Order Reaction

$r = K[A]^0$

$\boxed{r = K} = mol\ L^{-1} sec^{-1}$

② For 1st Order

$A \longrightarrow B$

$rate = K[A]^1$

$r = K[A]$

$\frac{r}{[A]} = K$

$K = \frac{mol\ L^{-1} sec^{-1}}{mol\ L^{-1}}$

$\boxed{K = sec^{-1}}$

③ for 2nd Order

$A \rightarrow B$

$r = K[A]^2$

$mol\ L^{-1} s^{-1} = K[mol\ L^{-1}]^2$

$\frac{mol\ L^{-1} sec^{-1}}{mol^2\ L^{-2}} = K$

$\boxed{K = mol^{-1}\ L\ s^{-1}}$

(4) For n^{th} Order

$r = k[A]^n$, n = Order of Reaction

$$\frac{mol\ L^{-1} sec^{-1}}{mol^n\ L^{-n}} = k$$

$$k = mol^{1-n}\ L^{n-1}\ s^{-1}$$

DPP - 03

Qu.1)

$$A_2 + B_2 \rightarrow 2AB$$

$r = k[A_2]^a[B_2]^b$ — Eq (1)

Exp-(1) $0.04 = k[0.2]^a[0.2]^b$

Exp-(3) $0.08 = k[0.2]^a[0.4]^b$

Exp (3) $\div$ Exp (1)

$$\left(\frac{0.08}{0.04}\right) = \frac{k}{k}\left(\frac{[0.2]^a}{[0.2]^a}\right)\left(\frac{[0.4]^b}{[0.4]^b}\right)$$

$$2 = 1\ (1)^a (2)^b$$

$$(2)^1 = (2)^b$$

$$\boxed{b = 1}$$

$$\frac{Exp.3}{Exp.2} \quad \frac{(0.08)}{(0.04)} = \frac{K}{K} \frac{[0.2]^a}{[0.1]^a} \quad \frac{[0.4]^b}{[0.4]^b}$$

$$\boxed{a = 1}$$

Qu.2)

$$r = K[A]^{\frac{1}{2}}[B]^2$$

↓ 4 times ↳ 2 times

$$r_{new} = K[4A]^{\frac{1}{2}}[2B]^2$$

$$\frac{r}{r_{new}} = \frac{K[A]^{\frac{1}{2}}[B]^2}{K[4A]^{1/2}[2B^2]} = \frac{1}{(4)^{1/2}(2)^2} = \frac{1}{(2^2)^{\frac{1}{2}}(2)^2}$$

4

$$\frac{r}{r_{new}} = \frac{1}{8}$$

$$\boxed{r_{new} = 8r}$$

Order of Reaction is an experimental value

Qu.3)

$A + B \rightarrow$ Product

$$r = K[A]^x[B]^y$$

$$\frac{\text{Experiment 2)}}{\text{Experiment 1)}} \quad \frac{4}{4} = \frac{K(2)^x(2)^y}{K(1)^x(2)^y}$$

$$1 = 1(2)^x$$

$$(2)^0 = (2)^x \qquad \boxed{x = 0}$$

Experiment -3 / Experiment - 2

$$\frac{16}{4} = \frac{K}{K}\frac{[2]^x}{(2)^x}\frac{(4)^y}{(2)^y}$$

$$4 = (2)^y$$

$$(2)^2 = (2)^y$$

$$\boxed{y = 2}$$

Qu. 4)

$$2A + B \rightarrow \text{products}$$

$$r = k[A]^2[B]^1$$

For A:- $r' = k[2A]^2[B]$

$$\frac{r}{r'} = \frac{k[A]^2[B]}{k[2A]^2[B]}$$

$$\frac{r}{r'} = \frac{1}{4}$$

$$\boxed{r' = 4r}$$

Qu 5)

(3) Twice the rate that B will decrease

Qu. 6) $r = k[A][B]$

$$r = k\frac{n_A}{V}\cdot\frac{n_B}{V} = k\frac{n}{\frac{1}{4}}\frac{n_B}{\frac{1}{4}}$$

$$V = \frac{1}{4}$$

$$r \propto \frac{1}{V}$$

$$\boxed{r = 16}$$

Qu. 7)

$$2A + B \rightarrow A_2B$$

$$\frac{r}{r'} = \frac{K[A]^2[B]}{K[2A]^2[B]}$$

$$\frac{r}{r'} = \frac{1}{2}$$

$$\boxed{r' = 2r}$$

Qu. 8)

$$r = K(P)^{\frac{3}{2}} \qquad r = \text{mol } L^{-1} \text{min}^{-1}$$

$$\boxed{r = \text{bar } s^{-1}}$$

$$\text{bar } s^{-1} = K(\text{bar})^{\frac{3}{2}}$$

$$K = \frac{\text{bar } s^{-1}}{\text{bar}^{3/2}} = \text{bar}^{-1/2}\, s^{-1}$$

$$\boxed{K = \text{bar}^{-\frac{1}{2}}\, s^{-1}}$$

Qu. 9) Order $= A^{1/2} B^{1/3} C^{1/4}$

$$= \frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \boxed{\text{Order} = \frac{13}{12}}$$

Qu. 11)

for Zero Order

(4) 0

13/05/2025

Molecularity of the reaction

The total number of molecules, atoms, ions [reacting species] participating in an elementary reaction is called it's Molecularity.

Molecularity is a theoritical value.

Molecularity can be an integer [1, 2, 3] but it cannot be zero, negative or fraction

In an Elementary Reaction molecularity is equal to it's order.

In the complex reaction molecularity of each step of mechanism define Separately.

Total Molecularity of complex reaction is meaning less.

In the complex reaction, molecularity is defined by the slowest step

The maximum value of molecularity is 3, Because it is not possible to create effective collision for more than 3 molecules. It is very rare.

→ Elementary Reaction

A Reaction which completes in single step is called Elementary Reaction.

Zero Orders Rxn can never be Elementary Reaction

For Elementary Reaction fraction Order are not possible.

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

$r = K[A][B]$ Order = 2

molecularity = 2

Complex Reaction

Those Reaction which can complete in multiple steps that is called complex Reaction.

This type of Reaction conduct by mechanism.

For the complex Reaction the overall reaction rate and order controlled by slowest step. This slowest step are called Rate Determination step [RDS].

The Rate law expression, order depend on the concentration of reactant of slowest step. which must be free from intermediate.

In RDS the value in the form of intermediate can be solved by the above fast Reaction by solving in term of [Equilibrium].

Mechanism of complex reaction

Example ①

$2NO_2Cl \longrightarrow 2NO_2 + Cl_2$

① $NO_2Cl \rightarrow NO_2 + Cl$ [Slow step, RDS]

② $NO_2Cl + Cl \rightarrow NO_2 + Cl_2$ [Fast step]

$r = K[NO_2Cl]$

So, Order = 1

② $2NO + 2H_2 \rightarrow N_2 + 2H_2O$

Step ① fast step $2NO \underset{k_b}{\overset{k_f}{\rightleftharpoons}} N_2O_2$

Step ② → Slow step → RDS

$N_2O_2 + H_2 \rightarrow N_2O + H_2O$

Step-③ fast step

$N_2O + H_2 \rightarrow N_2 + H_2O$

$r = K[N_2O_2][H_2]$

$r = k_f[NO]^2$ — ①

$r = k_b[N_2O_2]$ — ②

Equating eq ① and ②

$k_f[NO]^2 = k_b[N_2O_2]$

$\frac{k_f}{k_b}[NO]^2 = N_2O_2 = (III)$

$r = \frac{k \cdot K_f}{k_b} [NO]^2 [H_2]$

$r = K \cdot K_{eq} \cdot [NO_2]^2 [H_2]$ $\left[\frac{K_f}{k_b} = K_{eq}\right]$

$r = K' [NO]^2 [H_2]$

Order = 3

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Qu ①

$2A + B \rightarrow$ Product

$A + B \rightarrow C + D$ [slow step) RDS]

$A + C \rightarrow E$ [Fast]

$r = K[B][A]$

Order = 2

Qu. 2

$A_2 + B_2 \rightarrow 2AB$

$A_2 \underset{k_b}{\overset{K_f}{\rightleftharpoons}} A + A$ [Fast] - I

$A + B_2 \rightarrow AB + B$ [Slow]

$r = K[A][B_2]$

$\frac{K_f}{k_b} = K_{equi}$

$r \overset{eq(I)}{=} K_f [A_2]$ - II

$r = k_b [A]^2$ - III

Divide (II) and (III)

$1 = K_{equ} \frac{[A_2]}{[A]^2}$

$A^2 = K_{eq} [A_2]$

$A = \sqrt{K_{eq} [A_2]}$

$A = (K_{eq} [A_2])^{1/2}$

$r = K\ K_{equ}\ [A_2]^{\frac{1}{2}}[B_2]$

Order = $\frac{3}{2}$

Que. 3 $2A + B \rightarrow P$

$2A \underset{k_b}{\overset{k_f}{\rightleftharpoons}} A_2$ [Fast]

$A_2 + B \rightarrow P$ [Slow]

$r = k[A_2][B]$

$k_f [A]^2 = k_b [A_2]$

$\frac{k_f}{k_b}[A]^2 = [A_2]$ — (1)

$r = K_{equ} \cdot K\ [A]^2[B]$

$r = K'[A]^2[B]$

Order = 3

(NCERT Assign)
Que. 136 $H_2 + ICl \rightarrow$ Slow

$H_2 + 2ICl$

$r = K[H_2][ICl]$

Order = 2

Que. 137
Recently Solved

Order = $\frac{3}{2}$

Pg 71 Sec (G and H) – 4 Ques

Exercise - ②

Que. 18)

$X_2 + Y_2 \rightarrow 2XY$

$X_2 \underset{k_b}{\overset{k_f}{\rightleftharpoons}} 2X \quad \left[K_{eq.} = \frac{X_2}{[X]^2}\right]$

$X + Y_2 \rightarrow XY + Y \quad$ [Slow Step]

$r = k[X \exists [Y_2]$

$X = \sqrt{K_{eq}[X_2]}$

$X = (K_{eq}[X_2])^{\frac{1}{2}}$

$r = K'[X_2]^{\frac{1}{2}}[Y_2]$

Order $= \frac{3}{2}$

Pg - 78 Q. 21, 54, 55, 63, 71, 189, 199, 210, 266, 322, 325, 336, 345.

* Pseudo First Order reaction

If Chemical Rxn in which value of order of reaction is 1, but molecularity is more than 1.

Example - Hydrolysis of Ester in Acidic Medium

$$C_2H_5COOCH_3 + H_2O \longrightarrow C_2H_5COOH + CH_3-OH$$

$$r = k\,[C_2H_5COOCH_3]\,[H_2O]$$

So H_2O Act as solvent.

