Electrochemistry

1. The $E^{\ominus}$ values for
$Al^{+}/Al = +0.55$ V and $Tl^{+}/Tl = -0.34$ V
$Al^{3+}/Al = -1.66$ V and $T^{3+}/Tl = +1.26$ V
Identify the incorrect statement **(2023)**
(a) Al is more electropositive than Tl
(b) Tl^{3+} is a good reducing agent than Tl^{1+}
(c) Al^{+} is unstable in solution
(d) Al^{+} can be easily oxidised Tl than Tl^{3+}

2. Molar conductance of an electrolyte increase with dilution according to the equation:
$\Lambda_m = \Lambda_m^{\circ} - A\sqrt{c}$
Which of the following statements are true?
(a) This equation applies to both strong and weak electrolytes.
(b) Value of the constant A depends upon the nature of the solvent.
(c) Value of constant A is same for both $BaCl_2$ and $MgSO_4$.
(d) Value of constant A is same for both $BaCl_2$ and $Mg(OH)_2$.
Choose the most appropriate answer from the options given below: **(2023)**
(a) A and B only
(b) A, B and C only
(c) B and C only
(d) B and D only

3. The correct value of cell potential in volt for the reaction that occurs when the following two half cells are connected, is
$Fe^{2+}(aq) + 2e^{-} \longrightarrow Fe(s)$, $E^{\circ} = -0.44$ V
$Cr_2O_7^{2-}(aq) + 14H^{+} + 6e^{-} \longrightarrow 2Cr^{3+} + 7H_2O$
$E^{\circ} = +1.33$ V **(2023)**
(a) +1.77 V
(b) +2.65 V
(c) +0.01 V
(d) +0.89 V

4. The conductivity of centimolar solution of KCl at 25°C is 0.0210 ohm^{-1} cm^{-1} and the resistance of the cell containing the solution at 25°C is 60 ohm. The value of cell constant is- **(2023)**
(a) 3.28 cm^{-1}
(b) 1.26 cm^{-1}
(c) 3.34 cm^{-1}
(d) 1.34 cm^{-1}

5. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion: In equation $\Delta_{rG} = -nFE_{cell}$, vlaue of Δ_{rG} depends on n.
Reason: E_{cell} is an intensive property and Δ_{rG} is an extensive property.
In the light of the above statements, choose the correct answer from the options given below: **(2023)**
(a) Both A and R are true but R is NOT the correct explanation of A.
(b) A is true but R is false.
(c) A is false but R is true.
(d) Both A and R are true R R is the correct explanation of A.

6. Two half cell reactions are given below:
$Co^{3+} + e^{-} \longrightarrow Co^{2+}$, $E^{\circ}_{Co^{2+}/Co^{3+}} = -1.81$ V
$2Al^{3+} + 6e^{-} \longrightarrow 2Al(s)$, $E^{\circ}_{Al/Al^{3+}} = +1.66$ V
The standard EMF of a cell with feasible redox reaction will be: **(2022)**
(a) −3.47 V
(b) +7.09 V
(c) +0.15 V
(d) +3.47 V

7. Standard electrode potential for the cell with cell reaction
$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$
is 1.1 V. Calculate the standard Gibbs energy change for the cell reaction.
(Given: F = 96487 C mol^{-1}) **(2022)**
(a) −200.27 J mol^{-1}
(b) −200.27 kJ mol^{-1}
(c) −212.27 kJ mol^{-1}
(d) −212.27 J mol^{-1}

8. At 298 K, the standard electrode potentials of Cu^{2+}/Cu, Zn^{2+}/Zn, Fe^{2+}/Fe and Ag^{+}/Ag are 0.34 V, −0.76 V, −0.44 V and 0.80 V, respectively.
On the basis of standard electrode potential, predict which of the following reaction cannot occur?
(a) $CuSO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + Cu(s)$

(b) $CuSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Cu(s)$
(c) $FeSO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + Fe(s)$
(d) $2CuSO_4(aq) + 2Ag(s) \longrightarrow 2Cu(s) + Ag_2SO_4(aq)$

