



Electrochemistry Important Questions With Answers

NEET Chemistry 2023

1. A solution contains Fe^{2+} , Fe^{3+} and I^- ions. This solution was treated with iodine at 35°C . E° for $\text{Fe}^{3+}/\text{Fe}^{2+}$ is $+0.77\text{V}$ and, E° for $\text{I}_2/2\text{I}^- = 0.536\text{V}$. The favourable redox reaction is:
- a) I_2 will be reduced to I^- b) There will be no redox reaction c) **I^- will be oxidised to I_2**
d) Fe^{2+} will be oxidised to Fe^{3+}

Solution : -

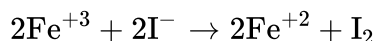
$$\text{Given } \text{Fe}^{3+}/\text{Fe}^{2+} = +0.77\text{ V}$$

$$\text{and } \text{I}_2/2\text{I}^- = 0.536\text{ V}$$

$$2(\text{e}^- + \text{Fe}^{3+} \rightarrow \text{Fe}^{2+}) \quad E^\circ = 0.77\text{ V}$$



Balance:



$$E^\circ = E^\circ_{\text{ox}} + E^\circ_{\text{red}}$$

Hence, reduction potential of $\text{Fe}^{3+}/\text{Fe}^{2+} > \text{I}_2/\text{I}^-$, so Fe^{3+} will be reduced and I^- will be oxidised.

2. Which of the following statements is correct regarding variations of molar conductivity with concentration?

The variation in A_m with concentration for a strong electrolyte can be represented by the equation,

$$A_m = A_m^0 - AC^{1/2}$$

The value of constant A for a given solvent and temperature depends upon the type of electrolyte i.e., cations and anions produced on dissociation of electrolyte in the solution.

- a) Molar conductivity decreases with decrease in concentration.
b) Variation in molar conductivity of weak and strong electrolytes is same.
c) **Molar conductivity increases with decrease in concentration.**
d) When concentration of the solution approaches zero, the molar conductivity is known as conductance.

3. Limiting molar conductivity for some ions is given below (in $\text{S cm}^2 \text{ mol}^{-1}$):

$$\text{Na}^+ - 50.1, \text{Cl}^- - 76.3, \text{H}^+ - 349.6, \text{CH}_3\text{COO}^- - 40.9, \text{Ca}^{2+} - 119.0.$$

What will be the limiting molar conductivities of CaCl_2 , CH_3COONa and NaCl respectively?

- a) 97.65, 111.0 and $242.8\text{ S cm}^2 \text{ mol}^{-1}$ b) 195.3, 182.0 and $26.2\text{ S cm}^2 \text{ mol}^{-1}$
c) **271.6, 91.0 and $126.4\text{ S cm}^2 \text{ mol}^{-1}$** d) 119.0, 1024.5 and $9.2\text{ S cm}^2 \text{ mol}^{-1}$

Solution : -

$$A_{m\text{CaCl}_2}^0 = \lambda_{\text{Ca}^{2+}}^0 + 2\lambda_{\text{Cl}^-}^0$$

$$= 119.0 + 2 \times 76.3 = 271.6\text{ S cm}^2 \text{ mol}^{-1}$$

$$A_{m\text{CH}_3\text{COONa}}^0 = \lambda_{\text{CH}_3\text{COO}^-}^0 + \lambda_{\text{Na}^+}^0$$

$$40.9 + 50.1 = 91\text{ S cm}^2 \text{ mol}^{-1}$$

$$A_{m\text{NaCl}}^0 = \lambda_{\text{Na}^+}^0 + \lambda_{\text{Cl}^-}^0$$

$$50.1 + 76.3 = 126.4\text{ S cm}^2 \text{ mol}^{-1}$$

4. If the E_{cell}^0 for a given reaction has a negative value, which of the following gives the correct relationships for the values of ΔG^0 and K_{eq} ?

- a) $\Delta G^0 > 0$, $K_{\text{eq}} < 1$ b) $\Delta G^0 > 0$, $K_{\text{eq}} > 1$ c) $\Delta G^0 < 0$, $K_{\text{eq}} > 1$ d) $\Delta G^0 < 0$, $K_{\text{eq}} < 1$

Solution : -

We know that

$$\Delta G^0 = -nFE_{\text{cell}}^0$$

If $E_{\text{cell}}^0 = -ve$ then $\Delta G^0 = +ve$ i.e. ; $\Delta G^0 > 0$

$$\Delta G^0 = -nRT \log K_{\text{eq}}$$

For $\Delta G^0 = +ve$, $K_{\text{eq}} = -ve$ i.e., $K_{\text{eq}} < 1$

5. Assertion: EMF of the cell is the potential difference between the electrode potentials of the cathode and anode when no current is drawn through the cell.