Correct $\{ r = k\,[C_2H_5COOCH_3]$

If Reactant is excess so, we don't have to write in ROR

Ex. (2) Inversion of cane Sugar

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow \underset{\text{(Glucose)}}{C_6H_{12}O_6} + \underset{\text{(fructose)}}{C_6H_{12}O_6}$$

If any reactant are present in excess amount so we can remove that reactant in rate of reaction because it's change in concentration are negligable.

$$r = k\,[C_{12}H_{22}O_{11}]\,[H_2O]$$

$$r = k'\,[C_{12}H_{22}O_{11}]$$

$$\boxed{k' = k\,[H_2O]}$$

15/05/2025

Integrated Rate Equation

#NCERT

#NCERT

- Zero Order
- First Order Reaction
- 2nd Order Reaction

Integrated rate equation of zero order Reaction

$A \rightarrow B$

$r = K[A]^0$ — (I) $r = -\frac{d[A]}{dt}$ — (II)

$-\frac{d[A]}{dt} = K[A]^0$

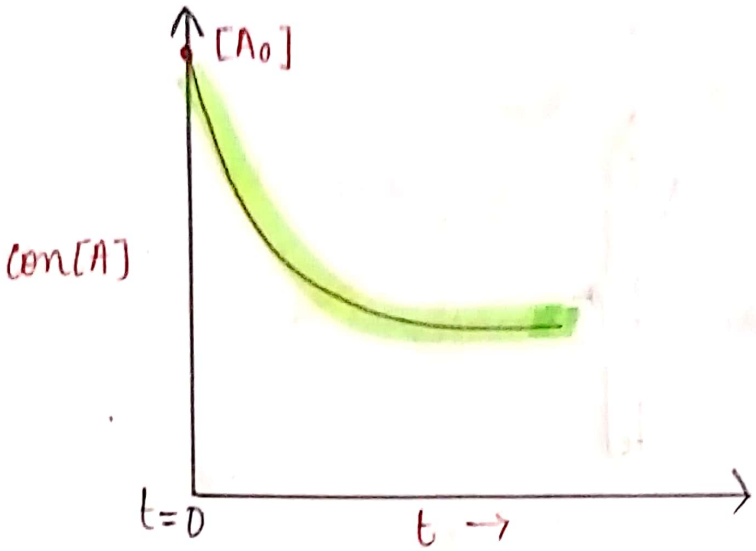
$-d[A] = K \cdot dt$

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

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

$[A] = -Kt + C$ $C = [A_0]$

↳ Integration constant



$[A] = -Kt + [A_0]$

$Kt = [A_0] - [A]$

$$K = \frac{[A_0] - [A]}{t}$$

Value of K for Integrated rate equation of zero order Reaction

$t_{\frac{1}{2}}$ = half life

70 year → 35 year

Reaction → initial → half

$t_{\frac{1}{2}}$ = half life

A = final = $\frac{A_0}{2}$

A_0 = initial

$$K = \frac{A_0 - \frac{A_0}{2}}{\frac{t_{1/2}}{2}}$$

So, $$t_{12} = \frac{A_0}{2K}$$

half life of Zero Order Rxn

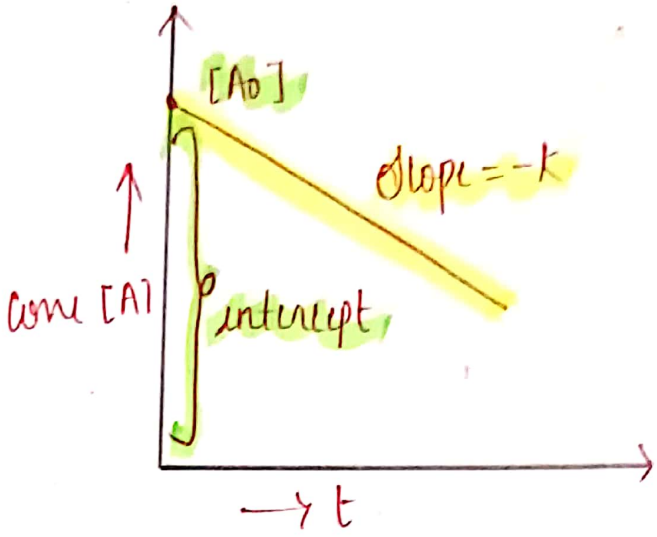
Graph

① A and t

$A = -kt + c$

$A = -kt + A_0$

Comparing , $y = mx + c$

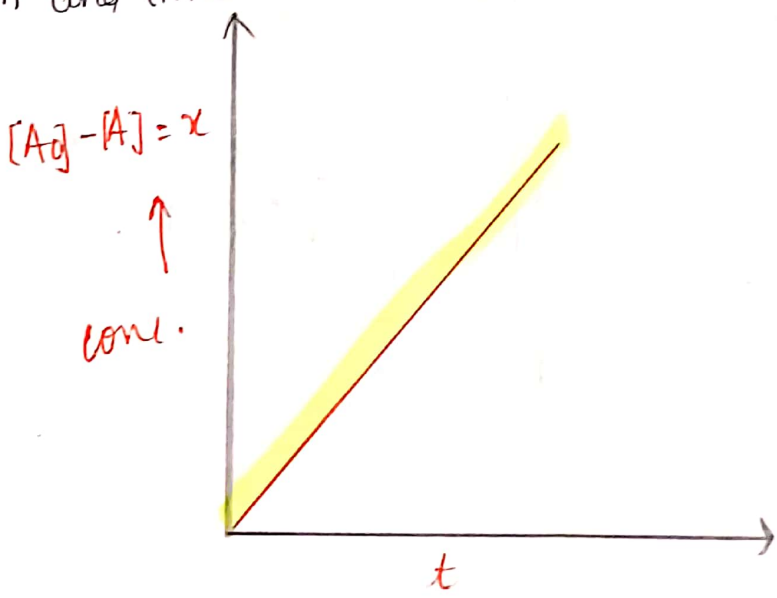


② Change in concentration and time

$A = -kt + A_0$

$kt = A_0 - A$

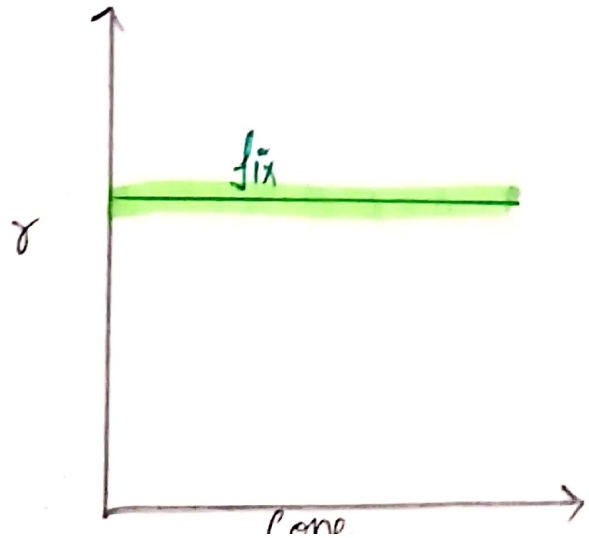
As, $t \propto [A]$



③ rate and concentration

r $[A]$ $r = k[A_0]^0$

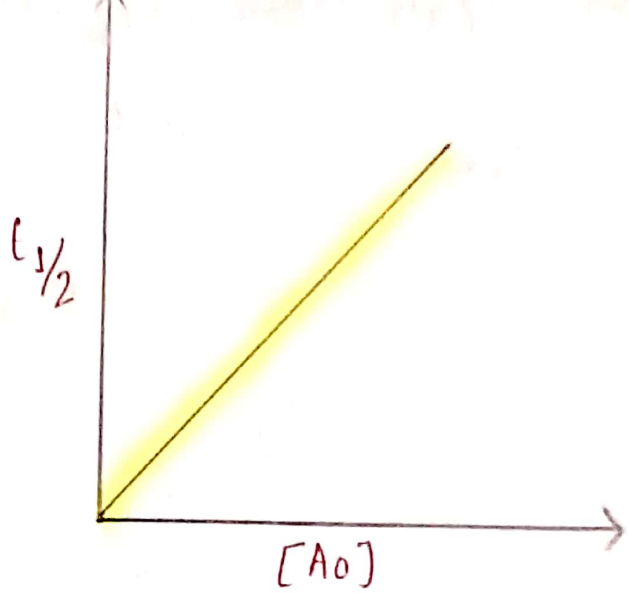
$r = k$ (constant)



(4) Half Life and Concentration

$t_{1/2} = \frac{A_0}{2k}$

$A_0 \propto t_{1/2}$, $t_{1/2} \propto A_0$



Examples of Zero order Reaction

(1) $H_2(g) + Cl_2(g) \xrightarrow[U.V]{h\nu} 2HCl(g)$

#NCERT

(2) $2NH_3 \xrightarrow[1130\ K]{Pt} N_2(g) + 3H_2(g)$

(3) Reaction Between Acetone and Bromine

$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + Br_2$

NCERT

(4) Thermal decomposition of HI in Gold Surface

(5) The process of Adsorption of gases in metal Surface

Calculation of log

$\int \frac{1}{x} \cdot dx = \ln x$

log

$\log_{10} = \log$

$\log_e = \ln$

$\log_e x = 2.303 \log_{10} x$

Basic → for both log

$\log(x \cdot y) = \log x + \log y$

$\log\left(\frac{x}{y}\right) = \log x - \log y$

$\log x^y = y \log x$

Value of $\log_{10}$

→ $\log_{10} 1 = 0$

→ $\log_{10} 2 = 0.3010$

→ $\log_{10} 3 = 0.477$

→ $\log_{10} 4 = \log_{10} 2^2 = 2\log 2 = 2 \times 0.3010 =$

→ $\log_{10} 5 = 0.69$

→ $\log_{10} 6 = \log(2 \times 3) = \log 2 + \log 3 = 0.3010 + 0.477$

$\log_{10} 6 =$

→ $\log_{10} 7 = 0.84$

→ $\log_{10} 9 = \log 3^2 = 2\log 3 = 2 \times (0.477)$

→ $\log_{10} 10 = 1$

0	0.3010	0.477	0.69	0.84	1
↑	↑	↑	↑	↑	↑
$\log_{10} 1$	$\log_{10} 2$	$\log_{10} 3$	$\log_{10} 5$	$\log_{10} 7$	$\log_{10} 10$

Integrate rate Equation of first Order Reaction

$A \rightarrow B$

$r = k[A]^1$ - (I) $\qquad r = -\frac{d[A]}{dt}$ - (II)