9. Given below are half cell reactions:
$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$,
$E^\circ_{Mn^{2+}/MnO_4^-} = -1.510$ V
$\frac{1}{2}O_2 + 2H^+ + 2e^- \longrightarrow H_2O$
$E^\circ_{O_2/H_2O} = +1.223$ V
will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid? **(2022)**
(a) Yes, because $E^\circ_{cell} = +0.287$ V
(b) No, because $E^\circ_{cell} = -0.287$ V
(c) Yes, because $E^\circ_{cell} = +2.733$ V
(d) No, because $E^\circ_{cell} = -2.733$ V

10. Find the emf of the cell in which the following reaction takes place at 298 K
$Ni(s) + 2Ag^+(0.001\ M) \longrightarrow Ni^{2+}(0.001\ M) + 2Ag(s)$
(Given that $E^\circ_{cell} = 10.5$ V, $\frac{2.303\ RT}{F} = 0.059$ at 298 K) **(2022)**
(a) 1.0385 V
(b) 1.385 V
(c) 0.9615 V
(d) 1.05 V

11. **The m**olar conductance of NaCl, HCl and CH_3COONa at infinite dilution are 126.45, 426.16 and 91.0 S cm^2 mol^{-1} respectively. The molar conductance of CH_3COOH at infinite dilution is. Choose the right option for your answer. **(2021)**
(a) $390.71\ S\ cm^2 mol^{-1}$
(b) $698.28\ S\ cm^2 mol^{-1}$
(c) $540.48\ S\ cm^2 mol^{-1}$
(d) $201.28\ S\ cm^2 mol^{-1}$

12. The molar conductivity of 0.007 M acetic acid is 20 S cm^2 mol^{-1}. What is the dissociation constant of acetic acid? Choose the correct option. **(2021)**
$\begin{bmatrix} \Lambda^\circ_{H^+} = 350\ S\ cm^2 mol^{-1} \\ \Lambda^\circ_{CH_3COO^-} = 50\ S\ cm^2 mol^{-1} \end{bmatrix}$
(a) $2.50 \times 10^{-4}\ mol\ L^{-1}$
(b) $1.75 \times 10^{-5}\ mol\ L^{-1}$
(c) $2.50 \times 10^{-5}\ mol\ L^{-1}$
(d) $1.75 \times 10^{-4}\ mol\ L^{-1}$

13. On electrolysis of dil sulphuric acid using Platinum (Pt) electrode, the product obtained at anode will be: **(2020)**
(a) Oxygen gas
(b) H_2S gas
(c) SO_2 gas
(d) Hydrogen gas

14. The number of Faradays (F) required to produce 20 g of calcium from molten $CaCl_2$ (Atomic mass of Ca = 40 g mol^{-1}) is: **(2020)**
(a) 2
(b) 3
(c) 4
(d) 1

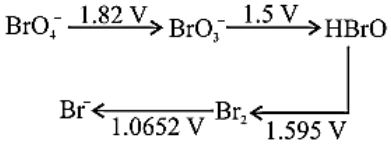
15. Identify the reaction from following having top position in EMF series (Std. red. Potential) according to their electrode potential at 298 K. **(2020 Covid Re-NEET)**
(a) $Fe^{2+} + 2e^- \rightarrow Fe(s)$
(b) $Au^{\cdot 3+} + 3e^- \rightarrow Au(s)$
(c) $K^+ + le^- \rightarrow K(s)$
(d) $Mg^{2+} + 2e^- \rightarrow Mg(s)$

16. In a typical fuel cell, the reactants (R) and product (P) are **(2020 Covid Re-NEET)**
(a) $R = H_{2(g)}, O_{2(g)}; P = H_2O_{(l)}$
(b) $R = H_{2(g)}, O_{2(g)}, Cl_{2(g)}; P = HClO_{4(aq)}$
(c) $R = H_{2(g)}, N_{2(g)}; P = NH_{3(aq)}$
(d) $R = H_{2(g)}, O_{2(g)}; P = H_2O_{2(l)}$

17. For a cell involving one electron E°cell = 0.59 V at 298 K, the equilibrium constant for the cell reaction is: **(2019)**
$\left[Given\ that \frac{2.303RT}{F} = 0.059V\ at\ T = 298K\right]$
(a) 1.0×10^2
(b) 1.0×10^5
(c) 1.0×10^{10}
(d) 1.0×10^{30}

