

Electrochemistry Important Questions



Here are the key points for each of the important questions related to **Electrochemistry** in Class 12:

Short Answer Questions (2-3 Marks)

1. Electrochemical Cells:

- A device that converts chemical energy into electrical energy or vice versa.
- Consists of two half-cells connected via a salt bridge.
- Example: Galvanic cells (spontaneous), Electrolytic cells (non-spontaneous).

2. Differences Between Electrolytic and Galvanic Cells:

- **Galvanic Cell:** Converts chemical energy to electrical energy, spontaneous reaction.
- **Electrolytic Cell:** Uses electrical energy to drive a non-spontaneous reaction.
- In a galvanic cell, the anode is negative, and the cathode is positive, while in an electrolytic cell, the anode is positive, and the cathode is negative.

3. Faraday's Laws of Electrolysis:

- **First Law:** The amount of substance deposited or liberated at an electrode is directly proportional to the quantity of electricity passed through the electrolyte.
- **Second Law:** The amount of different substances liberated by the same quantity of electricity is proportional to their equivalent weights.

4. Conductance and Its Units:

- **Conductance (G):** The ability of an electrolyte to conduct electricity. It is the inverse of resistance.
- **Units:** Siemens (S) or ohm^{-1} .

5. Kohlrausch's Law and Applications:

- States that at infinite dilution, each ion contributes a definite value to the molar conductivity of the electrolyte, independent of the other ions.
- **Applications:**
 - To determine the limiting molar conductivities of weak electrolytes.
 - To calculate the degree of dissociation and ion concentration.

6. Nernst Equation:

- $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \left(\frac{RT}{nF}\right) \ln Q$
- Where:
 - E_{cell} is the cell potential.
 - E_{cell}° is the standard cell potential.
 - R is the gas constant, T is the temperature, n is the number of moles of electrons, F is the Faraday constant, and Q is the reaction quotient.

Numerical Problems (2-5 Marks)

1. Standard Cell Potential Calculation:

- Use the equation: $E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$.
- Apply standard electrode potentials from tables and subtract the anode from the cathode potential.

2. Molar Conductivity and Degree of Dissociation:

- $\Lambda_m = \frac{\kappa}{c}$, where Λ_m is molar conductivity, κ is conductivity, and c is concentration.
- Degree of dissociation $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$.

3. Nernst Equation for Emf Calculation:

- Use the Nernst equation to calculate the emf under non-standard conditions.

4. Faraday's Laws:

- For calculating substance deposition: $m = \frac{ZIt}{F}$, where Z is the equivalent weight, I is current, and t is time.

Long Answer Questions (5 Marks)

1. Lead-Acid Battery Working:

- Consists of lead (Pb) and lead dioxide (PbO₂) as electrodes and sulfuric acid (H₂SO₄) as the electrolyte.
- Cell reactions: $\text{Pb} + \text{SO}_4^{2-} \rightarrow \text{PbSO}_4$ (at the anode) and $\text{PbO}_2 + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O}$ (at the cathode).
- Provides electrical energy during discharge and is recharged by reversing the reaction.

2. Relation Between Gibbs Free Energy and Cell Potential:

- $\Delta G = -nFE_{\text{cell}}$, where ΔG is Gibbs free energy, n is the number of moles of electrons, F is Faraday's constant, and E_{cell} is the cell potential.
- This shows how spontaneity of a reaction is linked to the cell potential.

3. Corrosion:

- **Definition:** The degradation of metals due to chemical reactions with the environment.
- **Prevention Methods:**
 - Coating with paint or other metals (galvanization).
 - Using corrosion inhibitors or sacrificial anodes (cathodic protection).

Application-Based Questions

1. Electrolysis of Molten Sodium Chloride:

- Inert electrodes (like platinum) are used because they do not react with the products of electrolysis.
- Sodium metal is produced at the cathode, and chlorine gas at the anode.

2. Importance of Salt Bridge:

- Maintains electrical neutrality by allowing the exchange of ions.
- Prevents the mixing of electrolytes while completing the circuit.

3. Arrhenius Theory and Weak Electrolytes:

- Arrhenius theory doesn't explain the partial dissociation of weak electrolytes at different concentrations.
- Degree of dissociation varies with concentration, which requires Kohlrausch's law for explanation.

Tips for Numerical Problems:

- Memorize standard values like the gas constant R , Faraday constant F , and electrode potentials for common electrodes.
- Practice applying the Nernst equation and Faraday's laws in different scenarios.
- Understand the steps to derive formulas like conductivity, molar conductance, and the relation between free energy and cell potential.

