

Q1. The standard electrode potential of Zn^{2+}/Zn and Cu^{2+}/Cu are -0.76 V and $+0.34\text{ V}$ respectively. The EMF of the cell $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$ is:

- A. 1.10 V
- B. -1.10 V
- C. 0.42 V
- D. -0.42 V

Answer: A. 1.10 V

Explanation:

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.34 - (-0.76) = 1.10\text{ V}$$

Q2. Which of the following will have the highest electrical conductivity?

- A. 0.1 M acetic acid
- B. 0.1 M NaCl
- C. 0.1 M glucose
- D. 0.1 M NH_4OH

Answer: B. 0.1 M NaCl

Explanation:

NaCl is a strong electrolyte and completely ionizes \rightarrow maximum conductivity

Q3. Which of the following is used as a salt bridge in electrochemical cells?

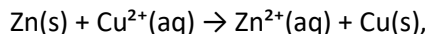
- A. KNO_3
- B. NaOH
- C. HCl
- D. CH_3COOH

Answer: A. KNO_3

Explanation:

KNO_3 is a neutral salt and does not interfere with redox reactions.

**Q4. For the cell reaction:



which of the following statements is true?**

- A. Cu is oxidized
- B. Zn is reduced
- C. Cu^{2+} is reduced
- D. Zn^{2+} is reduced

Answer: C. Cu^{2+} is reduced

Explanation:

Cu^{2+} gains electrons \rightarrow gets reduced.

****Q5.** The Nernst equation for the cell reaction:

$\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$ is:**

- A. $E = E^\circ - (0.0591/n) \log [\text{Zn}^{2+}]/[\text{Cu}^{2+}]$
- B. $E = E^\circ + (0.0591/n) \log [\text{Zn}^{2+}]/[\text{Cu}^{2+}]$
- C. $E = E^\circ - (0.0591/n) \log [\text{Cu}^{2+}]/[\text{Zn}^{2+}]$
- D. $E = E^\circ + (0.0591/n) \log [\text{Cu}^{2+}]/[\text{Zn}^{2+}]$

Answer: A. $E = E^\circ - (0.0591/n) \log [\text{Zn}^{2+}]/[\text{Cu}^{2+}]$

Explanation:

Nernst: $E = E^\circ - (0.0591/n) \log Q$

$Q = [\text{Zn}^{2+}]/[\text{Cu}^{2+}]$ for the cell

Q6. The number of Faradays required to deposit 1 mole of Al from Al^{3+} is:

- A. 1
- B. 2
- C. 3
- D. 6

Answer: C. 3

Explanation:

$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$

\rightarrow Requires 3 Faradays per mole of Al

Q7. In an electrolytic cell, which of the following occurs at the cathode?

- A. Oxidation
- B. Reduction
- C. Electron loss
- D. Anion discharge

Answer: B. Reduction

Explanation:

Cathode is the site of reduction (gain of electrons) in all cells.

Q8. Which of the following electrodes has the highest standard reduction potential?

- A. $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$
- B. $\text{Fe}^{2+}/\text{Fe} = -0.44 \text{ V}$
- C. $\text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$
- D. $\text{Ag}^{+}/\text{Ag} = +0.80 \text{ V}$

Answer: D. $\text{Ag}^{+}/\text{Ag} = +0.80 \text{ V}$

Explanation:

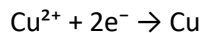
More positive $E^{\circ} \rightarrow$ stronger oxidizing agent \rightarrow greater reduction potential.

Q9. If 9650 C of charge is passed through CuSO_4 solution, the mass of Cu deposited is: (Atomic mass of Cu = 63.5 g/mol)

- A. 6.35 g
- B. 31.75 g
- C. 0.635 g
- D. 1.587 g

Answer: A. 6.35 g

Explanation:



1 mol Cu (63.5 g) needs 2 Faradays = $2 \times 96500 \text{ C}$

So, 9650 C gives: $(63.5 \times 9650)/(2 \times 96500) = 6.35 \text{ g}$

Q10. Conductivity (κ) of a solution is $1.5 \times 10^{-2} \text{ S/cm}$ and its cell constant is 1.2 cm^{-1} . What is its molar conductivity if concentration is 0.01 mol/L ?

