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Unit: V

Topic: Reaction Kinetics

# Kinetic stability

Kinetics deals with the study of the rate at which processes occur and mechanism of chemical reactions It involves the study of rate of change and the way in which this rate is influenced by the concentration of reactants, products, and other chemical species that may be present, and by factors such as solvents, pressure, and temperature.

**Kinetics applies to:**

Stability

Incompatibility

Dissolution

Absorption

Distribution

Drug action at molecular level

Elimination processes

# Rate & order of reaction

**Rate**

- The speed or velocity of a reaction with which a reactant or reactants undergoes a change.
- It is determined by the change in the concentration of the reactants or products as a function of time.

**Order of reaction**

- The number of concentrations that determine rate.
- The way in which the concentration of the reactant influences the rate.

# Types of order of reaction

**Zero order of reaction**

- Rate is constant and is independent of the concentration of any of the reactants.

**First order of reaction**

- The reaction rate of change is proportional to drug concentration.

**Second order of reaction**

- Rate depends on the product of two concentration terms. When you have two components reacting with each other or one component reacting with itself.

**Pseudo order of reaction**

- For some reactions, the rate of the reaction may be independent of the concentration of one or more of the reacting species over a wide range of reactions.

# Overall order of reaction

| Order | Rate Law | Concentration - Time Equation | Half Life | Graphical Plot |
|---|---|---|---|---|
| 0 | Rate = $k_0$ | $[A]_0 - [A] = k_0 t$ | $\frac{[A]_0}{2k_0}$ | [A] vs t |
| 1 | Rate = $k_1 [A]$ | $\log \frac{[A]_0}{[A]} = \frac{k t}{2.303}$ | $\frac{0.693}{k}$ | log A vs t |
| 2 | Rate = $k_2 [A]^2$ | $\frac{1}{[A]} = kt + \frac{1}{[A]_0}$ | $\frac{1}{(k_2 [A]_0)}$ | $\frac{1}{[A]}$ vs t |

# Shelf life

It is defined as the time required for the concentration of the reactant to reduce to 90% of its initial concentration .

Represented as t90

the units of time /conc.

$t90 = (a-0.9a)/ k_o = 0.1\ a/ k_o$

Where,

a = initial concentration.

ko = specific rate constant for zero order reaction.