18. For the cell reaction
$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$
$E^\ominus_{cell} = 0.24\,V$ at 298 K. The standard Gibbs energy ($\Delta_r G^\ominus$) of the cell reaction is:
[Given that Faraday constant F = 96500 C mol^{-1}] **(2019)**
(a) –46.32 kJ mol^{-1}
(b) –23.16 kJ mol^{-1}
(c) 46.32 kJ mol^{-1}
(d) 23.16 kJ mol^{-1}

19. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below:



Then the species undergoing disproportionation is: **(2018)**

(a) BrO_3^-
(b) BrO_4^-
(c) $HBrO$
(d) Br_2

20. In the electrochemical cell $Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$, the emf of this Daniel cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0 M and that of $CuSO_4$ changed to 0.01 M, the emf changes to E_2. From the following, which one is the relationship between E_1 and E_2? (Given, $\frac{RT}{F}$ = 0.059) **(2017-Gujarat)**

(a) $E_2 = 0 \neq E$
(b) $E_1 = E_2$
(c) $E_1 < E_2$
(d) $E_1 > E_2$

21. Given that $\Lambda_m^\circ = 133.4,5\ cm^2\ mol^{-1}$ $(AgNO_3)$; $\Lambda_m^\circ = 149.9\ S\ cm^2\ mol^{-1}$ (KCl); $\Lambda_m^\circ = 144.9\ S\ cm^2\ mol^{-1}$ (KNO_3) the molar conductivity at infinite dilution for AgCl is: **(2017-Gujarat)**

(a) $132\ S\ cm^2\ mol^{-1}$
(b) $140\ S\ cm^2\ mol^{-1}$
(c) $138\ S\ cm^2\ mol^{-1}$
(d) $134\ S\ cm^2\ mol^{-1}$

22. The zinc/silver oxide cell is used in electric watches. The reaction is as following:
$Zn^{2+} + 2e^- \rightarrow Zn$; $E^\circ = -0.760\ V$
$Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-$; $E^\circ = 0.344\ V$
If F is 96,500 C mol^{-1}, ΔG° of the cell will be: **(2017-Gujarat)**

(a) 413.21 kJ mol^{-1}
(b) 113.072 kJ mol^{-1}
(c) –213.072 kJ mol^{-1}
(d) 4313.082 kJ mol^{-1}

23. During the electrolysis of molten sodium chloride, the time required to produce 0.10 mol of chlorine gas using a current of 3 amperes is: **(2016-II)**

(a) 220 minutes
(b) 330 minutes
(c) 55 minutes
(d) 110 minutes

24. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because: **(2016-II)**

(a) Zinc has lower negative electrode potential than iron
(b) Zinc has higher negative electrode potential than iron
(c) Zinc is lighter than iron
(d) Zinc has lower melting point than iron

25. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is: **(2016-II)**
(charge on electron = 1.60×10^{-19} C)

(a) 3.75×10^{20}
(b) 7.48×10^{23}
(c) 6×10^{23}
(d) 6×10^{20}

26. If the E°cell for a given reaction has a negative value, which of the following gives the correct relationships for the values of ΔG° and K_{eq}? **(2016-II)**

(a) $\Delta G^0 < 0; K_{eq} > 1$
(b) $\Delta G^0 < 0; K_{eq} < 1$
(c) $\Delta G^0 > 0; K_{eq} < 1$
(d) $\Delta G^0 > 0; K_{eq} > 1$

27. The molar conductivity of a 0.5 mol dm^{-3} solution of $AgNO_3$ with electrolytic conductivity of 5.76×10^{-3} S cm^{-1} at 298 K is: **(2016-II)**

(a) 0.086 S cm^2 mol^{-1}
(b) 28.8 S cm^2 mol^{-1}
(c) 2.88 S cm^2 mol^{-1}
(d) 11.52 S cm^2 mol^{-1}