- A. $150 \text{ S cm}^2 \text{ mol}^{-1}$

- B. $180 \text{ S cm}^2 \text{ mol}^{-1}$
- C. $120 \text{ S cm}^2 \text{ mol}^{-1}$
- D. $200 \text{ S cm}^2 \text{ mol}^{-1}$

Answer: B. $180 \text{ S cm}^2 \text{ mol}^{-1}$

Explanation:

$$\kappa = \text{Conductance} \times \text{Cell constant} = 1.5 \times 10^{-2} \times 1.2 = 0.018 \text{ S/cm}$$

$$\Lambda_m = \kappa \times 1000 / C = 0.018 \times 1000 / 0.01 = 180 \text{ S cm}^2 \text{ mol}^{-1}$$

Q11. Kohlrausch's law is used to determine:

- A. Molecular weight of salt
- B. EMF of cell
- C. Limiting molar conductivity of weak electrolyte
- D. Solubility

Answer: C. Limiting molar conductivity of weak electrolyte

Explanation:

$$\text{Kohlrausch's Law: } \Lambda^0(\text{AB}) = \Lambda^0(\text{A}^+) + \Lambda^0(\text{B}^-)$$

Q12. Which of the following is correct regarding electrolytic cell?

- A. EMF is positive
- B. Chemical energy \rightarrow electrical
- C. Spontaneous reaction
- D. Anode is positive

Answer: D. Anode is positive

Explanation:

In electrolytic cell, anode is positive (connected to + terminal) and oxidation occurs there.

Q13. The limiting molar conductivity of NH_4OH can be calculated using:

- A. $\lambda^0(\text{NH}_4^+) + \lambda^0(\text{OH}^-)$
- B. $\lambda^0(\text{NH}_4\text{OH})$
- C. $\lambda^0(\text{NH}_4^+) - \lambda^0(\text{OH}^-)$
- D. $\lambda^0(\text{H}^+) + \lambda^0(\text{NH}_4^+)$

Answer: A. $\lambda^\circ(\text{NH}_4^+) + \lambda^\circ(\text{OH}^-)$

Explanation:

Kohlrausch's law: $\Lambda^\circ = \lambda^\circ(\text{cation}) + \lambda^\circ(\text{anion})$

Q14. Which of the following statements is incorrect?

- A. Electrolytic cells use external power
- B. Galvanic cells produce electricity
- C. Salt bridge maintains electrical neutrality
- D. Oxidation occurs at cathode in galvanic cell

Answer: D. Oxidation occurs at cathode in galvanic cell

Explanation:

Oxidation occurs at anode, not cathode.

Q15. Which of the following has highest molar conductivity at infinite dilution?

- A. NaCl
- B. KCl
- C. CH_3COOH
- D. HCl

Answer: D. HCl

Explanation:

H^+ has highest ionic mobility \rightarrow HCl has highest Λ°

Q16. Which one of the following solutions will have the lowest molar conductivity?

- A. 0.01 M NaCl
- B. 0.01 M CH_3COOH
- C. 0.01 M HCl
- D. 0.01 M NH_4OH

Answer: D. 0.01 M NH_4OH

Explanation:

NH_4OH is a weak base and ionizes very little, resulting in lowest Λ_m .

Q17. Which metal is best suited for making the anode in a galvanic cell based on standard electrode potential values?

- A. Cu
- B. Zn
- C. Ag
- D. Fe

Answer: B. Zn

Explanation:

Zn has more negative E° (-0.76 V), making it easily oxidizable \rightarrow good anode.

Q18. Which of the following does NOT function as an electrolytic cell component?