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

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

$$\int \frac{1}{[A]} \cdot d[A] = \int -k \cdot dt$$

$\because$ since $\int \frac{1}{x} \cdot dx = \ln x$

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

at $t = 0$, $c = \ln[A_0]$

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

$$kt = \ln[A_0] - \ln[A]$$

$\because$ Since $\log \frac{x}{y} = \log x - \log y$

$$K = \frac{2.303}{t} \cdot \log_{10} \frac{[A_0]}{[A]}$$

Value of K for 1st Order Rxn in Integrated Rate Equation

Half life

$A \rightarrow \frac{A_0}{2}$

$$K = \frac{2.303}{t_{1/2}} \log_{10} \frac{A_0}{\frac{A_0}{2}}$$

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

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

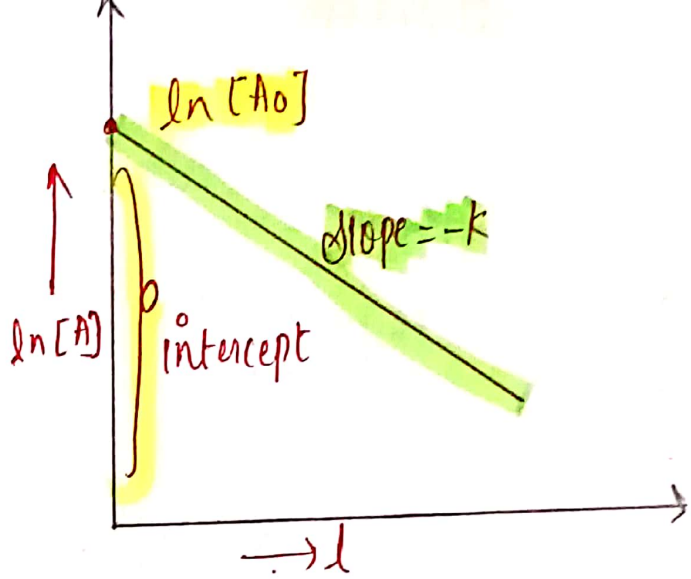
Half life for 1st Order Reaction

Graph

① A and t

$\ln [A] = -kt + \ln [A_0]$

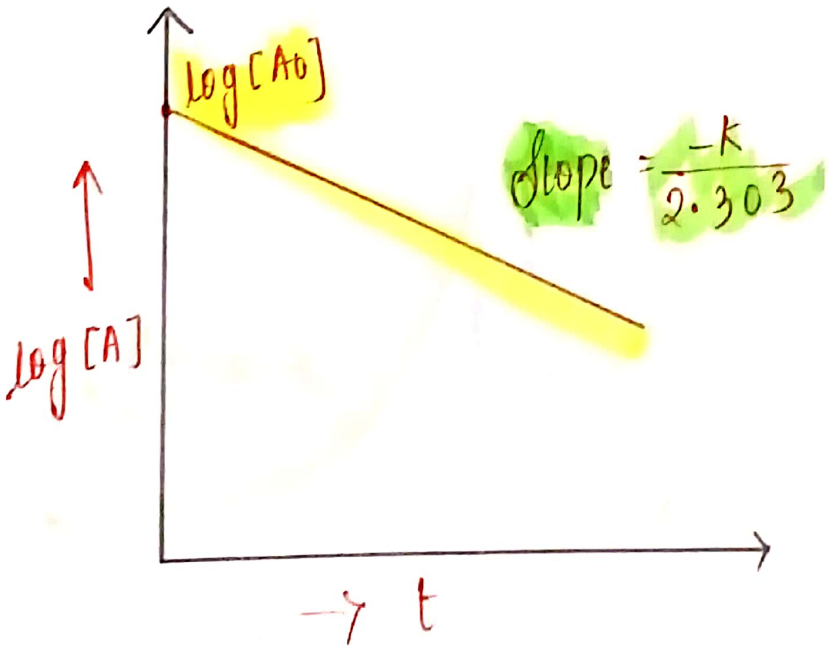
comparing, $y = mx + c$



② $2.303 \log_{10} [A] = -kt + 2.303 \log_{10} [A_0]$

$\log_{10} [A] = \frac{-kt}{2.303} + \log_{10} [A_0]$

comparing, $y = mx + c$

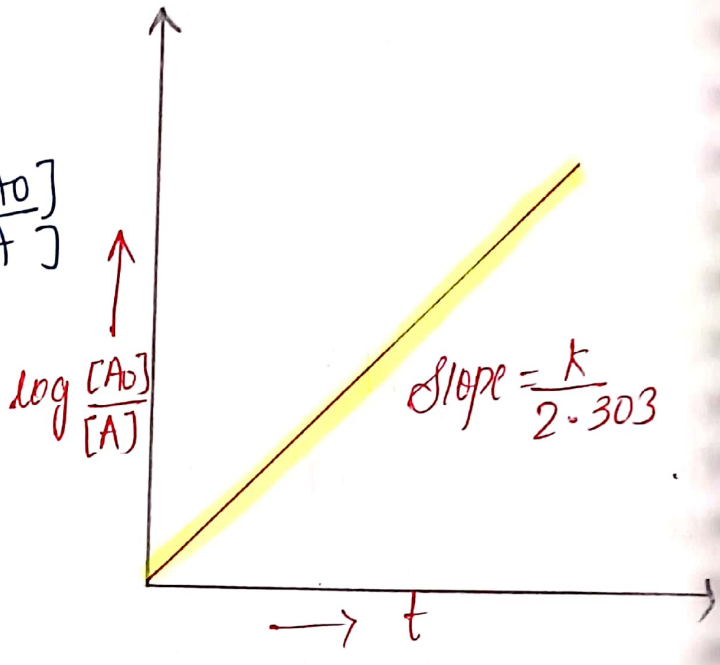


#③ SD stars

$$\log_{10}[A_0] = \frac{-kt}{2.303} + \log_{10}[A_0]$$

$$\frac{Kt}{2.303} = \log_{10}\frac{[A_0]}{[A]}$$

$$t \propto \log\frac{[A_0]}{[A]}$$



④ $\ln[A] = -kt + \ln[A_0]$

$\ln[A] - \ln[A_0] = -kt$

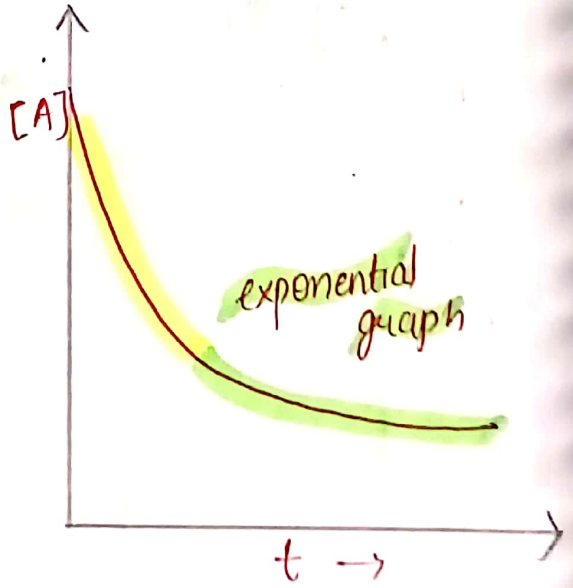
$$\ln\frac{[A]}{[A_0]} = -kt$$

As, $\frac{1}{\ln}x = e^x$

$$\frac{[A]}{[A_0]} = \frac{1}{\ln}\cdot(-kt)$$

$$\frac{[A]}{[A_0]} = e^{-kt}$$

$$A = A_0 e^{-kt}$$



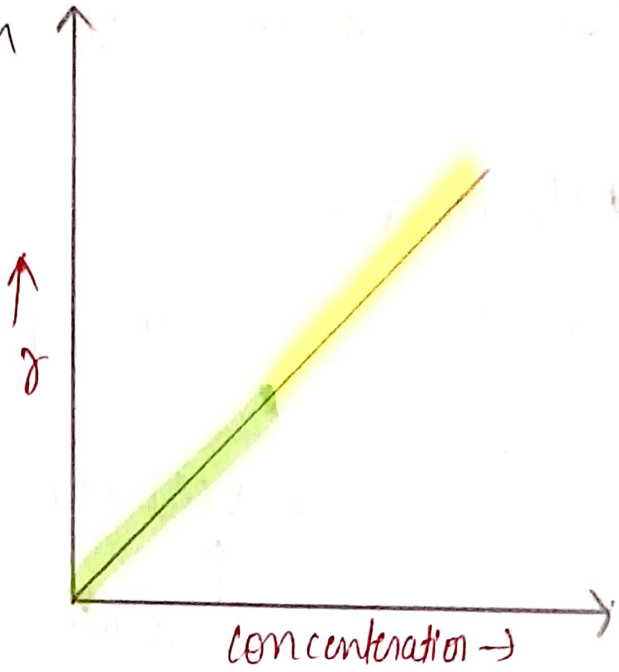
(5) rate and concentration

(1) [A]

$r = K[A]$

$r = K[A]^1$

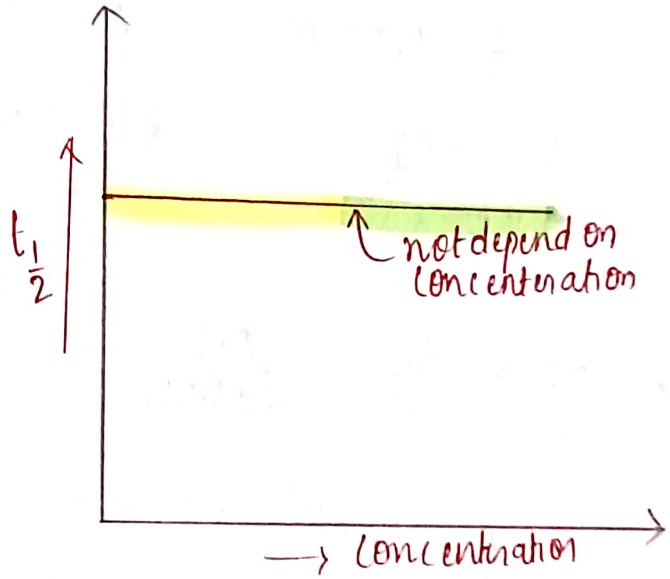
$r \propto [A]$



100 Stars

(6) $t_{\frac{1}{2}}$ and [A]

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



Examples

(1) $2N_2O_5 \longrightarrow 4NO_2 + O_2$ NCERT

(2) $NH_4NO_2 \longrightarrow N_2 + 2H_2O$ NCERT

(3) $CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$ NCERT

(4) $2H_2O_2 \rightarrow 2H_2O + O_2$

(5) Radio Activity decay

(6) Hydrogenation of Ethane $C_2H_4 + H_2 \rightarrow C_2H_6$

(7) Decomposition of N_2O

17/05/2025

Pg-20 OPP-05

(Qu 1) $r = K[A]^2[B]$

↑ excess amount

$r = K[B]^1$ Order = 1

(Qu 2) $A = 0.08$ M $A_0 = 0.1$ M $t = 10$ min

$K = \frac{[A_0]-[A]}{t}$ $K = \frac{0.1-0.08}{10} = \frac{0.02}{10}$

$K = 0.002$

So, $t_{\frac{1}{2}} = \frac{A_0}{2K} = \frac{0.1}{2 \times 0.002}$

$t_{\frac{1}{2}} = \frac{1 \times 10^2}{4} = 25$ min

For complete $t = \frac{A_0 - A}{K} = \frac{0.1 - 0}{0.002} = \frac{1 \times 10^2}{2} = \frac{100}{2} = 50$

$t = 50$ min

Opt 3 [25 min, 50 min]

Qu.3 $K = 2 \times 10^{-2}$

$A_0 = ?$ $\quad K = \frac{A_0 - A}{t}$ → 0.5, → 25 sec

$2 \times 10^{-2} \times 25 = A_0 - 0.5$

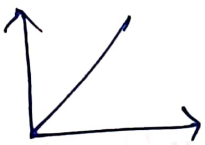
$0.5 + 0.5 = A_0$

$\boxed{A_0 = 1\ M}$

Qu.4 unit $mol\ L^{-1} sec^{-1}$

↳ Zero Order

Qu.5 For zero order, $\boxed{t \propto A}$



So, Zero Order

Qu.6 $\frac{dx}{dt} = K[A]^0$

Qu.7 conc. $time^{-1}$

Qu.8 $r = K[\ ]^{s-1}$ rate doesn't depend upon conc.

r = conc sec^{-1}

$r \propto [A]^0$

$r = 1$

OPP-06 Pg = 22

Qu.1 $t_{\frac{1}{2}} \propto a$ $t_{\frac{1}{2}} \propto a^0$

Qu.2 to → 1 day by → 24

$A_0 = 100\%$

$A = 90\%$

$A = 10\%$

$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{A}$ → 100%, → 10.1

$K = \frac{2.303}{t}$ = for half life $t_{1/2} = \frac{0.693}{K}$

$K = \frac{0.693}{t_{\frac{1}{2}}} = \frac{0.693}{10}$

$K = \frac{2.303}{0.693} \times 10$ $K = 33.22$ min

So, 33 min

Qu3 75 complete in 100 min

$A = 25\%$

$A_0 = 100\%$

$t = 100$ min

$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{[A]}$

$K = \frac{2.303}{100} \cdot \log_{10} \frac{100}{25}$

87.5% completing in t = ?