28. The pressure of H_2 required to make the potential of H_2 electrode zero in pure water at 298 K is: **(2016-I)**

(a) 10^{-4} atm
(b) 10^{-14} atm
(c) 10^{-12} atm
(d) 10^{-10} atm

29. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as: **(2015)**

(a) Electrolytic cell
(b) Dynamo
(c) Ni-Cd cell
(d) Fuel cell

30. The pair of compounds that can exist together is: **(2014)**

(a) $HgCl_2, SnCl_2$

(b) $FeCl_2, SnCl_2$
(c) $FeCl_3, KI$
(d) $FeCl_3, SnCl_2$

31. Using the Gibbs energy change, $\Delta G^0 = +63.3\ kJ$, for the following reaction, $Ag_2CO_3(s) \rightleftharpoons 2Ag^+(aq) + CO_3^{2-}(aq)$ the K_{sp} of $Ag_2CO_3(s)$ in water at 25°C is: **(2014)**
($R = 8.314\ JK^{-1}mol^{-1}$)
(a) 8.0×10^{-12}
(b) 2.9×10^{-3}
(c) 7.9×10^{-2}
(d) 3.2×10^{-26}

32. When 0.1 mol MnO_4^{2-} is oxidized, the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is: **(2014)**
(a) 96500 C
(b) 2 × 96500 C
(c) 9650 C
(d) 96.50 C

33. The weight of silver (atomic weight = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be: **(2014)**
(a) 10.8 g
(b) 54.0 g
(c) 108.0 g
(d) 5.4 g

34. At 25°C, molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is 9.54 $ohm^{-1}\ cm^2\ mol^{-1}$ and at infinite dilution its molar conductance is 238 $ohm^{-1}\ cm^2\ mol^{-1}$. The degree of ionization of ammonium hydroxide at the same concentration and temperature is: **(2013)**
(a) 2.080%
(b) 20.800%
(c) 4.008%
(d) 40.800%

35. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at one atm pressure. The oxidation potential of electrode would be? **(2013)**
(a) 0.059 V
(b) 0.59 V
(c) 0.118 V
(d) 1.18 V

36. A button cell used in watches functions as following
$Zn(s) + Ag_2O(s) + H_2O(l) \rightleftharpoons 2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$.
If half cell potentials are
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)\ ;\ E^\circ = -0.76\ V$
$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq)$
$E^\circ = 0.34\ V$. The cell potential will be: **(2013)**
(a) 1.10 V
(b) 0.42 V
(c) 0.84 V
(d) 1.34 V

Answer Key

S1. Ans. (b)

S2. Ans. (d)

S3. Ans. (a)

S4. Ans. (b)

S5. Ans. (d)

S6. Ans. (d)

S7. Ans. (c)

S8. Ans. (d)

S9. Ans. (a)

S10. Ans. (a)

S11. Ans. (a)

S12. Ans. (b)

S13. Ans. (a)

S14. Ans. (d)

S15. Ans. (b)

S16. Ans. (a)

S17. Ans. (c)

S18. Ans. (a)

S19. Ans. (c)

S20. Ans. (d)

S21. Ans. (c)

S22. Ans. (c)

S23. Ans. (d)

S24. Ans. (b)

S25. Ans. (a)

S26. Ans. (c)

S27. Ans. (d)

S28. Ans. (b)

S29. Ans. (d)

S30. Ans. (b)

S31. Ans. (a)

S32. Ans. (c)

S33. Ans. (c)

S34. Ans. (c)

S35. Ans. (b)

S36. Ans. (a)

Solutions

S1. Ans. (b)

Tl^3 act as an oxidising agent not reducing agent.

S2. Ans. (d)

B and D statements are correct.

S3. Ans. (a)

$E^\circ_{cell} = E^\circ_C - E^\circ_A$

= (1.33) – (–0.44)

= +1.77 V

S4. Ans. (b)

Centimolar solution = 1/100 M = 0.01 M

Conductivity (k) = 0.0210 ohm^{-1} cm^{-1}

Resistance (R) = 60 ohm

$k = 1/R\left(\frac{l}{A}\right)$

$\Rightarrow 0.0210 = 1/60\left(\frac{l}{A}\right) \Rightarrow \frac{l}{A} = 1.26\ cm^{-1}$

S5. Ans. (d)

$\Delta_{rG} = -nFE_{cell}$

E_{cell} is an intensive property and Δ_{rG} is an extensive property as it depends on number of e^- transferred in cell reaction.

S6. Ans. (d)

Since, E°_{OP} of Al is more than Co^{2+}, so at anode Al will oxidise and at cathode Co^{3+} will reduce.