Reason : Anode is kept on the right side and cathode on the left side while representing the galvanic cell.

- a) If both assertion and reason are true and reason is the correct explanation of assertion
 b) If both assertion and reason are true but reason is not the correct explanation of assertion
 c) **If assertion is true but reason is false.** d) If both assertion and reason are false.

Solution : -

We keep the anode on the left and the cathode on the right while representing the galvanic cell.

6. The efficiency of a fuel cell is given by :

- a) $\Delta G/\Delta S$ b) $\Delta G/\Delta H$ c) $\Delta S/\Delta G$ d) $\Delta H/\Delta G$

Solution : -

$$\text{Efficiency of a fuel cell } (\phi) = \frac{\Delta G}{\Delta H} \times 100$$

Generally, fuel cells are expected to have an efficiency of 100 percent.

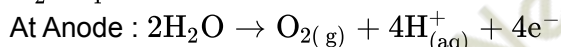
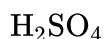
7. Limiting molar conductivity of NaBr is:

- a) $\Lambda_m^0 \text{NaBr} = \Lambda_m^0 \text{NaCl} + \Lambda_m^0 \text{KBr}$ b) $\Lambda_m^0 \text{NaBr} = \Lambda_m^0 \text{NaCl} + \Lambda_m^0 \text{KBr} - \Lambda_m^0 \text{KCl}$
 c) $\Lambda_m^0 \text{NaBr} = \Lambda_m^0 \text{NaOH} + \Lambda_m^0 \text{NaBr} - \Lambda_m^0 \text{NaCl}$ d) $\Lambda_m^0 \text{NaBr} = \Lambda_m^0 \text{NaCl} - \Lambda_m^0 \text{NaBr}$

8. On electrolysis of dil. sulphuric acid using platinum (pt) electrode, the product obtained at anode will be:

- a) SO_2 gas b) Hydrogen gas c) **Oxygen gas** d) H_2S gas

Solution : -



Oxygen gas will liberate at anode.

9. Mark the correct relationship from the following:

a) Equilibrium constant is related to emf as $\log k = \frac{nFE}{2.303RT}$

b) EMF of a cell $\text{Zn} | \text{Zn}^{2+}_{(\text{a1})} || \text{Cu}^{2+}_{(\text{a2})} | \text{Cu}$ is $E = E^0 - \frac{0.591}{n} \log \frac{[a_2]}{[a_1]}$

c) **Nernst equation is** $E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{[\text{Products}]}{[\text{Reactants}]}$

d) For the electrode M^{n+}/M at 273 K $E = E^0 - \frac{0.591}{n} \log [M^{n+}]$

Solution : -

$$\log k = \frac{nFE_{\text{cell}}^0}{2.303RT}$$

$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{[a_1]}{[a_2]}$$

Expression is valid at 298 K, not at 273 K.

10. Fluorine is the best oxidising agent because it has

- a) highest electron affinity b) **highest reduction potential** c) highest oxidation potential
 d) lowest electron affinity

Solution : -

Higher the reduction potential, stronger is the oxidising agent.

11. **Assertion** : Kohlrausch law helps to find the molar conductivity of weak electrolyte at infinite dilution.

Reason : Molar conductivity of a weak electrolyte at infinite dilution cannot be determined experimentally.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