$A_0 = 100\%$

$A = 12.5\%$

$t = ?$

$K = \frac{2.303}{t} \log_{10} \frac{100}{12.5}$

$$\frac{2.303}{100} \log_{10} 4 = \frac{2.303}{t} \log_{10} 8$$

$$\frac{1}{100} \times \log_{10} 2^2 = \frac{1}{t} \cdot \log 2^3$$

$$\frac{2}{100} \log 2 = \frac{3}{t} \log_{10} t$$

$$t = \frac{300}{2} = 150 \text{ min}$$

$$t = 150 \text{ min}$$

Qu. 4 $K = ?$ $\quad t_{\frac{1}{2}} = 480$ sec

$$K = \frac{0.693}{t_{\frac{1}{2}}} = \frac{0.693}{480}$$

$$K = 1.44 \times 10^{-3} \text{ sec}^{-1}$$

Qu. 5

$A_0 = 100\%$

$A = 10\%$

$t = 10$ hr

$$K = \frac{2.303}{t} \log_{10} \frac{A_0}{A}$$

$$= \frac{2.303}{10 \text{ hr}} \log_{10} \frac{100}{10}$$

$A_0 = 100\%$

$A = 0.1$

$t = ?$

$$\frac{2.303}{x \text{ hr}} \cdot \log_{10} \frac{100}{0.1} = \left[\log 1000 = 10^3\right]$$

$$\frac{1}{10} = \frac{x}{3}$$

$$\boxed{x = 30 \text{ hr}}$$

Ilm 6

for 1st

$A_0 = 100\%$

$A = 80\%$

$t = 5\ min$

for 2nd

$A_0 = 100\%$

$A = 40\%$

$t = ?$

$$K = \frac{2.303}{t} \cdot \log_{10} \frac{A_0}{A}$$

$$\frac{2.303}{5\ min} \cdot \log_{10} \frac{100}{80} \quad | \quad \frac{2.303}{t} \log_{10} \frac{100}{40}$$

$$\frac{1}{5}(\log 10 - \log 8) = \frac{1}{t} \log 10 - \log 4$$

$$\frac{1}{5}(1 - 3 \times 0.30) = \frac{1}{t}(1 - 2 \times 0.30)$$

$$\frac{1}{5} \times 0.1 = \frac{1}{t} \times 0.4$$

$$t = \frac{5 \times 0.4}{0.1}$$

$t = 20\ min$

Qu 7 (3) $0.1155\ min^{-1}$

half life = 6 min

$$K = \frac{0.693}{6} = 0.1155\ min^{-1}$$

Qu 8 90% complete in 40 min

$A_0 = 100\%$ $A = 10\%$ $t = 40$ min

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

$$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{[A]}$$

$$K = \frac{2.303}{40} \log_{10} \frac{100}{10}$$

$$t_{1/2} = \frac{0.693 \times 40}{2.303} = 12\ min$$

NEW CONCEPT

$$A(g) \longrightarrow B(g) + C(g)$$

at $t = 0$ sec	P_i	0	0
at $t = t$ sec	$P_f = P_i - \alpha$	α	α

$$P_{Total} = P_i - \alpha + \alpha + \alpha$$

$$P_{Total} = P_i + \alpha$$

$$\alpha = P_{Total} - P_i$$

$$k = \frac{2.303}{t} \log_{10} \frac{P_i}{P_f}$$

$$k = \frac{2.303}{t} \log_{10} \frac{P_i}{P_i - (P_{Total} - P_i)}$$

$$k = \frac{2.303}{t} \cdot \log_{10} \frac{P_i}{P_i - P_{Total} + P_i}$$

$$k = \frac{2.303}{t} \log_{10} \frac{P_i}{2P_i - P_{Total}}$$

$2A \rightarrow B + 3C$

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

at $t=0$	P_i	0	0
$t=t$	$P_i - 2\alpha$	α	3α

$P_{Total} = P_i - 2\alpha + \alpha + 3\alpha$

$P_{Total} = P_i + 2\alpha$

$\alpha = \frac{P_{Total} - P_i}{2}$

$P_{final} = P_i - 2\alpha$

$P_{final} = P_i - 2\left(\frac{P_{Total} - P_i}{2}\right)$

$P_{Final} = P_i - P_{Total} + P_i$

$P_{final} = 2P_i - P_{Total}$

$$\left\{ K = \frac{2.303}{t} \log_{10} \frac{P_i}{2P_i - P_{Total}} \right\}$$

$A \rightarrow 2B + C$

at $t=0$	P_i	0	0
$t=t$	$P_i - \alpha$	2α	α

$$P_{Total} = P_i + 2\alpha$$

$$\alpha = \frac{P_{Total} - P_i}{2}$$

$$P_{final} = P_i - \alpha = P_i - \left(\frac{P_{Total} - P_i}{2}\right)$$

$$P_{final} = \frac{2P_i - P_{Total} + P_i}{2}$$

$$P_{final} = \frac{3P_i - P_{Total}}{2}$$

$$K = \frac{2.303}{t} \log_{10} \frac{2P_i}{3P_i - P_{Total}}$$

$2A \longrightarrow 2B + C$

$t=0$	P_i	0	0
$t=t$	$P_i - 2\alpha$	2α	α

$P_{Total} = P_i + \alpha$

$\alpha = P_{Total} - P_i$

$P_{final} = P_i - 2(P_T - P_i)$

$P_{Final} = P_i - 2P_T + 2P_i$

$P_{final} = 3P_i - 2P_T$

$$k = \frac{2.303}{t} \log_{10} \frac{P_i}{3P_i - 2P_{Total}}$$

Pg-24 OPP = 07

Qu.1

$r = k[A]^1$

$r = 4 \times 10^{-3} (0.02)$

$r = 0.08 \times 10^{-3}$

$\boxed{r = 8 \times 10^{-5}}$

Qu.2 $A_0 = 100\%$

$A = 25\%$

$t = 32$ min

$A_0 = 100\%$

$A = 50\%$

$t = ?$

$$k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$$

$$\frac{2.303}{32} \log_{10} \frac{100}{25} \quad | \quad \frac{2.303}{t} \lg_{10} \frac{100}{50}$$

$$\frac{1}{32} \cdot 2 \log 2 \quad | \quad \frac{1}{t} \log 2$$

$\boxed{t = 16 \text{ min}}$

Qu.3

(4) 1 and 3 both

Qu.4

$\frac{1}{4}$ life of 1st order

$A_0 = 1$

$\frac{1}{4}$ the end

$A = 1 - \frac{1}{4}$

$A = \frac{3}{4}$

$$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{[A]}$$

$$K = \frac{2.303}{t} \log_{10} \frac{4}{3}$$

opt (4) $$t = \frac{2.303}{K} \log_{10}\left(\frac{4}{3}\right)$$

Qu.5 $A_0 = 100\%$ $\quad t_{\frac{1}{2}} = 10 \text{ min}$

$A = 10\%$ $\quad K = \frac{0.693}{10}$

$$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{[A]}$$

$t = 33 \text{ min}$

Qu.6 $t_{\frac{1}{4}}$ → initial ~~or~~ $\frac{1}{4}$

final $= 1 - \frac{1}{4}$

$A_0 = 1$

$A = \frac{3}{4}$ $\quad$ final $= \frac{3}{4}$

$$K = \frac{2.303}{t} \log_{10} \frac{[A_0]}{[A]}$$

$$K = \frac{2.303}{t_{\frac{1}{4}}} \log \frac{4}{3}$$

$$k = \frac{2.303}{t_{\frac{1}{4}}} \times \log 2^2 - \log 3$$

$$k = \frac{2.303}{t_{\frac{1}{4}}} (0.60 - 0.47)$$

$$t_{\frac{1}{4}} = \frac{2.303 \times 0.13}{k}$$

$$\boxed{t_{\frac{1}{4}} = \frac{0.299}{k}}$$

Qu. 7)

$$r = k[A]^1$$

$$2 \times 10^{-5} = k[0.01]$$

$$k = \frac{2 \times 10^{-5}}{0.01} = 2 \times 10^{-3}$$

$$t_{\frac{1}{2}} = \frac{0.693}{k} = \frac{0.693}{2 \times 10^{-3}}$$

$$t_{\frac{1}{2}} = \frac{0.347}{10^{-3}}$$

$$\boxed{t_{\frac{1}{2}} = 347 \text{ sec}}$$

Qu. 8)

(3) $t_{\frac{1}{2}} \propto C^0$

$t_{\frac{1}{2}} \propto [A]^0$

$t_{\frac{1}{2}}$ = constant

Qu 9 —

$0.8 \longrightarrow 0.4$ in 15 min

A_0 A

$$K = \frac{2.303}{15} \log_{10} \frac{0.8}{0.4}$$

$$K = \frac{2.303}{15} \log_{10} 2 \quad - (1)$$

$0.1 \longrightarrow 0.025$

A_0 A

$$K = \frac{2.303}{t} \cdot \log_{10} \left(\frac{0.1}{0.025}\right)$$

$$K = \frac{2.303}{t} 2 \log 10$$

$$\frac{2.303}{15} = \frac{2 \times 2.303}{t}$$

$$\boxed{t = 30 \text{ min}}$$

20/5/25

OPP-08

Qu. 1

$t = 0$ sec

$t = 100$ sec

$P_{initial} = 0.5$

$P_{Total} = 0.512$

$$2N_2O_5 \longrightarrow 2N_2O_4 + O_2$$

	$2N_2O_5$	$2N_2O_4$	O_2
$t=0$	P_i	0	0
$t=100$ sec	$P_i - 2\alpha$	2α	α

$P_{Total} = P_i - 2\alpha + 2\alpha + \alpha$

$P_{Total} = P_i + \alpha$

$\alpha = P_{Total} - P_i$

$P_f = P_i - 2(P_{Total} - P_i)$

$P_f = P_i - 2P_T + 2P_i$

$P_{final} = 3P_i - 2P_{Total}$

New formula

$$K = \frac{2.303}{t} \log_{10} \frac{P_i}{3P_i - 2P_{Total}}$$

$$K = \frac{2.303}{100} \log_{10} \left(\frac{0.5}{3 \times 0.5 - 2 \times 0.512} \right)$$

$$K = 4.91 \times 10^{-4}$$

Ques 2 $N_2O_5 \longrightarrow N_2O_4 + \frac{1}{2} O_2$

$t = 20$ sec

$P_{initial} = 114$ mm of Hg

$P_{Total} = 133$ mm of Hg

$N_2O_5 \longrightarrow$	N_2O_4	$+ \frac{1}{2} O_2$
P_i	0	0
$P_i - \alpha$	α	$\frac{\alpha}{2}$

$P_{Total} = P_i - \alpha + \alpha + \frac{\alpha}{2}$

$P_{Total} - P_{initial} = \frac{\alpha}{2}$

$2P_T - 2P_i = \alpha$

$P_{Final} = P_i - \alpha$

$P_{final} = P_i - 2P_T + 2P_i$

$P_{final} = 3P_i - 2P_T = 76$

$P_{final} = 3(114) - 2(133) = 76$

$ROR = \frac{\text{change in Pressure}}{\text{Change in Time}}$

$R = \frac{P_f - P_i}{t} = \frac{76 - 114}{20} = \frac{38}{20} = 1.9 \text{ mm sec}^{-1}$

$ROR = \frac{1.9 \text{ mm sec}^{-1}}{760} = 2.5 \times 10^{-2} \text{ atm s}^{-1}$

$t_{1/2} \propto \frac{1}{[A]^{n-1}}$ for Any Order general

Qu·3

Second Order ⇒ $\boxed{\frac{t_1}{2} \propto \frac{1}{[A]}}$

Qu·4

Qu·5 $A \rightarrow B + C$

$$K = \frac{2.303}{t} \log_{10} \frac{P_i}{2P_i - P_T}$$

$$K = \frac{2.303}{10\ min} \log_{10} \frac{100}{2(100) - 120} =$$

$$K = \frac{2.303}{10} \log_{10} \frac{100}{80}$$

$\not\equiv$.

22/05/25

FACTOR AFFECTING RATE OF REACTION

1. Nature of Reactant
2. Concenteration of reactant
3. Presence of light
4. Pressure (only for gas)
5. Temperature
6. Catalyst

→ Nature of Reactant

Nature of Reactant

- Physical state of Reactant

Increasing Order of Rate of Reaction [Solid < Liquid < Gas]

- Physical Size of Particles

Rate of Reaction is ~~inversely~~ directly propotional to Surface Area

- Chemical Nature of reactant

different type of reactant have different activation energy

The molecules have less activation Energy take place at faster rate.

→ Concentration of Reactant

It is directly proportional to ~~Log~~ Rate of Reaction

Excluding zero order Reaction (Conc. of Reactant ∝ ROR)

→ Presence of light

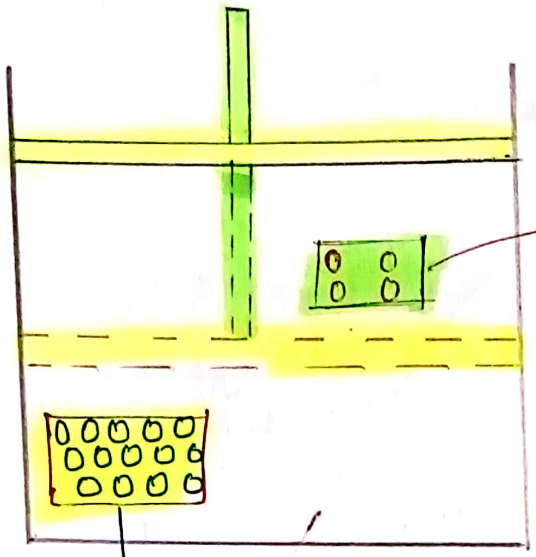
Rate of reaction are very slow in absence of light, But in the presence of light the rate of reaction increases that is only in photochemical reaction.

