Chapter Summary: Kinetics: Rates of Reactions

Rate of reaction: Change in concentration of product in unit time.
Rate of reaction = Δ[product] / Δ t [ ] indicates concentration, Δ indicates change
Rate law of a reaction: Expresses the relationship of concentration of reactants to rate of reaction.

e.g. aA + bB ⟶ cC + dD

Rate = k $[A]^m$ $[B]^n$
Where k is rate constant and *m*, *n* are small positive integers 0, 1, 2 etc. determined experimentally only.
Reaction Order: Indicates which reactant concentration affects the rate of reaction.
Zero Order Reaction: reaction rate is independent of the concentration of reactants.
First Order Reaction: sum of *m* and *n* is 1. Rate doubles when conc. is doubled.
Second Order Reaction: sum of *m* and *n* is 2. Rate quadruples when conc. is doubled.
Integrated Rate Law: used to determine concentrations of reactions at different times.
Half life of Reaction (t ½): is the time in which half of the reactants are consumed.

Order	**Rate Law**	**Integrated Rate Law**	**Half life**	**Straight-Line Plot**
0	Rate = k	$[A]_t = -kt + [A]_0$	$\frac{[A]_0}{2k}$	[A] vs t The y-intercept is $[A]_0$
1	Rate = k[A]	$\ln \frac{[A]t}{[A]0} = -kt$	$\frac{0.693}{k}$	ln[A] vs t The graph crosses the origin (0)
2	Rate = $k[A]^2$	$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$	$\frac{1}{k[A]_0}$	$\frac{1}{[A]0}$ vs t The y-intercept is $1/[A]_0$

Theories of Chemical Kinetics
Transition State Theory: All reactants form a transition state before forming products. Activation energy is the minimum energy required for a transition state to form which results in formation of products.
Collision theory: Rate of reaction depends on how many collisions the reactants molecules undergo and the effectiveness of the collisions. Thus, rates are dependent on energy/temperature of reaction. Generally, rate increases tenfold when temperature is doubled.
Arrhenius equation: Rate constant k = $Ae^{-Ea/RT}$

$$ln\frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

Speed of reactions depends on:
1) concentration/state of reactants 2) temperature 3) surface area 4) catalysts

Key Words

Speed of reaction	Rate of reaction	Rate law, Rate constant
Zero, First and Second order reaction	Half life	Activation energy Transition state
Collision theory	Rate determining step	Catalyst: Homogeneous, heterogeneous,