

CLASS 12

CHEMISTRY

EXTRA QUESTIONS

Class 12 Chemistry Chapter 2 Electrochemistry – Extra Questions with Answers

These extra practice questions for Class 12 Chemistry Chapter 2 – Electrochemistry go beyond the NCERT textbook exercises to reinforce galvanic cells, electrode potentials, the Nernst equation, conductivity and molar conductivity, Kohlrausch's law, and Faraday's laws of electrolysis. Useful for board exam revision...

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How to Approach the HOTS Questions in This Chapter

HOTS questions on Electrochemistry often ask you to predict whether a reaction is feasible using standard electrode potentials, rather than just calculating an EMF value directly — practice using electrode potentials to reason about spontaneity and feasibility, not only to compute a number.

Very Short Answer Type Questions (1 Mark)

Q1. What is a galvanic cell?

Ans: A galvanic (voltaic) cell is an electrochemical device that converts the chemical energy of a spontaneous redox reaction directly into electrical energy, using two electrodes dipped in electrolyte solutions and connected externally by a wire and internally by a salt bridge.

Q2. Define the term “standard electrode potential.”

Ans: The standard electrode potential is the potential of an electrode measured relative to a standard hydrogen electrode (taken as 0V), under standard conditions (1M concentration, 1 bar pressure for gases, 298K).

Q3. What is molar conductivity?

Ans: Molar conductivity (Λ_m) is the conducting power of all the ions produced by dissolving one mole of an electrolyte in a given volume of solution; it equals the conductivity (κ) divided by molar concentration ($\Lambda_m = \kappa/c$).

Q4. State Kohlrausch's law of independent migration of ions.

Ans: At infinite dilution, the molar conductivity of an electrolyte can be expressed as the sum of the individual contributions of its constituent ions — each ion migrates independently and contributes a fixed value to the total molar conductivity, regardless of the nature of the other ion it is paired with.

Short Answer Type Questions (2–3 Marks)

Q5. Distinguish between a strong electrolyte and a weak electrolyte on the basis of how their molar conductivity varies with concentration.

Ans: For a **strong electrolyte**, molar conductivity increases only slightly as concentration decreases (dissociation is already nearly complete at all concentrations), and a plot of Λ_m against $\sqrt{c}$ is nearly linear, allowing Λ°_m to be found by extrapolation to zero concentration. For a **weak electrolyte**, molar conductivity increases sharply as concentration decreases, because the degree of dissociation increases markedly on dilution; the Λ_m vs $\sqrt{c}$ plot is not linear near $c=0$, so Λ°_m for a weak electrolyte must instead be obtained using Kohlrausch's law from the Λ°_m values of strong electrolytes containing the same ions.

Q6. Write the Nernst equation for a general electrode reaction $M^{n+} + ne^- \rightarrow M$, and explain what each term means.

Ans: $E = E^\circ - (RT/nF) \ln[1/[M^{n+}]]$, or in the common base-10, 298K form: $E = E^\circ - (0.0591/n) \log[1/[M^{n+}]]$. Here E is the electrode potential under the given (non-standard) conditions, E° is the standard electrode

potential, R is the gas constant, T is the temperature in kelvin, n is the number of electrons transferred, F is the Faraday constant, and $[M^{n+}]$ is the molar concentration of the metal ion.

Q7. State Faraday's first law of electrolysis and write its mathematical form.

Ans: Faraday's first law states that the mass of a substance deposited or liberated at an electrode during electrolysis is directly proportional to the quantity of electricity (charge) passed through the electrolyte.

Mathematically, $m = Zq = Z \times I \times t$, where m is the mass deposited, Z is the electrochemical equivalent, I is the current, and t is the time for which the current flows.

Higher Order Thinking Skills (HOTS)

Q8. A galvanic cell has a positive standard cell potential (E°_{cell}). Explain, using the relationship between E°_{cell} and ΔG° , why the corresponding cell reaction is spontaneous, and explain what happens to E_{cell} as the reaction proceeds toward equilibrium.

Ans: The two quantities are related by $\Delta G^\circ = -nFE^\circ_{\text{cell}}$. Since n and F are always positive, a positive E°_{cell} makes ΔG° negative, which is the thermodynamic condition for a spontaneous process — so a galvanic cell with positive E°_{cell} drives its reaction forward on its own. As the cell reaction proceeds, reactant concentrations fall and product concentrations rise; by the Nernst equation this steadily reduces E_{cell} toward zero. E_{cell} becomes exactly zero when the reaction reaches equilibrium, at which point $\Delta G = 0$ and no further net current flows — this is also the basis of the relation $E^\circ_{\text{cell}} = (RT/nF) \ln K_c$ connecting the standard cell potential to the equilibrium constant.

Q9. Two solutions of the same electrolyte are diluted: one is a strong electrolyte, the other a weak electrolyte. Explain why extrapolating a Λ_m vs $\sqrt{c}$ plot to $c \rightarrow 0$ works well for the strong electrolyte but fails for the weak electrolyte, and describe how Λ°_m is obtained for the weak electrolyte instead.

Ans: For the strong electrolyte, dissociation is essentially complete at every concentration studied, so Λ_m varies only gently (and almost linearly with $\sqrt{c}$) as concentration falls, making a short linear extrapolation to $\sqrt{c}=0$ reliable. For the weak electrolyte, the degree of dissociation itself changes sharply with dilution (rising toward 1 only at extremely low, experimentally inaccessible concentrations), so Λ_m rises very steeply just before $c=0$ and the plot is strongly non-linear there — a linear extrapolation from measurable concentrations would badly underestimate Λ°_m . Instead, Λ°_m for the weak electrolyte is calculated using Kohlrausch's law of independent migration: it is built up from the (reliably extrapolated) Λ°_m values of strong electrolytes that share its ions — for example, $\Lambda^\circ_m(\text{CH}_3\text{COOH}) = \Lambda^\circ_m(\text{CH}_3\text{COONa}) + \Lambda^\circ_m(\text{HCl}) - \Lambda^\circ_m(\text{NaCl})$.

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