DEPTH OF BIOLOGY

STUDY MATERIAL

YT-DEPTH OF BIOLOGY

INSTA- DEPTH OF BIOLOGY

TELE- DEPTH OF BIOLOGY

Units of Rate Constant (K).

(K) → Has Units depend on rate Law.

Zero Order → $rate = K[A]^0$ (1)

rxn.

$rate = K$ (molar/sec.) → Unit for Zero.

m/sec. ← rate

Ist Order → Rate = $K[A]^1$

rxn.

Rate → m/sec.

K → 1/sec. → Molar.

Find. (K) = $\frac{Rate}{[A]} = \frac{m/sec.}{Molar} = \frac{1}{sec.}$

IInd order ⇒ $Rate = K[A]^2$.

rxn.

Rate → m/s

K → $\frac{1}{m \cdot s}$

$[A]^2 \rightarrow m^2$

$K = \frac{Rate}{[A^2]} = \frac{M/s}{m^2} = \frac{1}{m \cdot s}$

Methods of determination or reaction order

- There is no straight forward method to theoretically know the order of a reaction.
- The exact order can be determined experimentally. The following methods are employed to decide the order of a reaction.

1. Graphic Method

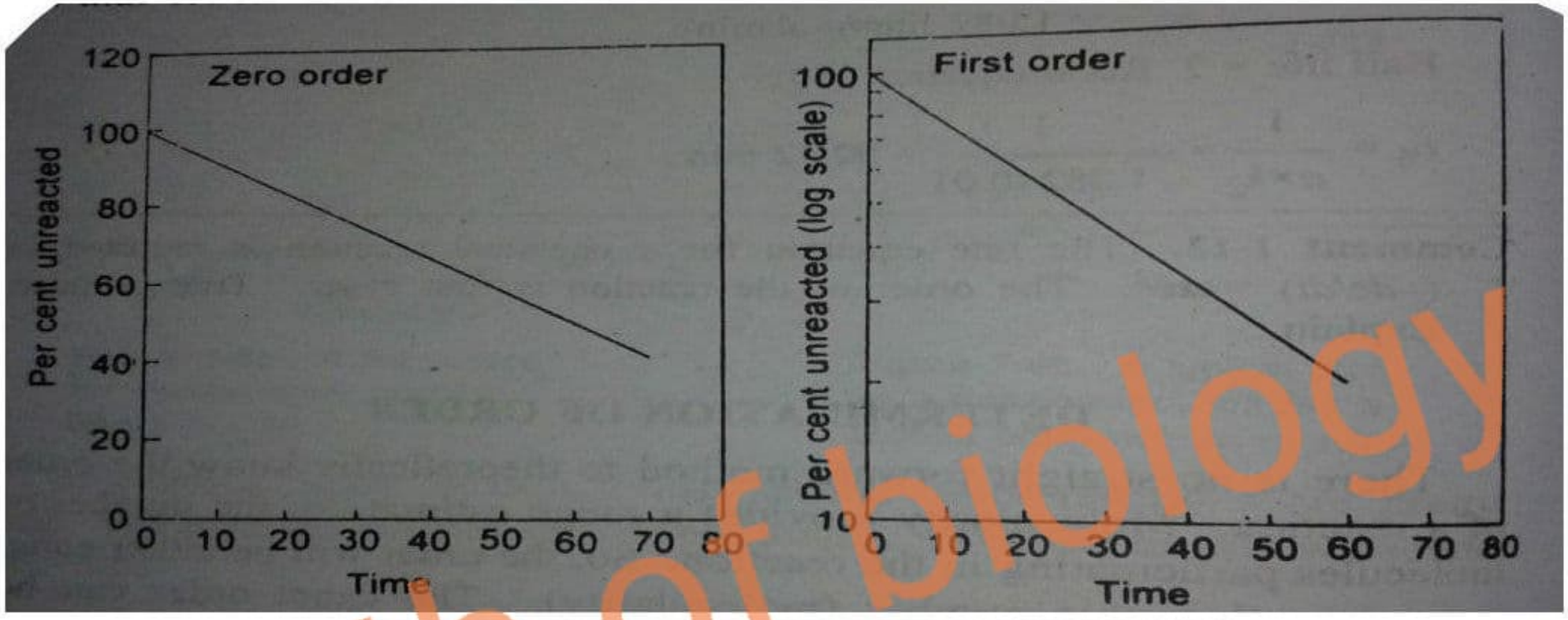
2. Substitution Method

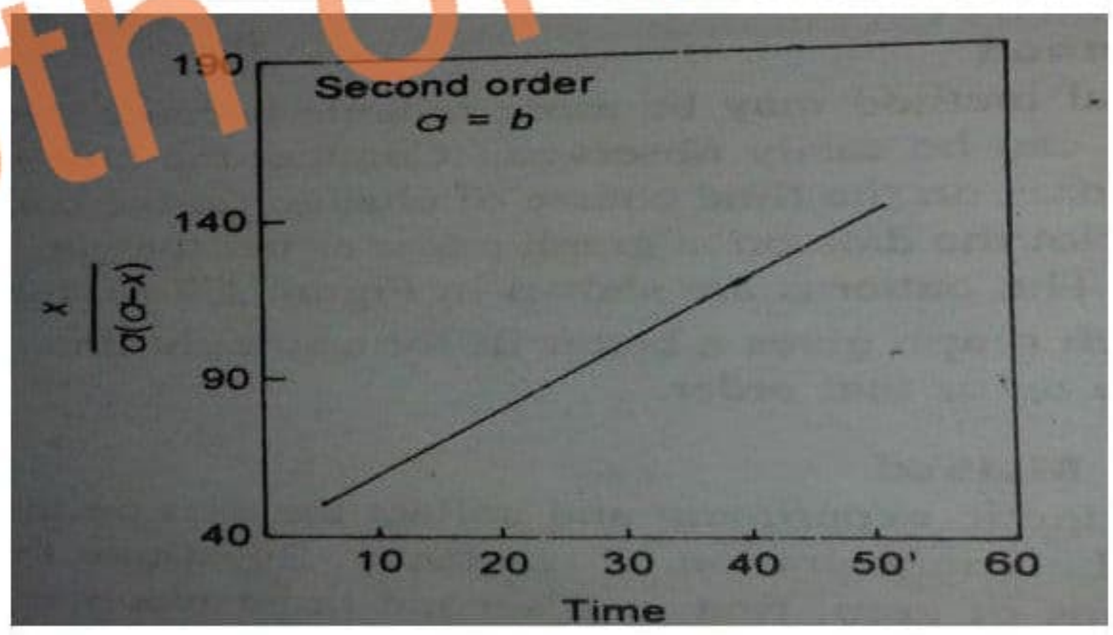
3. Half Life Method

1.Graphic Method

- This pictorial method may be more reliable because deviations from the best fit line can be easily observed. Conduct the kinetic experiment and collect the data on the time course of changes in the concentration of the reactants. Plot the data on a graph paper as per the general principles of each order.
- Decide which graph gives a better fit for a straight line. The reaction is considered to be of that order.

1.Graphic Method





2. Substitution Method

- Conduct a kinetic experiment and collect the data on the time course of changes in the concentration of reactants. Substitute the data in the integral equation of zero, first, and second order reactions to get k values.

Zero order : $k_o = \frac{A_o - A_t}{t}$

First order : $k_1 = \frac{2.303}{t} \log \frac{c_o}{c_t}$

2. Substitution Method

- Select the order in which k values at different time periods remain constant within the experimental errors. The reaction is considered to be of that order.