$H_2 + Cl_2 \rightarrow 2HCl$ [Very slow]

$H_2 + Cl_2 \xrightarrow{h\nu} 2HCl$ [Explosive]

→ Effect of Pressure

Effect of Pressure are very rare in Solid and Liquid Because Solid are highly incompressible But for gas when pressure increases the numbes of molecules per unit ~~volume~~ area increases, So the collision also increases.



→ Number of molecules before increasing pressure

→ Number of molecules after increasing Pressure

100 Stars

→ Effect of Temperature

When Temperature increases Rate of Reaction also increases
Generally it is found rise in temperature every 10°C rise in temperature Rate of Reaction became 2 -3 times
(↳ INNCERT Given This)

[Temp ∝ ROR]

For 2 times

$$r_{New} = r_{old} \times 2^{\frac{T_2 - T_1}{10}}$$

{Discoved By "Vijay Kant" Sir formula}

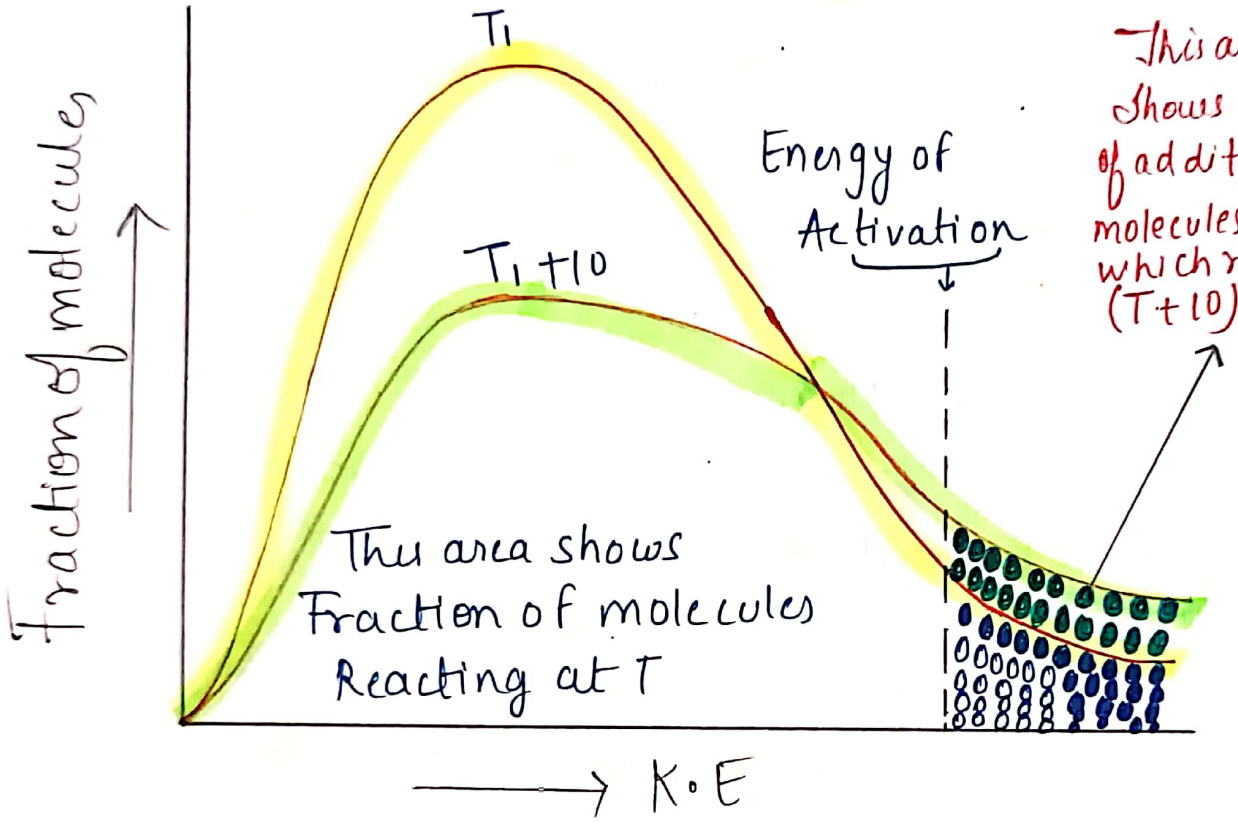
Example :- 30°C ⟶ 70°C

$$r_{new} = r_{old} \times 2^{\frac{70-30}{10}}$$

$$r_{new} = r_{old} = 2^4$$

$$r_{new} = 16 r_{old}$$

Maxwell and Boltzmann Energy Distribution Curve



Arrhenius Equation

$$K = Ae^{-\frac{Ea}{RT}}$$

A = Arrhenius factor
= Frequency Factor
= pre exponential factor

K = rate constant

T = Temperature (in kelvin)

$e^{-\frac{Ea}{RT}}$ = Boltzman factor

e = exponential

Ea = Activation Energy (in KJ/mol)

R = Universal Gas Constant = 8.314 $JK^{-1}mol^{-1}$

* Calculation of Activation energy for given Temperature

$$K = Ae^{-\frac{Ea}{RT}}$$

Taking Ln on Both side

$$\ln K = \ln\left(Ae^{-\frac{Ea}{RT}}\right)$$

{∵ $\log(xy) = \log x + \log y$}

$$\ln K = \ln A + \ln e^{-\frac{Ea}{RT}}$$

{∵ $\log x^y = y \log x$}

$$\ln K = \ln A - \frac{Ea}{RT} \ln e$$

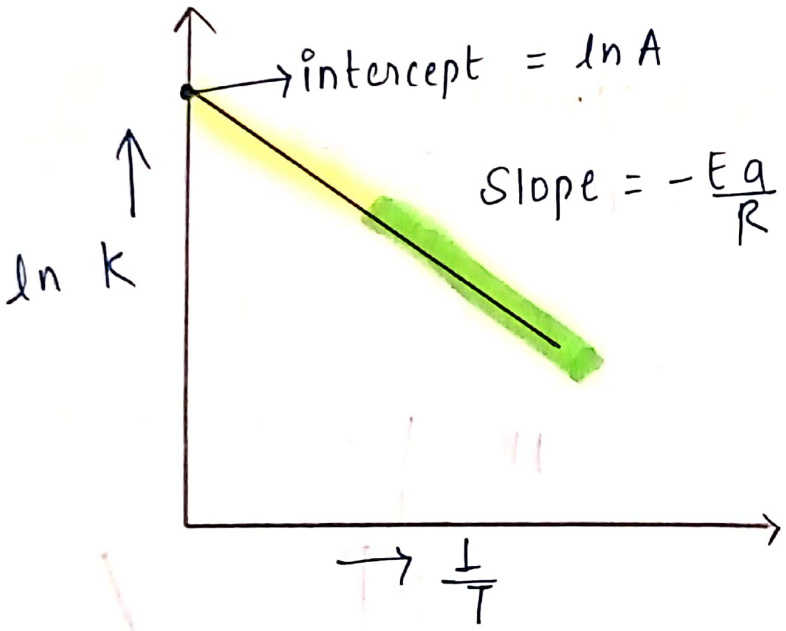
Arrhenius Equation Graph

{ ∵ $\ln \cdot e = 1$ }

$$\ln K = \ln A - \frac{Ea}{RT}$$

comparing with equation

↳ $y = c - mx$



$$\ln K = \ln A - \frac{Ea}{RT}$$

{ ∵ $\ln x = 2.303 \log_{10} x$ }

$$2.303 \log_{10} K = 2.303 \log_{10} A - \frac{Ea}{RT}$$

$$\log_{10} K = \frac{2.303 \log_{10} A - \frac{Ea}{RT}}{2.303}$$

$\log_{10} K = \frac{2.303}{2.303} \log_{10} A - \frac{Eq}{2.303 RT}$

$$\log_{10} K = \log_{10} A - \frac{Ea}{2.303 RT}$$

For Calculation activation energy for given fixed Temperature

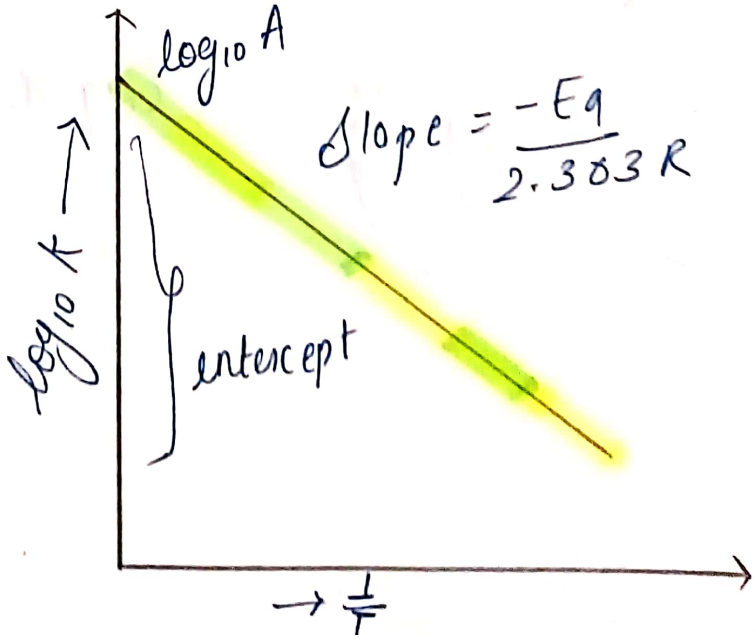
$$y = c - mx$$

$$y = \log A - mx$$

$$y = \log_{10} K \quad \frac{-Eq}{2.303R} \left[x = \frac{1}{T} \right]$$

$$m = \frac{-Ea}{2.303R} = \text{Slope}$$

c = intercept



Derivation of Activation Energy for two different value of K and Temperature

$$K_1 = Ae^{-\frac{Eq}{RT_1}} \quad - \quad Eq\,(1)$$

$$K_2 = Ae^{-\frac{Eq}{RT_2}} \quad - \quad Eq\,(2)$$

Dividing Eq (2) and Eq (1)

$$\frac{K_2}{K_1} = \frac{Ae^{-\frac{Eq}{RT_2}}}{Ae^{-\frac{Eq}{RT_1}}}$$

Now Taking Ln on Both sides

$$\ln\left(\frac{K_2}{K_1}\right) = \ln\left(\frac{e^{-\frac{Eq}{RT_2}}}{e^{-\frac{Eq}{RT_1}}}\right)$$

$\because \log\frac{x}{y} = \log x - \log y$

$$\ln\frac{K_2}{K_1} = \ln e^{-\frac{Ea}{RT_2}} - \ln e^{-\frac{Ea}{RT_1}}$$

$\because \log xy = y \log x$

$$\ln \frac{k_2}{k_1} = -\frac{Eq}{RT_2} \ln e + \frac{Eq}{RT_1} \ln e$$

$\{ \because \ln xe = 1 \}$

$$\ln \frac{k_2}{k_1} = -\frac{Eq}{RT_2} + \frac{Eq}{RT_1}$$

$$\ln \frac{k_2}{k_1} = \frac{Eq}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\ln \frac{k_2}{k_1} = \frac{Eq}{R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

$\{ \because \ln k = 2.303 \log_{10} \}$

$$\ln \frac{k_2}{k_1} = \frac{Eq}{R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

$$2.303 \log_{10} \left(\frac{k_2}{k_1} \right) = \frac{Eq}{R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

$$\log_{10}\left(\frac{K_2}{K_1}\right) = \frac{E_a}{2.303\,R}\left(\frac{T_2 - T_1}{T_1\,T_2}\right)$$

Value of Activation Energy for two different value of rate constant and two different temperature.

