

CLASS 12

CHEMISTRY

REVISION NOTES

Class 12 Chemistry Chapter 3 Chemical Kinetics – Revision Notes

Quick revision notes for Class 12 Chemistry Chapter 3 – Chemical Kinetics, covering rate of reaction, rate laws and order, integrated rate equations, half-life, and the Arrhenius equation. Ideal for last-minute board exam revision.

Contents

Rate of Reaction and Rate Law

Zero-Order and First-Order Reactions

Half-Life

Pseudo First-Order Reactions

Temperature Dependence: The Arrhenius Equation

One-Line Summary

Quick revision notes for **Class 12 Chemistry Chapter 3 – Chemical Kinetics**, covering rate of reaction, rate laws and order, integrated rate equations, half-life, and the Arrhenius equation. Ideal for last-minute board exam revision.

Rate of Reaction and Rate Law

The **rate of a reaction** is the change in concentration of a reactant or product per unit time. The **rate law** expresses rate as a function of reactant concentrations raised to experimentally determined powers, e.g. $\text{Rate} = k[A]^x[B]^y$, where k is the **rate constant**. The **order of reaction** is the sum of these powers ($x+y$) — it can be zero, fractional or a whole number, and must be found experimentally, unlike **molecularity** (the number of species colliding in an elementary step), which is always a whole number and applies only to a single mechanistic step.

Zero-Order and First-Order Reactions

For a **zero-order** reaction, $\text{rate} = k$ (independent of concentration); integrating gives $[A]_t = [A]_0 - kt$, so concentration falls **linearly** with time, and k has the same units as rate (e.g. $\text{mol L}^{-1}\text{s}^{-1}$). For a **first-order** reaction, $\text{rate} = k[A]$; integrating gives $k = (1/t)\ln([A]_0/[A]_t)$, and k has units of $(\text{time})^{-1}$. Radioactive decay and many pseudo-first-order reactions (like ester hydrolysis in excess water) follow first-order kinetics.

Half-Life

The **half-life** ($t_{1/2}$) is the time taken for the concentration of a reactant to fall to half its initial value. For a **zero-order** reaction, $t_{1/2} = [A]_0/2k$ (depends on initial concentration). For a **first-order** reaction, $t_{1/2} = 0.693/k$ — notably **independent of initial concentration**, which is why radioactive decay (always first order) has a fixed, well-defined half-life regardless of sample size.

Pseudo First-Order Reactions

A reaction that is intrinsically of higher order can behave as **pseudo first order** when one reactant is present in large excess, so its concentration stays effectively constant during the reaction. A classic example is the acid hydrolysis of an ester ($\text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH}$), which is genuinely second order but, since water is the solvent and present in vast excess, follows first-order kinetics with respect to the ester alone.

Temperature Dependence: The Arrhenius Equation

The rate constant of most reactions **increases with temperature**, quantified by the **Arrhenius equation**: $k = Ae^{-E_a/RT}$, where A is the pre-exponential (frequency) factor, E_a is the **activation energy** (the minimum extra energy reactant molecules need to react successfully), R is the gas constant, and T is the absolute temperature. Taking logarithms gives the linear form $\ln k = \ln A - E_a/RT$, so plotting $\ln k$ against $1/T$ gives a straight line of slope $-E_a/R$, letting E_a be found graphically from rate-constant data at different temperatures.

One-Line Summary

Chapter 3 explains how reaction rate is captured by an experimentally determined rate law and order, how

zero- and first-order reactions integrate to give concentration-time relationships and a characteristic half-life, and how the Arrhenius equation quantifies why raising the temperature speeds up a reaction by increasing the fraction of molecules with enough energy to cross the activation-energy barrier.

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