

CLASS 12

CHEMISTRY

REVISION NOTES

Class 12 Chemistry Chapter 2 Electrochemistry – Revision Notes

Quick revision notes for Class 12 Chemistry Chapter 2 – Electrochemistry, covering galvanic cells, electrode potentials, the Nernst equation, conductivity and molar conductivity, Kohlrausch's law, and Faraday's laws of electrolysis. Ideal for last-minute board exam revision.

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Common Mistakes Students Make in Electrochemistry

Mixing up electrode conventions: oxidation happens at the anode in both galvanic and electrolytic cells, but which electrode is positive/negative flips between the two cell types — a very common mix-up.

Nernst equation sign/unit errors: sign mistakes, or forgetting to convert temperature to Kelvin before substituting.

Confusing molar and specific conductivity: mixing up the two, or misapplying Kohlrausch's law for weak electrolytes.

Faraday's law mix-ups: losing track of which quantity (charge, moles of electrons, mass deposited) to solve for first in a multi-step numerical.

Galvanic Cells and Electrode Potential

A **galvanic (voltaic) cell** converts the chemical energy of a spontaneous redox reaction into electrical energy using two half-cells connected by a salt bridge and an external wire. The electrode where oxidation occurs is the **anode** (negative terminal); the electrode where reduction occurs is the **cathode** (positive terminal). The **standard electrode potential (E°)** of a half-cell is measured relative to the standard hydrogen electrode ($E^\circ = 0\text{V}$) under standard conditions (1M, 1 bar, 298K), and the **standard cell potential** is $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$.

The Nernst Equation

For a general electrode $M^{n+} + ne^- \rightarrow M$, the electrode potential under non-standard conditions is given by the **Nernst equation**: $E = E^\circ - (0.0591/n)\log[1/[M^{n+}]]$ at 298K. For a full cell reaction, $E_{\text{cell}} = E^\circ_{\text{cell}} - (0.0591/n)\log Q$, where Q is the reaction quotient. The relation $\Delta G^\circ = -nFE^\circ_{\text{cell}}$ links cell potential to Gibbs energy and confirms that a positive E°_{cell} means a spontaneous reaction; at equilibrium, $E_{\text{cell}} = 0$ and $\Delta G = 0$.

Conductivity and Molar Conductivity

Conductivity (κ) is the reciprocal of resistivity and measures a solution's ability to conduct current. **Molar conductivity ($\Lambda_m = \kappa/c$)** is the conductivity contributed by one mole of electrolyte. For **strong electrolytes**, Λ_m rises only gently with dilution and can be extrapolated to Λ°_m (molar conductivity at infinite dilution) from a Λ_m vs $\sqrt{c}$ plot. For **weak electrolytes**, Λ_m rises sharply near $c=0$ (because the degree of dissociation itself increases on dilution), so direct extrapolation fails and Λ°_m must be found using Kohlrausch's law instead.

Kohlrausch's Law

Kohlrausch's law of independent migration of ions states that at infinite dilution, each ion migrates independently and contributes a fixed amount to the total molar conductivity, regardless of the other ion present. This allows Λ°_m of a weak electrolyte to be calculated from the Λ°_m values of strong electrolytes sharing its ions (e.g. $\Lambda^\circ_m(\text{CH}_3\text{COOH}) = \Lambda^\circ_m(\text{CH}_3\text{COONa}) + \Lambda^\circ_m(\text{HCl}) - \Lambda^\circ_m(\text{NaCl})$), and lets the degree of dissociation ($\alpha = \Lambda_m/\Lambda^\circ_m$) and dissociation constant (K_a) of a weak electrolyte be determined.

Faraday's Laws of Electrolysis

Faraday's first law: the mass of substance deposited/liberated at an electrode is directly proportional to the charge passed ($m = Zq = ZIt$). **Faraday's second law:** when the same quantity of charge passes through several electrolytes, the masses deposited are proportional to their equivalent weights. One **Faraday ($F \approx 96,500 \text{ C}$)** is the charge carried by one mole of electrons, and is the charge needed to deposit one gram-equivalent of any substance.

One-Line Summary

Chapter 2 covers how galvanic cells convert redox chemistry into electrical energy via electrode potentials and the Nernst equation, how conductivity and molar conductivity behave differently for strong and weak electrolytes, how Kohlrausch's law finds Λ°_m for weak electrolytes, and how Faraday's laws quantify the mass changes that occur during electrolysis.

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What to Revise First (and Last) in This Chapter

Prioritise the anode/cathode conventions and the Nernst equation first, since they anchor most other questions in this chapter. Leave Kohlrausch's law and how molar conductivity varies with concentration for an earlier, slower revision pass.

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