$2.303 \times 8.314 = 19.14$

$2.303 \times 0.3010 = 0.693$

$308 \times 293 = 90,244$

$308 \times 298 = 91,784$

$2.303 \times 0.477 =$

Pg 30 21-72

Pg-41

Q 73 given $T_1 = 20^\circ C = 273 + 20 = 293\,K$

$T_2 = 35^\circ C = 273 + 35 = 308\,K$

$R = 8.314$ $\quad E_a = ?$

$$\log_{10}\left(\frac{K_2}{K_1}\right) = \frac{E_a}{2.303\,R}\left(\frac{T_2 - T_1}{T_1\,T_2}\right) = \left[\frac{308 - 293}{308 \times 293}\right]$$

$$\log_{10}(2) = \frac{E_a}{2.303 \times 8.314} \times \frac{15}{308 \times 293}$$

Commutative Property

$A \times B = B \times A$

muskil 1

$$Ea = \frac{0.3010 \times 2.303 \times 8.314 \times 308 \times 293}{15}$$

$Ea = 34673$ J/mol

$Ea = 34.67$ kJ/mol

Concept of Activation Energy

24/05/25

The minimum extra amount of energy required by reactant molecule for converting into product

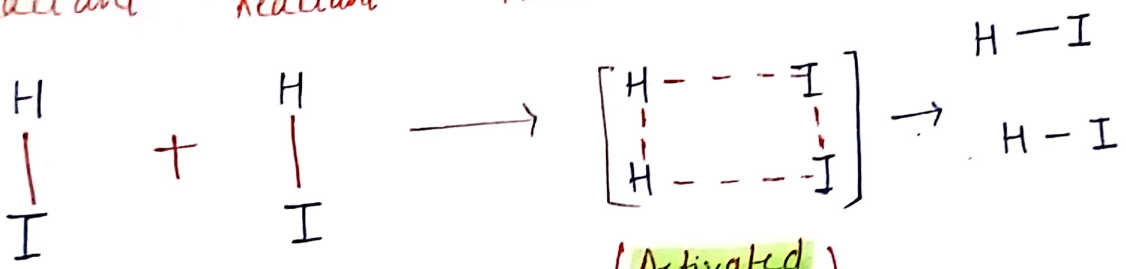
Threshold Energy

The minimum energy which must be possessed by reactant molecules for a chemical reaction to occurs

Example

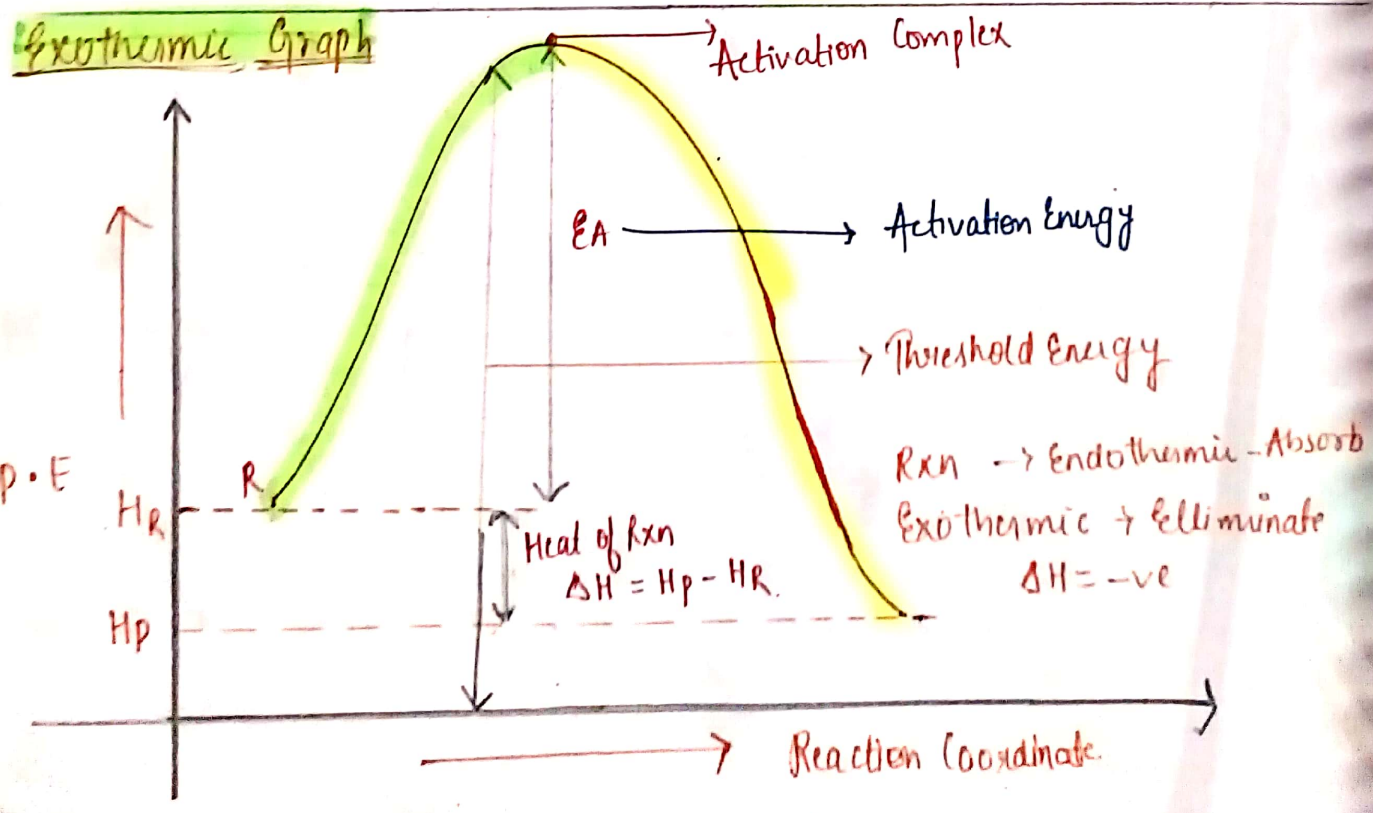
$$H_2 + I_2 \longrightarrow 2HI$$

Reactant Reactant Product



(Activated complex)
(Intermediate)

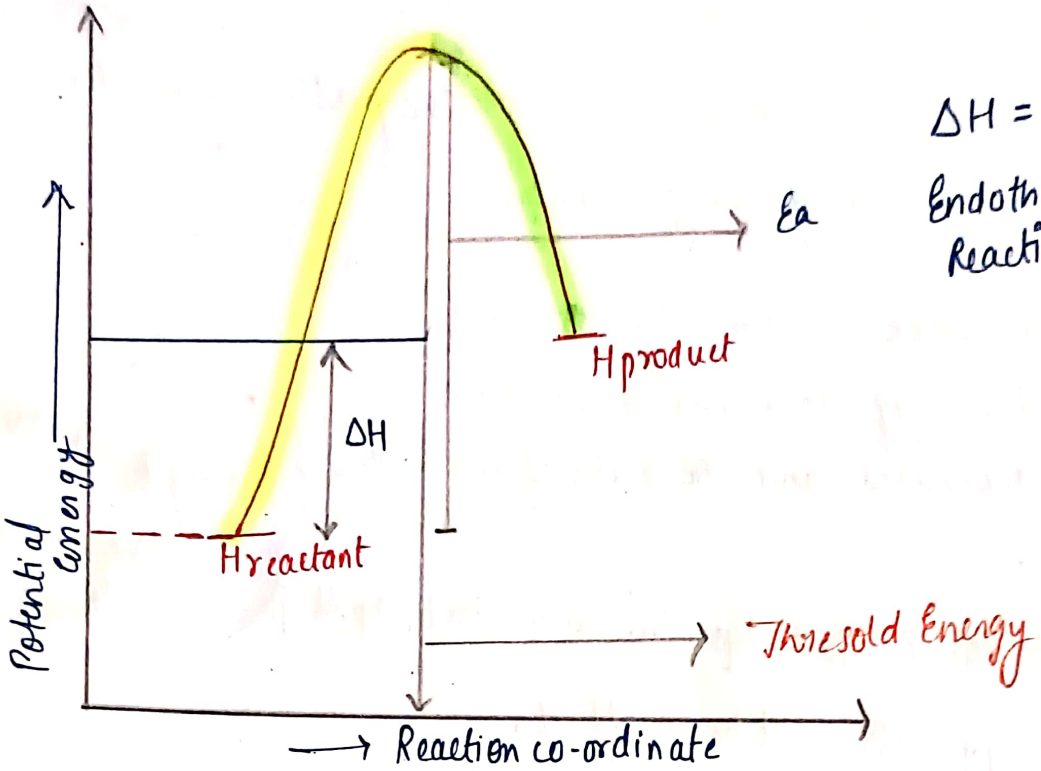
Exothermic Graph



$E_A > \Delta H$

ΔH = +ve

Endothermic Reaction



* Activation Energy Depends upon

① Nature of Reactant

a) For Different type of reactant There are different types of bond the Energy to break the bond are also different. So activation Energy are different for Different Reaction.

b) For Complex Rxn the activation Energy are more for slower step.

② Presence of Catalyst

→ Effect of Catalyst

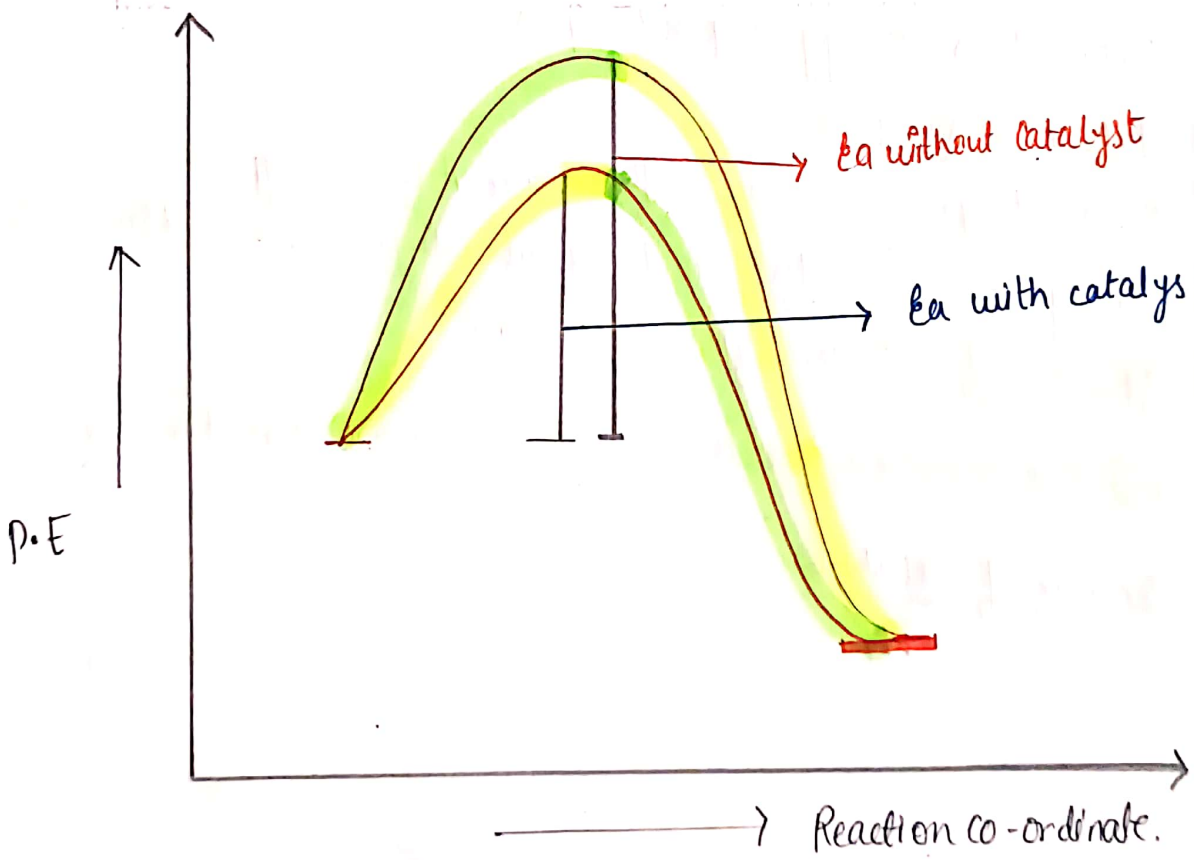
Catalyst Provide an alternative path of reaction mechanism for any reactant.

