Chemistry | JEE

Class 12 Chemistry - Chemical Kinetics

JEE track | Short Notes + 5 CBSE-based questions + 5 JEE Main PYQ-based questions with solutions

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Format: Quick revision + solved practice	Chapter scope: Class 12 Chemistry

1. Quick Short Notes

- Rate of reaction is the change in concentration of reactant or product per unit time.
- For a reaction aA + bB -> products, rate law may be written as r = k[A]^m[B]^n.
- Order of reaction = m + n. It is obtained experimentally and may differ from stoichiometric coefficients.
- Molecularity is the number of reacting species colliding in an elementary step.
- Zero-order integrated law: [A] = [A]0 - kt and t1/2 = [A]0 / 2k.
- First-order integrated law: ln[A] = ln[A]0 - kt and t1/2 = 0.693/k.
- Second-order integrated law for 2A -> products: 1/[A] = 1/[A]0 + kt.
- Arrhenius equation: k = A e^(-Ea/RT). Higher temperature generally increases k.
- A catalyst speeds up reaction by lowering activation energy; it does not change equilibrium constant.
- Board tip: always write correct units of rate constant because they identify order.

2. CBSE-based Board Practice

Q1. Differentiate between order and molecularity of a reaction.

Solution: Order is the sum of powers of concentration terms in the experimentally determined rate law. Molecularity is the number of species colliding in an elementary step and is always a whole number.

Q2. The rate constant of a first-order reaction is 0.231 min^-1. Find its half-life.

Solution: For first order, t1/2 = 0.693/k = 0.693/0.231 = 3.0 min.

Q3. For a zero-order reaction with [A]0 = 0.60 M and k = 0.02 M min^-1, find concentration after 10 min.

Solution: For zero order, [A] = [A]0 - kt = 0.60 - 0.02 x 10 = 0.40 M.

Q4. Why is half-life independent of initial concentration in a first-order reaction?

Solution: Because for first-order kinetics t1/2 = 0.693/k, which contains no concentration term.

Q5. If the unit of rate constant is s^-1, identify the order of the reaction.

Solution: A rate constant with unit s^-1 corresponds to a first-order reaction.

3. JEE Main PYQ-based Practice

Q1. For a reaction, doubling the concentration of the reactant doubles the rate. What is the order with respect to that reactant?

Solution: If rate becomes 2 times on doubling concentration, rate is proportional to concentration^1. Hence order = 1.

Q2. For a second-order reaction, k = 0.5 M^-1 s^-1 and initial concentration is 0.2 M. Find the half-life.

Solution: For second order, t1/2 = 1/(k[A]0) = 1/(0.5 x 0.2) = 10 s.

Q3. Give one common example of a pseudo-first-order reaction.

Solution: Hydrolysis of an ester in excess water is pseudo-first-order because concentration of water remains effectively constant.

Q4. Why does rate constant increase with increase in temperature according to Arrhenius theory?

Solution: At higher temperature, a larger fraction of molecules has energy greater than activation energy, so successful collisions increase and k rises.

Q5. For a first-order reaction, what is the time required for 75 percent completion?

Solution: 75 percent completion means 25 percent reactant left, i.e. two half-lives. Hence time = 2t1/2 = 2 x 0.693/k = 1.386/k.

Practice tip: First revise the short notes, then attempt CBSE board questions in written format, and finally solve the exam-specific section in timed mode.