Second order : $k_2 = \frac{1}{at} \cdot \frac{x}{(a-x)}$

3. Half Life Method

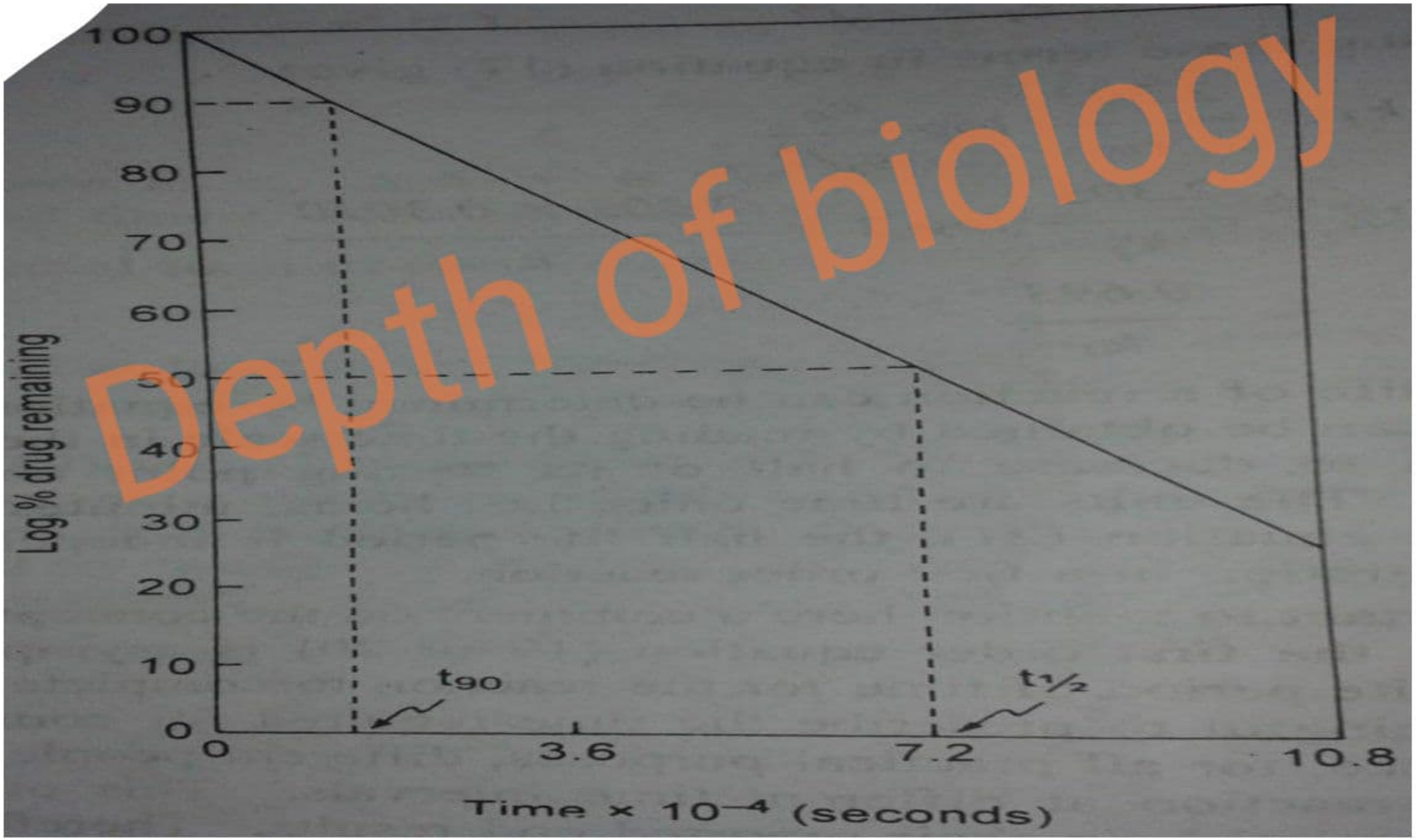
- Calculate the average k value using the data for zero, first, and second orders as given in substitution method or graphic method. Then, estimate the $t_{1/2}$ values for each time period in the kinetic study.
- Equations are as follows.