In the presence of positive Catalyst Threshold Energy decreases activation Energy decreases and the rate of reaction increases.

Catalyst → +ve catalyst
↳ -ve catalyst
↳ [Inhibitors]

Catalyst donot effect equilibrium constant, [Kp & Kc]

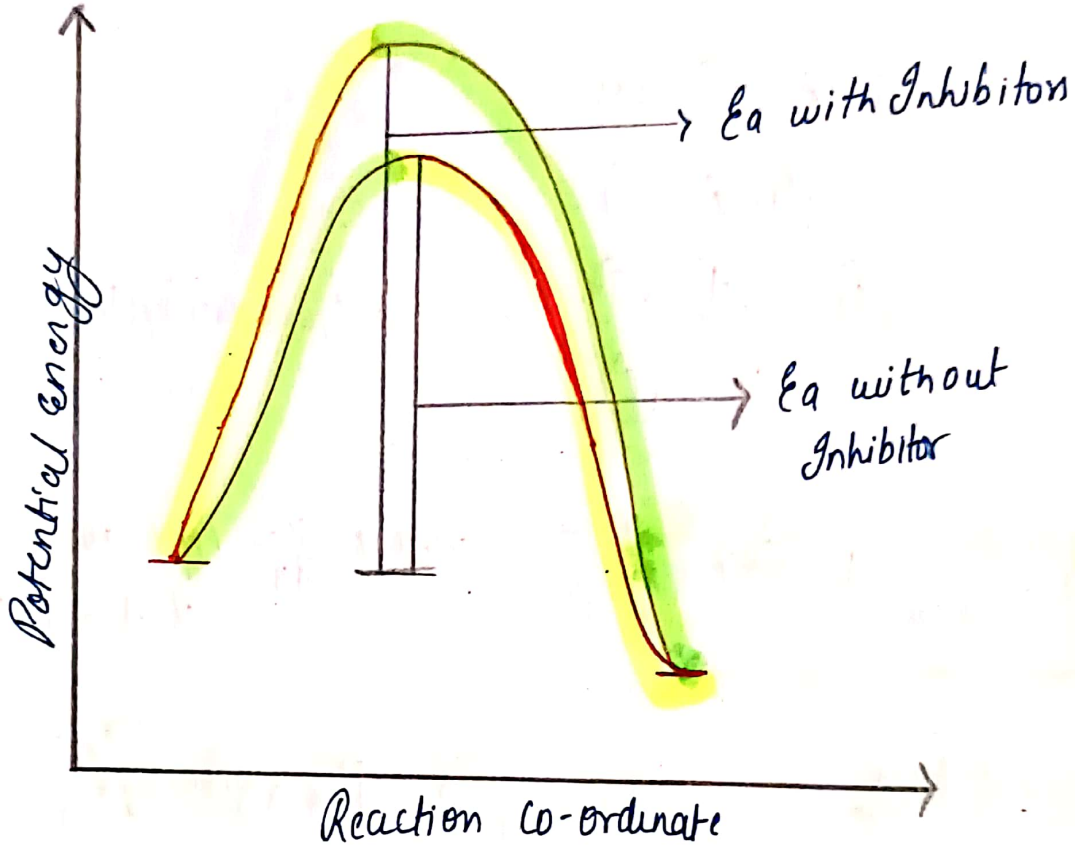
Gib's Energy also not been affect.



* Threshold Energy = Decrease
Ea → decrease
ROR → Increase

ΔG = Not change

* Effect of Inhibitors



Activation Energy - Increase
Threshold Energy - Increase
ROR - Decreases

→ Collision Theory of Chemical Reaction

Discovered by max Trautz and William lewis

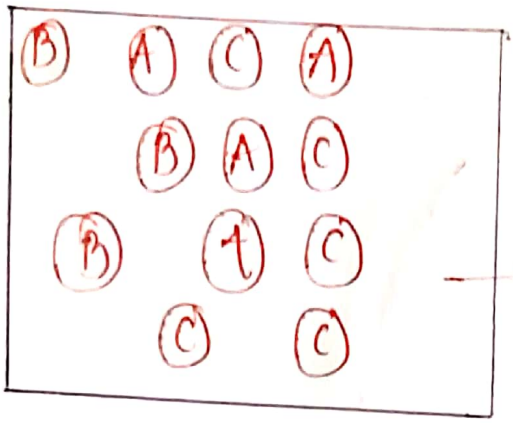
Collision Theory was proposed by both scientist. This Theory based on Kinetic Theory of gases.

According To This Theory,

Reactant molecules are assumed to Hard Sphere and Reaction is postulates to occur when molecules collide with each other.

The number of molecules / collision per unit volume of reaction mixture is known as Collision frequency.

$A + B \longrightarrow C$



→ In Gaseous System

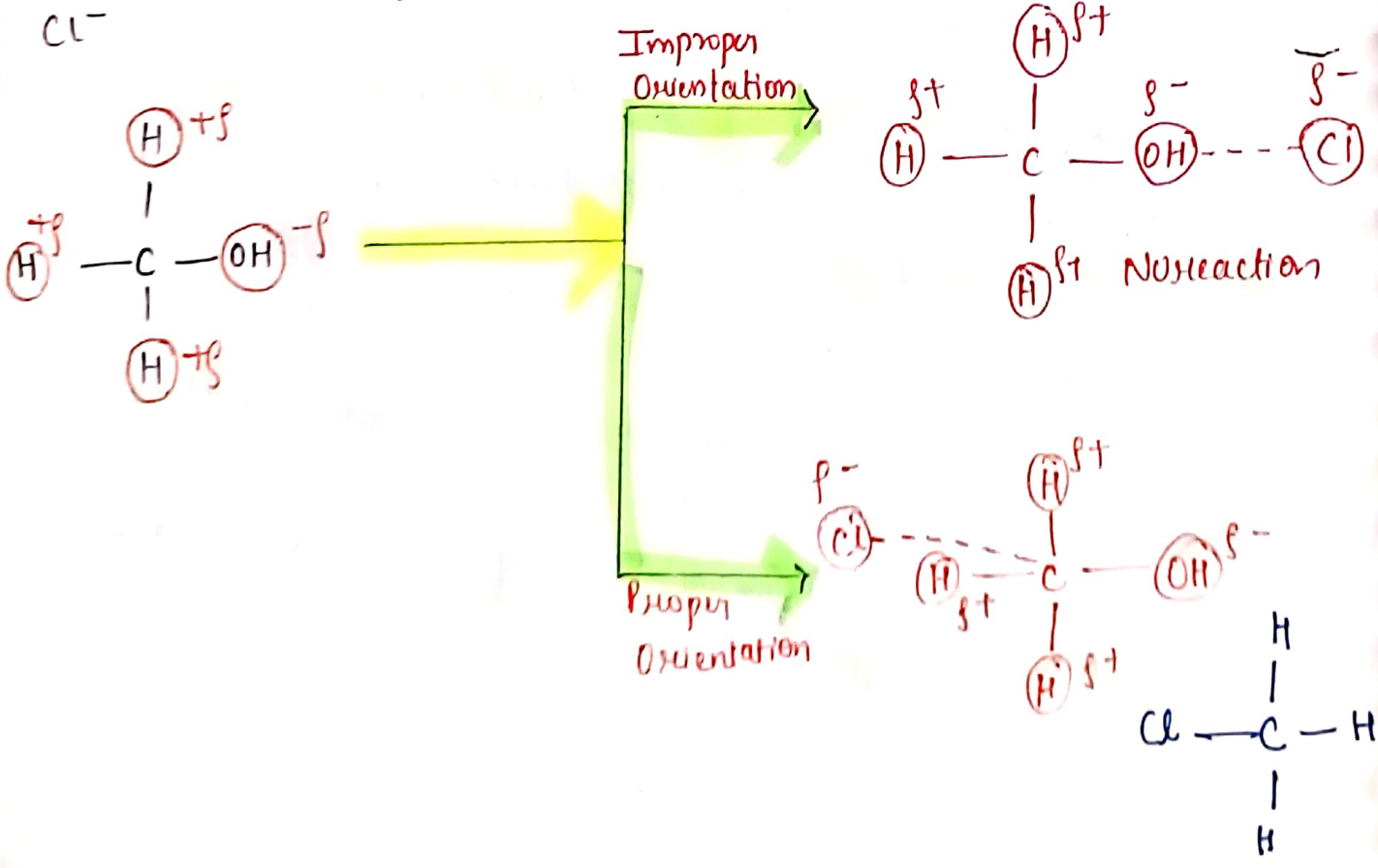
$$K = Z_{AB}\, Ae^{-\frac{Eq}{RT}}$$

where Z_{AB} = collision frequency of A and B

Orientation → $K = P Z_{AB} Ae^{-\frac{Eq}{RT}}$

⁘ The proper orientation of reactant molecules leads to bond formation where as improper orientation make simply bounce back and no product are formed.

There is introduction of P which is called Probability factor or Steric factor



Pg-33 OPP-10

(1) $10^\circ C \longrightarrow 50^\circ C$

$r_{new} = r_{old} \times 2^{\frac{T_2 - T_1}{10}}$

$r_{new} = r_{old} \times 2^{\frac{50-10}{10}}$

$r_{new} = r_{old} \times 2^4$

$r_{new} = 16$ times

(2) Temp coefficient $= \frac{K_2}{K_1}$

Temp - $25^\circ C$ - $35^\circ C$

$\log_{10}\left(\frac{K_2}{K_1}\right) = \frac{Ea}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$

$\log_{10} 2 = \frac{Ea}{2.303\,R}\left(\frac{308 - 298}{308 \times 298}\right)$

$T_1 = 25^\circ C + 273 = 298K$

$T_2 = 35^\circ C + 273 = 308k$

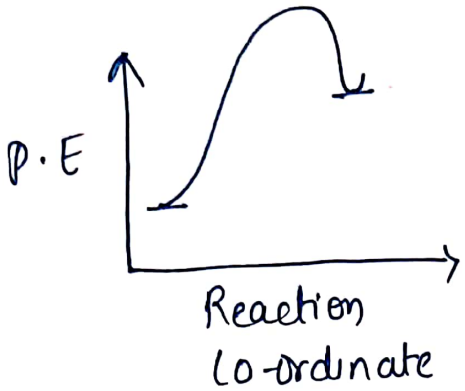
$0.3010 = \frac{Ea}{2.303 \times 8.314}\left(\frac{10}{308 \times 298}\right)$

$Ea = \frac{0.3010 \times 2.3030 \times 8.314 \times 308 \times 298}{10}$

$Ea = 52.89\ KJ$

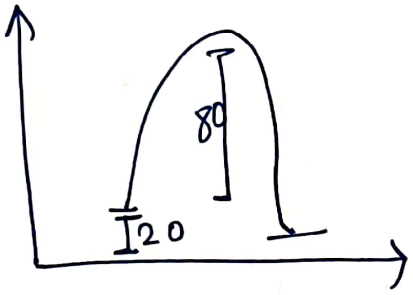
(3) (1) 29

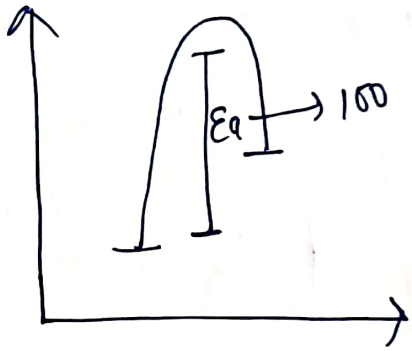
(4) (3)



