Q1. The standard electrode potential of Zn^{2+}/Zn and Cu^{2+}/Cu are –0.76 V and +0.34 V respectively. The EMF of the cell Zn | Zn^{2+} || Cu^{2+} | 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°cell = E°cathode – E°anode = 0.34 – (–0.76) = 1.10 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 → 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:

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$,
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 → gets reduced.

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

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

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

Answer: A. $E = E° – (0.0591/n) \log [Zn^{2+}]/[Cu^{2+}]$
Explanation:
Nernst: $E = E° – (0.0591/n) \log Q$
$Q = [Zn^{2+}]/[Cu^{2+}]$ 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:
$Al^{3+} + 3e^- \rightarrow Al$
→ 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. $Zn^{2+}/Zn = –0.76$ V
B. $Fe^{2+}/Fe = –0.44$ V
C. $Cu^{2+}/Cu = +0.34$ V
D. $Ag^{+}/Ag = +0.80$ V

Answer: D. $Ag^{+}/Ag = +0.80$ V
Explanation:
More positive E° → stronger oxidizing agent → 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:
$Cu^{2+} + 2e^{-} \rightarrow Cu$
1 mol Cu (63.5 g) needs 2 Faradays = 2 × 96500 C
So, 9650 C gives: (63.5 × 9650)/(2×96500) = 6.35 g

Q10. Conductivity (κ) of a solution is 1.5×10^{-2} 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 S cm^2 mol^{-1}

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

Answer: B. 180 S cm^2 mol^{-1}
Explanation:
κ = Conductance × Cell constant = $1.5\times10^{-2} \times 1.2 = 0.018$ S/cm
$\Lambda m = \kappa \times 1000 / C = 0.018 \times 1000 / 0.01 = 180$ S cm^2 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:
Kohlrausch's Law: $\Lambda^o(AB) = \Lambda^o(A^+) + \Lambda^o(B^-)$

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

A. EMF is positive
B. Chemical energy → 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. $\lambda^o(NH_4^+) + \lambda^o(OH^-)$
B. $\lambda^o(NH_4OH)$
C. $\lambda^o(NH_4^+) - \lambda^o(OH^-)$
D. $\lambda^o(H^+) + \lambda^o(NH_4^+)$

Answer: A. $\lambda^o(NH_4^+) + \lambda^o(OH^-)$
Explanation:
Kohlrausch's law: $\Lambda^o = \lambda^o(\text{cation}) + \lambda^o(\text{anion})$

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 → HCl has highest Λ^o

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 → 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:
$Al^{3+} + 3e^- \rightarrow Al$;
1 mole Al needs 3F → 1F deposits 1/3 mol = 27/3 = 9 g

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

A. Zn | Zn^{2+} || Ag^{+} | Ag
B. Ag | Ag^{+} || Zn^{2+} | Zn
C. Ag^{+} | Ag || Zn^{2+} | Zn
D. Zn^{2+} | Zn || Ag | Ag^{+}

Answer: A. Zn | Zn^{2+} || Ag^{+} | 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° = +0.80 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:
$E = E^{\circ} - (0.0591/1) \log(1/[Ag^{+}]) = 0.80 - 0.0591 \times \log(1/0.01)$
$= 0.80 - 0.0591 \times 2 = 0.74$ V

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 × concentration

Answer: A. Increases sharply on dilution
Explanation:
Weak electrolyte ionizes more on dilution → sharp rise in Λ_m.

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

A. Zn | Zn^{2+} || Cu^{2+} | Cu
B. Fe | Fe^{2+} || Cu^{2+} | Cu
C. Zn | Zn^{2+} || Ag^{+} | Ag
D. Cu | Cu^{2+} || Ag^{+} | Ag

Answer: C. Zn | Zn^{2+} || Ag^{+} | Ag
Explanation:
E° = E°Ag – E°Zn = 0.80 – (–0.76) = 1.56 V → 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:

$CH_3COOH \leftrightarrow CH_3COO^- + H^+$ 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 → 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 cm^2 eq^{-1}
B. 70 S cm^2 eq^{-1}
C. 14 S cm^2 eq^{-1}
D. 0.14 S cm^2 eq^{-1}

Answer: A. 140 S cm^2 eq^{-1}
Explanation:
$\Lambda eq = \kappa \times 1000 / C = 0.0014 \times 1000 / 0.01 = 140$ S cm^2 eq^{-1}

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

$Fe \rightarrow Fe^{2+} + 2e^-$?**

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 Fe^{2+} (+2)

Q30. Which electrode will oxidize Zn but not Fe? (Given: E°Zn = –0.76 V, E°Fe = –0.44 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) = 1.29×10^{-3} 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 = $\kappa \times R = 1.29 \times 10^{-3} \times 100 = 0.129\ cm^{-1}$

Q32. For the cell: Zn | Zn^{2+} (1 M) || Cu^{2+} (1 M) | Cu, if E°Zn = –0.76 V and E°Cu = +0.34 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°cell = E°cathode – E°anode = 0.34 – (–0.76) = 1.10 V

Q33. The molar conductivity at infinite dilution of Na^{+} and Cl^{-} are 50.1 and 76.3 S cm^2 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 S cm^2 mol^{-1}
Explanation:
$\Lambda^\circ_m = \Lambda^\circ(Na^+) + \Lambda^\circ(Cl^-) = 50.1 + 76.3 = 126.4$

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:
$Cu^{2+} + 2e^- \rightarrow Cu$
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. Zn | Zn^{2+} || Cu^{2+} | Cu
B. Fe | Fe^{2+} || Cu^{2+} | Cu
C. Zn | Zn^{2+} || Zn^{2+} | Zn
D. Cu | Cu^{2+} || Ag^{+} | Ag

Answer: C. Zn | Zn^{2+} || Zn^{2+} | 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 → max Λ°_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:
$E = E° – (0.0591/n) \log([Zn^{2+}]/[Cu^{2+}])$
↑Zn^{2+} = ↑denominator → lower Ecell

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

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

Answer: A. S cm^2 mol^{-1}
Explanation:
$\Lambda_m = \kappa \times 1000 / C$
→ Unit = S cm^{-1} × cm^3 mol^{-1} = S cm^2 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. Voltameter

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 → κ

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 → full ionization → 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: $Cu \rightarrow Cu^{2+} + 2e^-$