$E^\circ_{cell} = \left(E^\circ_{Cathode}\right)_{RP} - \left(E^\circ_{Anode}\right)_{RP}$

$= E^\circ_{Co^{3+}/Co^{2+}} - E^\circ_{Al^{3+}/Al}$

= (1.81) – (–1.66)

= +3.47 V

S7. Ans. (c)

$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$

E°_{cell} = 1.1 V

$\Delta G^\circ = -nFE^\circ_{cell}$

$\therefore n = 2$

$\Delta G° = -2\times 96487 \times 1.1$

$\Delta G° = -212271.4\ J\ mol^{-1}$

$\Delta\ G° = -212.27\ kJ\ mol^{-1}$

S8. Ans. (d)

For a reaction to be spontaneous, E°_{cell} must be positive.

■ For, $FeSO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + Fe(s)$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

= –0.44 V – (–0.76 V)

= 0.32 V

■ For, $2CuSO_4(aq) + 2Ag(s) \longrightarrow 2Cu(s) + Ag_2SO_4(aq)$

E°_{cell} = 0.34 V – 0.80 V

= –0.46 V

■ For, $CuSO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + Cu(s)$

E°_{cell} = 0.34 V – (–0.76 V)

= 1.1 V

■ Foe, $CuSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Cu(s)$

E°_{cell} = 0.80 V – (–0.44 V)

= 1.24 V

S9. Ans. (a)

■ $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$ -(i)

$E^\circ_{MnO_4^-/Mn^{2+}} = -E^\circ_{Mn^{2+}/MnO_4^-}$ = 1.51 V

■ $H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$ -(ii)

$E^\circ_{O_2/H_2O}$ = 1.223 V

Using 2 × (i) + 5 × (ii), net cell reactions is

$2MnO_4^- + 6H^+ \longrightarrow 2Mn^{2+} + \frac{5}{2}O_2 + 3H_2O$

$E^\circ_{cell} = E^\circ_C - E^\circ_A = E^\circ_{MnO_4^-/Mn^{2+}} - E^\circ_{O_2/H_2O}$

= 1.51 – 1.223 = 0.287 V

Since $E^\circ_{cell} > 0$, therefore net cell reaction is spontaneous and so MnO_4^- liberate O_2 from H_2O in presence of an acid.

S10. Ans. (a)

$Ni(s) + 2Ag^+(0.001\ M) \longrightarrow Ni^{2+}(0.001\ M) + 2Ag(s)$

E°_{cell} = 10.5 V

$E^\circ_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[ni^{2+}]}{[Ag^+]^2}$

$\Rightarrow 10.5 - \frac{0.059}{2}\log\frac{(10^{-3})}{(10^{-3})^2}$

$\Rightarrow 10.5 - \frac{0.059}{2}\log(10)^3$

$\Rightarrow 10.5 - 0.0295 \times 3$

$\Rightarrow 10.5 - 0.0885$

$\Longrightarrow$ 10.4115 V

S11. Ans.(a)

$\Lambda_{NaCl} = \Lambda_{Na^+} + \Lambda_{Cl^-}$

$\Lambda_{HCl} = \Lambda_{H^+} + \Lambda_{Cl^-}$

$\Lambda_{CH_3COONa} = \Lambda_{Na^+} + \Lambda_{CH_3COO^-}$

Let, $\Lambda_{Na^+} = x, \Lambda_{Cl^-} = y, \Lambda_{H^+} = \Lambda_{CH_3COO^-} = w$

Given,

x + y = 126.45 …(i)

y + z = 426.16 …(ii)

x + w = 91 …(iii)

From the above 3 equations, value of

z +w = 390.71d

S12. Ans.(b)

$\Lambda^{\circ}_{M(CH_3COOH)} = \Lambda^{\circ}_{M(H^+)} + \Lambda^{\circ}_{M(CH_3COO^-)}$

= 350 + 50 = 400 S cm^2 mol^{-1}

$\alpha = \frac{\Lambda^C_M}{\Lambda^{\circ}_M}$

$a = \frac{20}{400} = 5 \times 10^{-2}$

$K_{a(CH_3COOH)} = C\alpha^2$

$= 0.007 \times (5 \times 10^{-2})^2 = 1.75 \times 10^{-5} mol\ L^{-1}$

S13. Ans.(a)

The following reactions take place on electrolysis of dilute sulphuric acid on using pt electrodes are:

At cathode:

$4H^+ + 4e^-(aq) \rightarrow 2H_2(g)$

At anode:

$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Thus, the product obtained at anode is O_2.