Pg=34

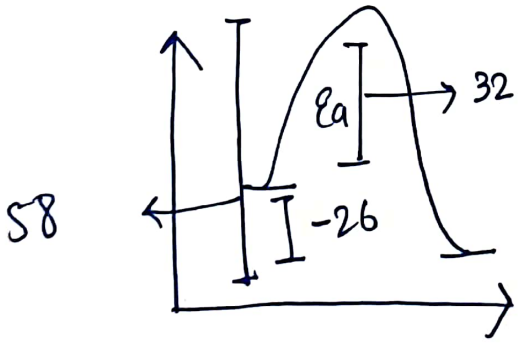
(1)





Opt (1)

(2)

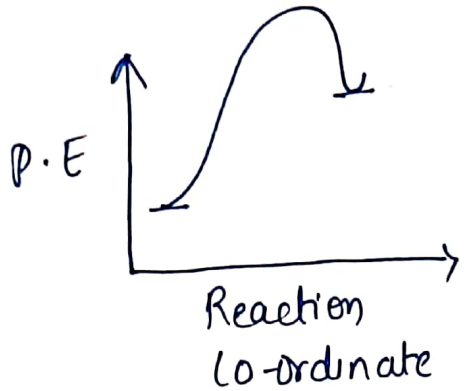


(3) (1) $E_a > \Delta H$

(4) (4) any one of the above

③ (1) 29

④ (3)



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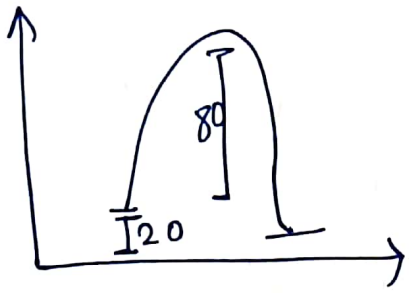
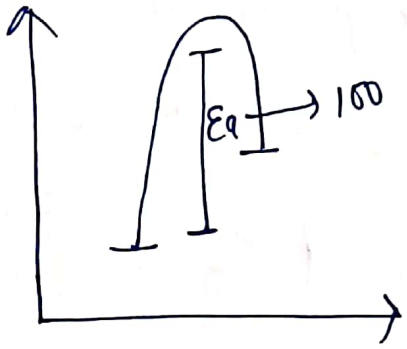
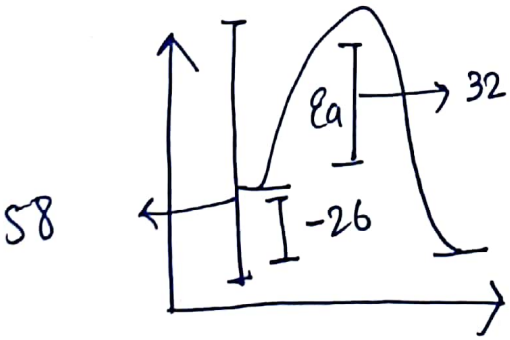
①





Opt ①

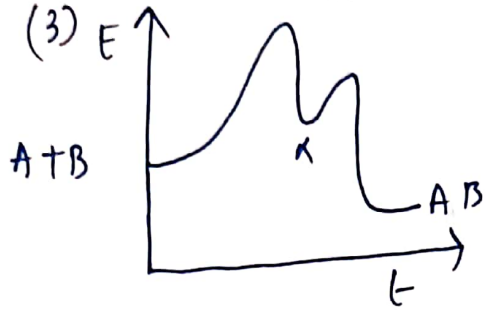
②



③ (1) $E_a > \Delta H$

④ (4) any one of the above

⑤ (3)



⑥ (3) minimum extra amount of Energy needed to overcome the potential barrier

⑦ (3) Threshold Energy

⑧ (3) Total number of effective collisions

29/05/25

OPP-12

(Qu 1)

$$\log K = 14.2 - \frac{1.0\times10^4}{T} K$$

$$\log_{10} K = \log_{10} A - \frac{Ea}{2.303 RT}$$

$$\frac{-Ea}{2.303 RT} = -\frac{1.0\times10^4}{T}$$

$$Ea = 1.0\times10^4 \times 2.303 \times 8.314$$

$$\boxed{Ea = 19.14\times10^4 \text{ J/mol}}$$

(Qu.2) $K_1 = 1.6\times10^6 s^{-1}$ at 280 K

$K_2 = ?$

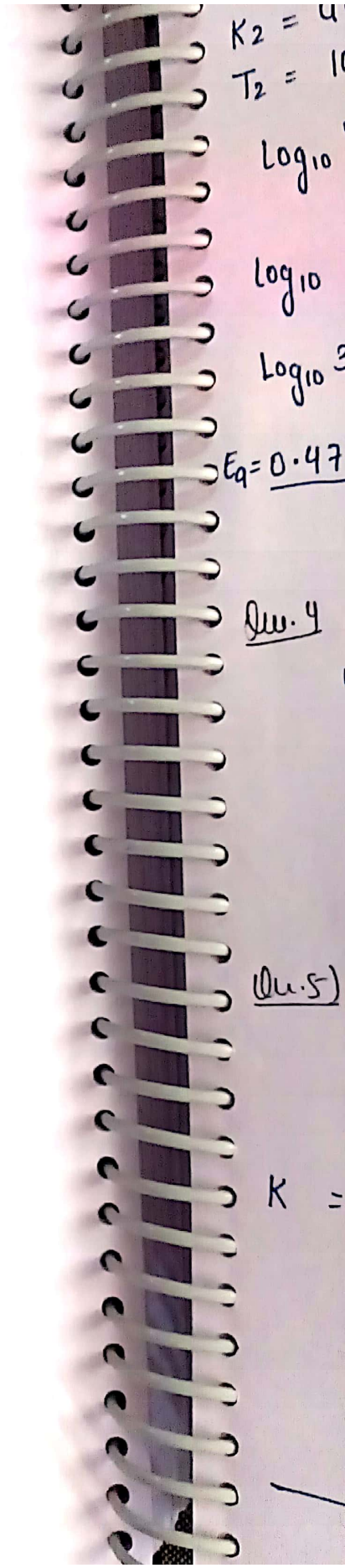
$$\log \frac{K_2}{K_1} = \frac{Ea}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$$\log \frac{K_2}{K_1} = 0$$

$$\log \frac{K_2}{K_1} = \log_{10} 1$$

$$\frac{K_2}{K_1} = 1 \qquad \boxed{K_2 = K_1}$$

Option (1) $\left[K_2 = 1.6\times10^6 s^{-1}\right]$



Qu.3) $K_1 = 1.5 \times 10^7 s^{-1}$, $T_1 = 50°C$

$T_1 = 50 + 273 = 323K$

$K_2 = 4.5 \times 10^7 s^{-1}$

$T_2 = 100°C + 273 = 373K$

$$\log_{10} \frac{K_2}{K_1} = \frac{Eq}{2.303R} \left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$$\log_{10} \frac{4.5 \times 10^7}{1.5 \times 10^7} = \frac{Eq}{2.303 \times 8.314} \left[\frac{50}{323 \times 373}\right]$$

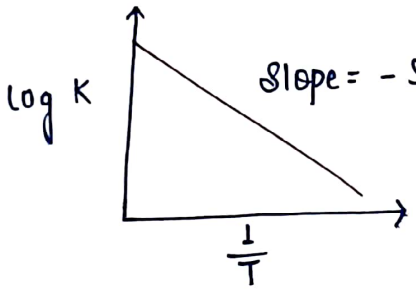
$$\log_{10} 3 = \frac{Eq}{2.303 \times 8.314} \left[\frac{50}{323 \times 373}\right]$$

$$Eq = \frac{0.477 \times 2.303 \times 8.314 \times 323 \times 373}{50}$$

$Eq = 22.007$ KJ/mol

Option (2) = 22 KJ

Qu.4



$$\text{slope} = \frac{-Eq}{2.303R}$$

$$-5841 = \frac{-Eq}{2.303 \times 8.314}$$

$5841 \times 19.14 = Eq$

Opt (1) $\boxed{Eq = 1.118 \times 10^5 \text{ J/mol}}$

Qu.5)

$K_1 = 2K \rightarrow E_1$

$K_2 = K \rightarrow E_2$

] Temp = same

$$K = Ae^{-\frac{Eq}{RT}}$$

$$K_1 = Ae^{-\frac{Eq_1}{RT}} \quad - (I)$$

$$K_2 = Ae^{-\frac{E_2}{RT}} \quad - (II)$$

Eq (I) ÷ Eq (II)

$$\frac{2K}{K} = \frac{e^{-\frac{E_2}{RT}}}{e^{-\frac{E_1}{RT}}}$$

$$\ln 2 = \frac{E_2}{RT} - \frac{E_1}{RT}$$

$$0.693 = \frac{E_2 - E_1}{RT}$$

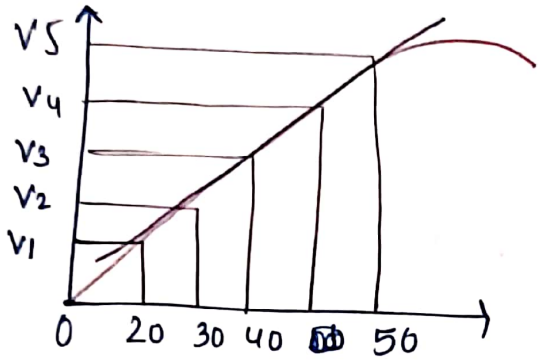
$0.693 \times 8.314 \times T = E_2 - E_1$

Opt (1) $\boxed{E_2 > E_1}$

Book -(2) Test

Pg-89 NCERT EXEMPLAR'S

Qu.2



average rate at 40-second = $\frac{\text{final - Initial}}{t_2 - t_1}$

$= \frac{V_3}{40}$ Opt (c)

Test

Qu.3

Opt (b) Instantaneous rate = $\frac{V_4 - V_2}{50 - 30}$

Note

① 500 stars

Integrate Rate Equation of 1st Order Reaction the value of k with respect to volume.

$$K = \frac{2.303}{t} \log_{10} \frac{V_\infty - V_i}{V_\infty - V_f}$$

Qu.37 Based on upper Note on Book -(2) Pg 81

at $t = 20$ min

$K = \frac{2.303}{20} \left(\frac{V_\infty - V_i}{V_\infty - V_f}\right)$ $K = \frac{2.303}{20} \log_{10} \frac{162}{152}$

Opt (b) $K = 3.2 \times 10^{-3} \text{ min}^{-1}$

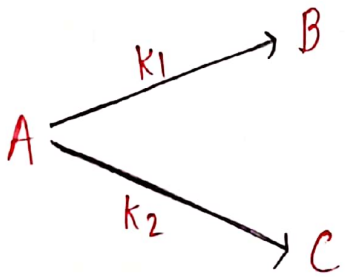
② 500 stars

Differential form of Arrhenius Equation

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

③ 500 stars

Parallel equation

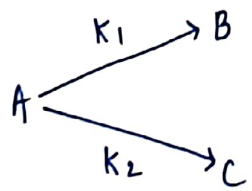


$$\% \text{ Yield of } B = \frac{k_1}{k_1 + k_2} \times 100\%$$

$$\% \text{ Yield of } C = \frac{k_2}{k_1 + k_2} \times 100\%$$

Book ① Section - H Pg - 72

(Q 1)



$k_1 = 1.26 \times 10^{-4}$

$k_2 = 3.8 \times 10^{-5}$

$k_2 = 0.38 \times 10^{-4}$

$$\% \text{ yield of } B = \frac{k_1}{k_1 + k_2} \times 100$$

$$\text{--- " ---} = \frac{1.26 \times 10^{-4}}{(1.26 + 0.38) \times 10^{-4}} \times 100 = 76.8\%$$

$$\% \text{ Yield of } C = (100 - 76.8)\% = 23.2\%$$