- A. Electrodes
- B. Battery
- C. Salt bridge
- D. Voltmeter

Answer: D. Voltmeter

Explanation:

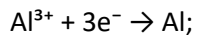
Voltmeter is used in galvanic cells to measure EMF, not in electrolytic cells.

Q19. When 1 Faraday of electricity is passed through molten Al_2O_3 , how many grams of Al are deposited?
(Atomic mass = 27 g/mol)

- A. 27 g
- B. 13.5 g
- C. 9 g
- D. 18 g

Answer: C. 9 g

Explanation:



1 mole Al needs 3F \rightarrow 1F deposits $\frac{1}{3}$ mol = $\frac{27}{3}$ = 9 g

Q20. What is the cell representation of a galvanic cell in which Zn is oxidized and Ag^+ is reduced?

- A. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$
- B. $\text{Ag} \mid \text{Ag}^+ \parallel \text{Zn}^{2+} \mid \text{Zn}$
- C. $\text{Ag}^+ \mid \text{Ag} \parallel \text{Zn}^{2+} \mid \text{Zn}$
- D. $\text{Zn}^{2+} \mid \text{Zn} \parallel \text{Ag} \mid \text{Ag}^+$

Answer: A. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$

Explanation:

Anode (oxidation) on left, cathode (reduction) on right.

Q21. A solution contains 0.01 M Ag^+ . The electrode potential for Ag^+/Ag at 298 K is ($E^\circ = +0.80 \text{ V}$):

- A. 0.80 V
- B. 0.74 V
- C. 0.86 V
- D. 0.60 V

Answer: B. 0.74 V

Explanation:

Use Nernst:

$$\begin{aligned} E &= E^\circ - (0.0591/1) \log(1/[\text{Ag}^+]) = 0.80 - 0.0591 \times \log(1/0.01) \\ &= 0.80 - 0.0591 \times 2 = 0.74 \text{ V} \end{aligned}$$

Q22. Which statement is true about conductivity of electrolytes?

- A. Increases with dilution
- B. Decreases with dilution
- C. Constant at all concentrations
- D. Independent of temperature

Answer: B. Decreases with dilution

Explanation:

Conductivity (κ) decreases because number of ions per volume reduces.

Q23. Molar conductivity of a weak electrolyte like CH_3COOH :

- A. Increases sharply on dilution
- B. Decreases on dilution
- C. Remains constant

D. Equals conductivity \times concentration

Answer: A. Increases sharply on dilution

Explanation:

Weak electrolyte ionizes more on dilution \rightarrow sharp rise in Λ_m .

Q24. Which cell will have the highest EMF under standard conditions?

A. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$

B. $\text{Fe} \mid \text{Fe}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$

C. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$

D. $\text{Cu} \mid \text{Cu}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$

Answer: C. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Ag}^+ \mid \text{Ag}$

Explanation:

$E^\circ = E^\circ_{\text{Ag}} - E^\circ_{\text{Zn}} = 0.80 - (-0.76) = 1.56 \text{ V} \rightarrow$ highest

Q25. What is the role of salt bridge in a galvanic cell?

A. Maintains voltage

B. Prevents mixing of solutions

C. Completes internal circuit and maintains charge balance

D. Provides electrons

Answer: C. Completes internal circuit and maintains charge balance

Explanation:

Salt bridge allows ion flow to maintain neutrality.

Q26. The conductivity of a 0.01 M solution of CH_3COOH is less than that of NaCl of same concentration because:

A. Acetic acid has higher molecular weight

B. NaCl is more volatile

C. CH_3COOH is weakly ionized

D. NaCl is a covalent compound

Answer: C. CH_3COOH is weakly ionized

Explanation:

$\text{CH}_3\text{COOH} \leftrightarrow \text{CH}_3\text{COO}^- + \text{H}^+$ is partial; NaCl ionizes completely.

