

Class 12 Chemistry - Electrochemistry

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

- A galvanic cell converts chemical energy into electrical energy through a spontaneous redox reaction.
- Anode is the electrode where oxidation occurs; cathode is the electrode where reduction occurs.
- Standard cell potential: $E_{\text{cell}} = E(\text{cathode}) - E(\text{anode})$.
- Gibbs energy relation: $\Delta G = -nFE_{\text{cell}}$ and $\Delta G^{\circ} = -nFE^{\circ}_{\text{cell}}$.
- Nernst equation at 298 K: $E = E^{\circ} - (0.0591/n) \log Q$.
- Conductance $G = 1/R$. Conductivity $\kappa = G \times (l/A) = G \times \text{cell constant}$.
- Molar conductivity $\Lambda_m = \kappa \times 1000 / C$ when C is in mol per litre.
- Molar conductivity increases on dilution because ions move more freely and ion-ion interactions reduce.
- Kohlrausch's law: at infinite dilution, limiting molar conductivity is the sum of individual ionic contributions.
- Board tip: in cell notation, anode is written on the left and cathode on the right.

2. CBSE-based Board Practice

Q1. Calculate the standard emf of the cell $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$. Given $E^{\circ}(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$ and $E^{\circ}(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$.

Solution: $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} = 0.34 - (-0.76) = 1.10 \text{ V}$.

Q2. Write the Nernst equation for the Zn-Cu cell and calculate cell emf when $[\text{Zn}^{2+}] = 1 \text{ M}$ and $[\text{Cu}^{2+}] = 0.01 \text{ M}$ at 298 K.

Solution: Cell reaction: $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$, so $n = 2$ and $Q = [\text{Zn}^{2+}]/[\text{Cu}^{2+}] = 100$. $E = 1.10 - (0.0591/2)\log 100 = 1.10 - 0.0591 = 1.0409 \text{ V}$.

Q3. State the relation between standard Gibbs energy change and standard cell emf. Calculate ΔG° for a 2-electron cell with $E^{\circ} = 1.10 \text{ V}$.

Solution: $\Delta G^{\circ} = -nFE^{\circ}$. So $\Delta G^{\circ} = -2 \times 96500 \times 1.10 = -2.123 \times 10^5 \text{ J mol}^{-1}$ approx $-212.3 \text{ kJ mol}^{-1}$.

Q4. Define molar conductivity. Why does it increase on dilution?

Solution: Molar conductivity is the conductivity of the volume of solution containing one mole of electrolyte between electrodes 1 cm apart. It increases on dilution because ions move more independently and total ionic mobility increases.

Q5. How much silver is deposited when 965 C of electricity is passed through AgNO₃ solution?

Solution: For Ag⁺, 96500 C deposits 108 g Ag. Therefore 965 C deposits $(108 \times 965/96500) = 1.08$ g Ag.

3. JEE Main PYQ-based Practice

Q1. For a cell with $E^0 = 0.80$ V and $n = 1$, calculate the cell emf when $Q = 10$ at 298 K.

Solution: $E = E^0 - (0.0591/n)\log Q = 0.80 - 0.0591 \times 1 = 0.7409$ V.

Q2. A conductivity cell has resistance 50 ohm and cell constant 1.25 cm⁻¹. Find the conductivity of the solution.

Solution: Conductance $G = 1/R = 1/50 = 0.02$ S. Therefore $\kappa = G \times \text{cell constant} = 0.02 \times 1.25 = 0.025$ S cm⁻¹.

Q3. The conductivity of a 0.01 M solution is 1.2×10^{-3} S cm⁻¹. Calculate its molar conductivity.

Solution: $\Lambda_m = \kappa \times 1000 / C = 1.2 \times 10^{-3} \times 1000 / 0.01 = 120$ S cm² mol⁻¹.

Q4. Why is a lithium-ion battery called a secondary battery?

Solution: Because it is rechargeable. The cell reaction can be reversed by passing current in the opposite direction.

Q5. If E_{cell} is positive under given conditions, what can you say about spontaneity and Gibbs energy?

Solution: A positive cell emf means the cell reaction is spontaneous. Hence ΔG is negative.

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.