Zero order : $t_{1/2} = \frac{a}{2k_o}$

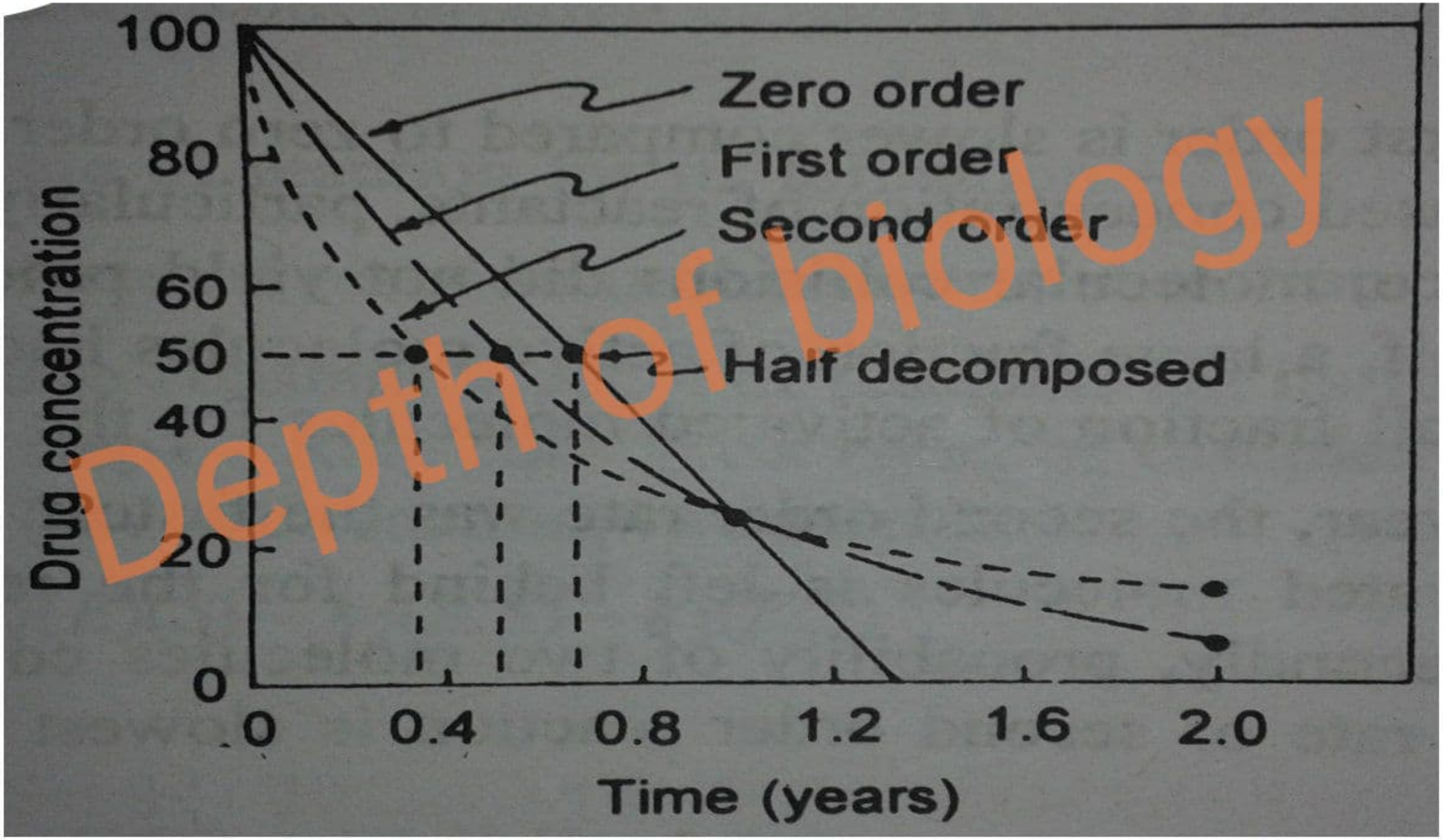
First order : $t_{1/2} = \frac{0.693}{k_1}$

Second order : $t_{1/2} = \frac{1}{ak_2}$ (where $a = b$)

3. Half Life Method



3. Half Life Method



Factors affecting reaction rate

- It is the time course of changes in the concentration of the reactants in a reaction.

1. Drug stability
2. Dissolution
3. Drug release
4. Pharmacokinetics
5. Drug action

Drug Stability and Stabilization Techniques

stable rahe

shelf life tak

DRUG STABILITY

- There are five types of stability that must be consider for each drug

Type of Stability	Conditions Maintained Throughout the Shelf-Life of the Drug Product
Chemical	Each active ingredient retains its chemical integrity and labeled potency, within the specified limits.
Physical	The original physical properties, including appearance, palatability, uniformity, dissolution, and suspendability are retained.
Microbiological	Sterility or resistance to microbial growth is retained according to the specified requirements. Antimicrobial agents that are present retain effectiveness within the specified limits.
Therapeutic	The therapeutic effect remains unchanged.
Toxicological	No significant increase in toxicity occurs.

What are changes?

- Physical changes
  - Appearance
  - Melting point
  - Clarity and color of solution
  - moisture
  - Crystal modification (Polymorphism)
  - Particle size
- Chemical changes
  - Increase in Degradation
  - Decrease of Assay
- Microbial changes

Forced degradation studies

- Acidic & Basic conditions.
- Dry heat exposure
- UV radiation exposure
- Influence of pH
- Influence of temperature
- Influence of ionic strength

Physical & Chemical factors Influencing the Chemical degradation of Pharmaceutical Product. ⇒

(a) Temp. (b) Solvent (c) Ionic strenght (d) dielectric Constant.

(e) Specific & General Acid Base Catalysis.

Pharmac. Product. → Prepared for Human Use.

↳ Diff. Brand & Diff. Packaging.

Chemical Degradation → Process in which Chemical molecule Break → Small Chemical

↓

Also Known as Chemical/Thermal Decomposition.] ⇒ This affect Pharmaceutical Value of Drug.

(a) Temprature → As you know Collision Theory.