Q27. In galvanic cells, electrons flow:

- A. From cathode to anode
- B. From salt bridge to anode
- C. From anode to cathode
- D. From electrolyte to electrode

Answer: C. From anode to cathode

Explanation:

Oxidation at anode releases electrons \rightarrow flow toward cathode

Q28. What is the equivalent conductance of 0.01 M NaCl solution if its specific conductance is 0.0014 S/cm?

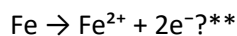
- A. 140 S cm² eq⁻¹
- B. 70 S cm² eq⁻¹
- C. 14 S cm² eq⁻¹
- D. 0.14 S cm² eq⁻¹

Answer: A. 140 S cm² eq⁻¹

Explanation:

$$\Lambda_{\text{eq}} = \kappa \times 1000 / C = 0.0014 \times 1000 / 0.01 = 140 \text{ S cm}^2 \text{ eq}^{-1}$$

**Q29. What is the oxidation number change of Fe in the reaction:



- A. 0 to +1
- B. 0 to +2
- C. +2 to 0
- D. +2 to +3

Answer: B. 0 to +2

Explanation:

Fe is oxidized from elemental state (0) to Fe²⁺ (+2)

Q30. Which electrode will oxidize Zn but not Fe? (Given: $E^\circ_{\text{Zn}} = -0.76 \text{ V}$, $E^\circ_{\text{Fe}} = -0.44 \text{ V}$)

- A. Cu^{2+}/Cu (0.34 V)
- B. Ag^+/Ag (0.80 V)
- C. Fe^{2+}/Fe (-0.44 V)
- D. Zn^{2+}/Zn (-0.76 V)

Answer: C. Fe^{2+}/Fe (-0.44 V)

Explanation:

Fe^{2+}/Fe can oxidize Zn (more negative) but not Fe (same)

Q31. In a conductivity cell, the resistance of 0.01 M KCl solution at 298 K is 100 ohm. If κ (conductivity) = $1.29 \times 10^{-3} \text{ S/cm}$, what is the cell constant?

- A. 0.0129 cm^{-1}
- B. 0.129 cm^{-1}
- C. 12.9 cm^{-1}
- D. 1.29 cm^{-1}

Answer: B. 0.129 cm^{-1}

Explanation:

Cell constant = $\kappa \times R = 1.29 \times 10^{-3} \times 100 = 0.129 \text{ cm}^{-1}$

Q32. For the cell: $\text{Zn} \mid \text{Zn}^{2+} (1 \text{ M}) \parallel \text{Cu}^{2+} (1 \text{ M}) \mid \text{Cu}$, if $E^\circ_{\text{Zn}} = -0.76 \text{ V}$ and $E^\circ_{\text{Cu}} = +0.34 \text{ V}$, the standard EMF is:

- A. 1.10 V
- B. 0.42 V
- C. -1.10 V
- D. -0.42 V

Answer: A. 1.10 V

Explanation:

$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.34 - (-0.76) = 1.10 \text{ V}$

Q33. The molar conductivity at infinite dilution of Na^+ and Cl^- are 50.1 and $76.3 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. What is the Λ°_{m} of NaCl?

- A. 126.4

- B. 136.4
- C. 116.4
- D. 126.0

Answer: A. $126.4 \text{ S cm}^2 \text{ mol}^{-1}$

Explanation:

$$\Lambda_m^\circ = \Lambda^\circ(\text{Na}^+) + \Lambda^\circ(\text{Cl}^-) = 50.1 + 76.3 = 126.4$$

Q34. In which case will Kohlrausch's law be used?

- A. Calculating solubility of salt
- B. Measuring pH
- C. Calculating λ_m° of weak electrolyte
- D. Determining resistance

Answer: C. Calculating λ_m° of weak electrolyte

Explanation:

Kohlrausch's law helps to estimate molar conductivity at infinite dilution.