S14. Ans.(d)

1 equivalent of any substance is deposited by 1 F of charge.

We have, 20 g calcium

The balance reaction will

The charge on Ca in $CaCl_2$

Cl has –1 charge so that

Ca + 2(–1) = 0

Ca = 2

We have to get Ca from Ca^{2+}

Number of required moles = mass/molar mass

Molar mass of Ca is 40 g/mol and required of Ca is 20 g

Hence number of moles = 20/40

= 0.5 mol

Electricity required to produce 1 mol of calcium = 2F

The electricity required to produce 0.5 mol of calcium = 0.5 × 2F

= 1F

S15. Ans.(b)

$Au^{3+} + 3e^- \rightarrow Au(s)\ E^{\circ} = 1.40\ V$

$Fe^{2+} + 2e^- \rightarrow Fe(s)\ E^{\circ} = -0.44\ V$

$Mg^{2+} + 2e^- \rightarrow Mg(s)$ E°=-2.36 V

$K^+ + 1e^- \rightarrow K(s)\ E^{\circ} = -2.93\ V$

Au^{3+} occupies the top position in the electrochemical series.

S16. Ans.(a)

Cell reaction involved in hydrogen-oxygen fuel cell is

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

Thus, $R = H_2(g), O_2(g); P = H_2O(l)$

S17. Ans.(c)

$E_{cell} = E^{\circ}{}_{cell} - \frac{0.059}{n} logQ$ …(i)

At equilibrium, $Q = K_{eq}$ and $E_{cell} = 0$)

$0^{\circ}E^{\circ}{}_{cell} - \frac{0.059}{1} logK_{eq}$ (from equation (i))

$logK_{eq} = \frac{E^{\circ}{}_{cell}}{0.059} = \frac{0.59}{0.059} = 10$

$K_{eq} = 10^{10} = 1 \times 10^{10}$

S18. Ans.(a)

$\Delta G^{\Theta} = -nF\ E^{\Theta}_{cell}$

$= -2 \times 96500 \times 0.24$

$= -46320\ Jmol^{-1} = \frac{-46320}{1000}$

$= -46.32\ kJ/mol$

S19. Ans.(c)

$\overset{+1}{H}BrO \rightarrow \overset{0}{B}r_2, E^0_{HBrO/Br_2} = 0.595\ V'$

$\overset{+1}{H}BrO \rightarrow \overset{+5}{B}rO_3^-, E^{\circ}_{BrO_3/HBrO} = 1.5\ V$

E°_{cell} for the disproportionation of $HBrO$,

$E^{\circ}_{cell} = E^{\circ}_{HBrO/Br_2} - E^{\circ}_{BrO_3^-/HBrO}$

$= 1.595 - 1.5$

$= 0.095\,V = +ve$

Hence, option (c) is correct answer.

S20. Ans.(d)

$Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$

$\therefore\ E_1 = E^{\circ}_{cell} - \frac{2.303RT}{2\times F} \times \log\frac{(0.01)}{1}$

When concentrations are changed

$\therefore\ E_2 = E^{\circ}_{cell} - \frac{2.303RT}{2F} \times \log\frac{1}{0.01}$

$i.e,\ E_1 > E_2$

S21. Ans.(c)

$\Lambda^{\circ}_m(AgCl) = \Lambda^{\circ}_m(AgNO_3) + \Lambda^{\circ}_m(KCl) - \Lambda^{\circ}_m(KNO_3)$

$= (133.4 + 149 - 144.9)\,S\,cm^2\,mol^{-1}$

$= 138.4\,S\,cm^2\,mol^{-1}$

S22. Ans.(c)

$Zn^{2+} + 2e^- \rightarrow Zn, E^{\circ} = -0.760\,V$

$Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-,$

$E^{\circ} = 0.344\,V$

Both are reducing potential :