⇓

High Temp. Can Cause Collission b/w Molecule. (of our Product)

⇓

Lead to Chemical degradation of Pharmaceutical product.

That's why → Pharmaceutical Product → Kept in cold Places.

↙

Medicine become safe & Best applied.

(b) Solvent → Any Chemical Compound which is Capable of dissolving any other Substance without Changing the Chemical Nature of Substance

Solvent → Aqueous or Inorganic Solvent. [Include H_2O].

→ Non-Aqueous or Organic Solvent. [Include Alcohol, Glycerine]

Solvent's → Dielectric Const.
→ Viscosity
] → Alter the Rate Constant & mechanism of chemical reaction

☆ Selection of Particular Solvent & Co-Solvent is essential for the Stabilit

☆ Different factor Must be considered before Selecting a Solvent.

→ Chemical Nature of Substance.
→ Polar Char. of Substance
→ Behaviour of drug On Particular Medium.

(c) Ionic Strenght. ⇒

Ionic Strenght also alter the Stability of Pharmaceutical product.

⇒ Higher the Ionic Strenght.
↓
Greater the Interaction
↓
Leading to Degradation.

(d) Dielectric Constant. ⇒

Every electric field Hold some energy in it for further Transfer.
The Measuring Units of this stored energy is the dielectric Constant.

The effect of Dielectric Constant on Rate of rxn. is given by ⇒

$$\left[\ln k = \ln k_{\varepsilon=\infty} - \frac{N Z_A Z_B e^2}{RT\, r^*} \frac{1}{\varepsilon} \right]$$

K = Observed reaction rate in a solvent off dielectric Constant ε

$K_{\varepsilon=\infty}$ = Reaction rate Constant in a Solvent of Infinite dielectric Constant.

N = Avagadro's Number.

Z_A & Z_B = Charge on two Ionic species.

e = Unit of electric Charge.

r^* = distance b/w Ionic Species in activate Complex

ε = Dielectric Constant of Solution.

(e) Acid - Base Catalyst. ⇒

Alter R.O.R.

Use R.O.Rxn. but remains Unchanged till end.

☆ The Chemical reaction is accerlated by the addition of Acid or Base
Acid & Base itself not combine In reaction.

If our drug is in solution form → Then it Undergo Hydrolytic Degradation

(So, We Can Say the reaction is Catalysed by H^+ & OH^- Ions) When we add Acid or Base.

The reaction which Catalysed through H^+ & OH^- Ions.

⇓

Is expressed as → $dp/dt = (K_0 + K_1[H]^+ + K_2[OH^-])[S]$

[S] ↓ Conc. of Substrate

Observed rate Const. →

$K_{obs.} = K_0 + K_1[H^+] + K_2[OH^-]$.

At Low pH ⇒ $[H^+]$ is High So, $K_1[H^+]$ is greater Than K_0 & $K_2[OH^-]$

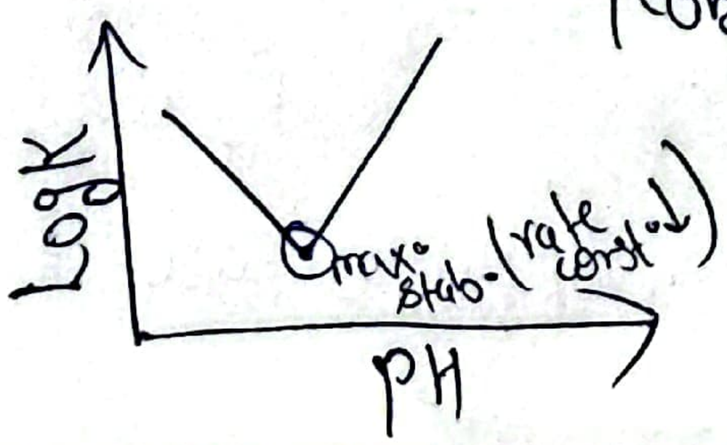
So, our Rate only depends on $K_1[H^+]$.

$K_{obs.} = K_1[H^+]$. (reaction is Specific Hydrogen Ion Catalysed)

At Higher pH ⇒ $[OH^-]$ is High, So $K_2[OH^-]$ is greater than K_0 & $K_1[H^+]$.

So, our rate depends on $K_2[OH^-]$. (reaction is Specific Hydroxyl Ion).

$K_{obs.} = K_2[OH^-]$.



We can Check stab. of dosage form at of diff. pH Level with the Help of this plot.