Q35. The change in Gibbs free energy (ΔG) for a cell reaction is related to EMF by:

- A. $\Delta G = -nFE$
- B. $\Delta G = nFE$
- C. $\Delta G = -E/nF$
- D. $\Delta G = E \times nF$

Answer: A. $\Delta G = -nFE$

Explanation:

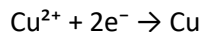
This is a standard thermodynamic relation for electrochemical cells.

Q36. How many faradays are required to deposit 1 mole of Cu from Cu^{2+} solution?

- A. 1 F
- B. 2 F
- C. 0.5 F
- D. 3 F

Answer: B. 2 F

Explanation:



1 mol needs 2 moles of electrons = 2 Faraday

Q37. Which factor does NOT affect electrode potential?

- A. Temperature
- B. Ion concentration
- C. Pressure
- D. Color of electrode

Answer: D. Color of electrode

Explanation:

Electrode potential depends on temp, concentration, and pressure—not color.

Q38. Which cell will not work as a galvanic cell?

- A. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$
- B. $\text{Fe} \mid \text{Fe}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$
- C. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Zn}^{2+} \mid \text{Zn}$
- D. $\text{Cu} \mid \text{Cu}^{2+} \parallel \text{Ag}^{+} \mid \text{Ag}$

Answer: C. $\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Zn}^{2+} \mid \text{Zn}$

Explanation:

Same electrodes and solution = no EMF = not galvanic

Q39. Which of the following has the highest molar conductivity at infinite dilution?

- A. NaCl
- B. KCl
- C. HCl
- D. CH_3COOH

Answer: C. HCl

Explanation:

H^{+} ion has extremely high mobility $\rightarrow \max \Lambda^{\circ}_{\text{m}}$

Q40. What will happen to cell EMF if concentration of Zn^{2+} is increased in Zn–Cu cell?

- A. Increases
- B. Decreases
- C. Remains same
- D. Becomes zero

Answer: B. Decreases

Explanation:

$$E = E^\circ - (0.0591/n) \log([\text{Zn}^{2+}]/[\text{Cu}^{2+}])$$

$\uparrow \text{Zn}^{2+} = \uparrow \text{denominator} \rightarrow \text{lower } E_{\text{cell}}$

Q41. What is the unit of molar conductivity (Λ_m)?

- A. $\text{S cm}^2 \text{ mol}^{-1}$
- B. S mol^{-1}
- C. S cm^{-1}
- D. Ohm^{-1}

Answer: A. $\text{S cm}^2 \text{ mol}^{-1}$

Explanation:

$$\Lambda_m = \kappa \times 1000 / C$$

$$\rightarrow \text{Unit} = \text{S cm}^{-1} \times \text{cm}^3 \text{ mol}^{-1} = \text{S cm}^2 \text{ mol}^{-1}$$

Q42. What is the main source of potential in an electrochemical cell?

- A. Flow of heat
- B. Transfer of electrons during redox reaction
- C. Electricity from salt bridge
- D. Friction in electrolyte

Answer: B. Transfer of electrons during redox reaction

Explanation:

EMF arises due to redox reactions causing charge separation.

Q43. Which method is used to determine conductance experimentally?

- A. Voltmeter

- B. Potentiometer
- C. Wheatstone bridge
- D. Conductivity cell and Wheatstone setup

Answer: D. Conductivity cell and Wheatstone setup

Explanation:

Wheatstone bridge + conductivity cell gives resistance $\rightarrow \kappa$

Q44. Which electrolyte will show highest conductivity at low concentration?

- A. HCl
- B. CH_3COOH
- C. NH_4OH
- D. H_2CO_3

Answer: A. HCl

Explanation:

Strong acid \rightarrow full ionization \rightarrow max conductivity

Q45. In electrolysis of CuSO_4 using copper electrodes, what happens at the anode?

- A. Oxygen evolution
- B. Hydrogen evolution
- C. Copper dissolves
- D. Copper is deposited

Answer: C. Copper dissolves

Explanation:

Anode (Cu) oxidized: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$