Chemical kinetics terms

Chemical Kinetics – Important Terms and Equations
(For NEET/JEE/UG level reference – concise but complete)

Key Terms

1. **Rate of Reaction** – Change in concentration of reactant/product per unit time.

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

2. **Average Rate** – Total change in concentration over a time interval.
3. **Instantaneous Rate** – Rate at a particular moment, obtained from derivative.
4. **Rate Law / Rate Equation** – Relation between rate and concentration of reactants.

$$r = k[A]^m[B]^n$$

   where m, n are reaction orders, k is the rate constant.

5. **Order of Reaction** – Sum of powers of concentrations in rate law.
6. **Molecularity** – Number of molecules colliding in an elementary step.
7. **Rate Constant (k)** – Proportionality constant, depends on temperature, independent of concentrations.
8. **Half-Life ($t_{1/2}$)** – Time required for half the reactant to be consumed.
9. **Activation Energy (E_a)** – Minimum energy required for a reaction to occur.
10. **Collision Theory** – Reactions occur due to effective collisions with proper orientation and energy.

Important Equations

1. **Rate Law (General)**

$$r = k[A]^m[B]^n$$

2. **Integrated Rate Laws**
   - **Zero Order:**

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

     Half-life:

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

   - **First Order:**

$$[A]_t = [A]_0 e^{-kt} \quad \text{or} \quad \ln \frac{[A]_0}{[A]_t} = kt$$

Half-life:

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

- **Second Order (single reactant):**

$$\frac{1}{[A]_t} = \frac{1}{[A]_0} + kt$$

Half-life:

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

3. **Arrhenius Equation**

$$k = Ae^{-\frac{E_a}{RT}}$$

Linear form:

$$\ln k = \ln A - \frac{E_a}{R}\frac{1}{T}$$

4. **Temperature Dependence**

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

5. **Pseudo First Order**
When one reactant is in large excess, higher-order reactions appear as first-order. Example: Hydrolysis of ester in presence of water.