As, $E^{\circ}_{Ag_2O/2Ag} > E^{\circ}_{Zn^{2+}/Zn}$

$\therefore$ Cell reaction will be

At anode; $Zn \rightarrow Zn^{2+} + 2e^-$ E° = +0.760 V

At cathode;

$Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-$

$E^{\circ} = +0.344\,V$

Cell reaction:

$Zn + Ag_2O + H_2O \rightarrow Zn^{2+} + 2Ag + 2OH^-$

$n = 2 \qquad E^{\circ}_{cell} = 1.104\,V$

$\because\ \Delta G^{\circ} = -nFE^{\circ}_{cell}$

$\Delta G^{\circ} = -2 \times 96500 \times 1.10$

$= -213072\,J\,mol^{-1}$

$= -213.072\,kJ\,mol^{-1}$

$|\Delta G^{\circ}| = 213.072\,kJ\,mol^{-1}$

S23. Ans.(d)

According to Faraday's first law:

w = z.i.t

$z = \frac{E}{96500}(molar\ mass)$

$0.1 \times 71 = \frac{35.5}{96500} \times 3 \times t$ as x factor 2

$t = 110\,min$

S24. Ans.(b)

Zn have a higher (–ve) electrode potential that is more reactive than Fe. It is coated on iron substances to provide resistance against rusting such a process is called galvanization. But in reverse, that is Fe cannot be coated on Zn, as corrosion will occur. In above, Zn displaces Fe from its salt solution.

S25. Ans.(a)

According to Faraday's law

Q = ne

Q = it

ne = it

$n = \frac{1\times60}{1.6\times10^{-19}} = 3.75 \times 10^{20}\ electrons$

S26. Ans.(c)

$\Delta G^{\circ} = -nFE^{\circ}\ cell \qquad E^{\circ}\ cell = (-ve)$

So, $\Delta G^{\circ} = (+ve) \quad \Delta G > 0$

Also, $\Delta G^{\circ} = -2.303\,RT \log K_{eq}$

$\therefore\ \ K_{eq} < 1$

S27. Ans.(d)

Concentration = 0.5 mol dm^{-3},

K = 5.76×10^{-3} S cm^{-1}

T = 298 K

$\lambda_m = \frac{K\times1000}{M}$

$= \frac{5.76\times10^{-3}}{0.5} = 11.52\,S\,cm^2\,mol^{-1}$

S28. Ans.(b)

$2H^+ + 2e^- \rightarrow H_2$

$E = E^{\circ} - \frac{0.059}{2}\log\frac{P_{H_2}}{(H^+)^2}$

$0 = 0 - \frac{0.059}{2}\log\frac{P_{H_2}}{(10^{-7})^2}$

$\log 1 = 0$

$P_{H_2} = (10^{-7})^2 = 10^{-14}\,atm$.

S29. Ans.(d)

S30. Ans.(b)

Sn^{2+} cannot reduce Fe^{2+}, so $FeCl_2$ and $SnCl_2$ can exists together.

S31. Ans.(a)

$\Delta G° = -2.303\ RT \log K_{sp}$

$63300 = -2.303 \times 8.314 \times 298 \log K_{sp}$

$K_{sp} \sim 8 \times 10^{-12}$

S32. Ans.(c)

$\overset{+6}{Mn}O_4^{-2} \quad \rightarrow \quad MnO_4^- + e^-$

0.1 mole 0.1 mole

Q = nF = 0.1 × 96500 = 9650 C

S33. Ans.(c)

$W_{O_2} = \frac{5600}{22400} \times 32 = 8g = 1\ equivalent$

$= 1\ equivalent\ of\ Ag$

$= 108\ g$

S34. Ans.(c)

According to Kohlrausch's law of limiting molar conductivity:

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{9.54}{238} = 0.04008$

% Dissociation (α) = 4.008%

S35. Ans.(b)

According to Nernst equation

$E_{oxi} = E_{red} - \frac{0.0592}{n} \log \frac{[Cation]}{[Anion]}$

$= 0 - \frac{0.592}{2} \log \frac{[10^{-10}]}{[1]}$

pH = 0.59 V

S36. Ans.(a)

$E°cell = E°_{cathode} - E°_{anode} = 0.76 - (-0.34)$

$= 1.1\ V$