12. For the cell reaction, $\text{Cu}^{2+}(\text{l}) + \text{Zn}(\text{s}) \rightleftharpoons \text{Zn}^{2+}(\text{l}) + \text{Cu}(\text{s})$ Of an electrochemical cell, the change in free energy (ΔG) at a given temperature is a function of :

a) $\ln(C_1)$ b) $\ln(C_1/C_2)$ c) $\ln(C_2)$ d) $\ln(C_1 + C_2)$

Solution : -

From Nernst Equation

$$E = E^0_{\text{cell}} - \frac{RT}{nF} \ln \frac{C_1}{C_2}$$

$$E^0_{\text{cell}} = 0,$$

$$\text{So } E = \frac{-RT}{nF} \ln \frac{C_1}{C_2}$$

$$E = \frac{RT}{nF} \ln \frac{C_2}{C_1}$$

$$C_2 > C_1$$

$$E = \frac{RT}{nF} \ln \frac{C_2}{C_1}$$

R, T, n and F are constants

$\therefore E^0$ depends upon $\ln \frac{C_2}{C_1}$

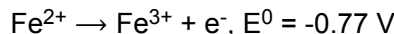
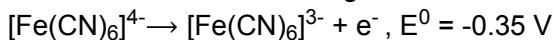
We know that

$$\Delta G = -nFE^0$$

$$\Delta G = -nF \times \frac{RT}{nF} \ln \frac{C_2}{C_1} = -RT \ln \frac{C_2}{C_1}$$

Thus, at constant temperature ΔG depends upon $\ln \frac{C_2}{C_1}$

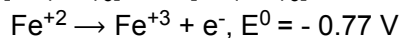
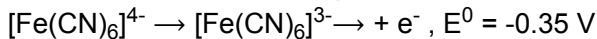
13. On the basis of the following E^0 values, the strongest oxidising agent is :



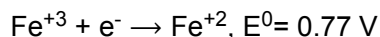
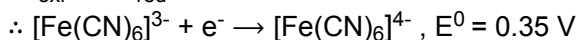
a) $[\text{Fe}(\text{CN})_6]^{4+}$ b) Fe^{2+} c) Fe^{3+} d) $[\text{Fe}(\text{CN})_6]^{3-}$

Solution : -

Substances which have higher reduction potential are stronger oxidizing agent.

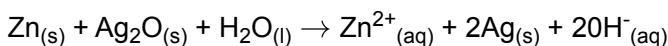


$$E^0_{\text{oxi}} = -E^0_{\text{red}}$$



Thus, Fe^{3+} has maximum tendency to reduced, so it is the strongest oxidizing agent.

14. $\Delta_r G^0$ for the cell with the cell reaction:



$$[E^0_{\text{Ag}_2\text{O}/\text{ag}} = 0.344 \text{ V}, E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}]$$

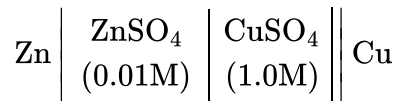
a) $2.13 \times 10^5 \text{ J mol}^{-1}$ b) $-2.13 \times 10^5 \text{ J mol}^{-1}$ c) $1.06 \times 10^5 \text{ J mol}^{-1}$ d) $-1.06 \times 10^5 \text{ J mol}^{-1}$

Solution : -

$$E^0_{\text{cell}} = E^0_{\text{Ag}_2\text{O}/\text{ag}} - E^0_{\text{Zn}^{2+}/\text{Zn}}$$

$$= 0.344 - (-0.76) = 1.104 \text{ V}$$

15. The e.m.f. of a Daniell cell at 298K is E_1



When the concentration of ZnSO_4 is 1.0M and that of CuSO_4 is 0.01 M, the e.m.f. changed to E_2 . What is the relationship between E_1 and E_2 ?

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

Solution : -

Cell reaction is, $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

and, then, greater the factor $\left[\frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} \right]$ less is the EMF

Hence $E_1 > E_2$

16. At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is $9.54 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ and at infinite dilution, its molar conductance is $238 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is :

- a) 2.080 % b) 20.800 % c) **4.008 %** d) 40.800 %

Solution : -

Molar conductance at 0.1 M concentration

$$\lambda_c = 9.54 \text{ S cm}^2 \text{ mol}^{-1}$$

Molar conductance at infinite dilution

$$\lambda_c^{\infty} = 238 \text{ S cm}^2 \text{ mol}^{-1}$$

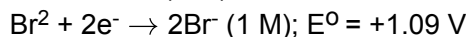
We know that,

Degree of dissociation,

$$\alpha = \frac{\lambda_c}{\lambda_c^{\infty}} \times 100 = \frac{9.54}{238} \times 100$$

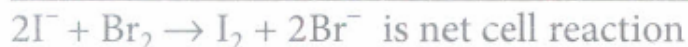
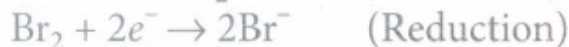
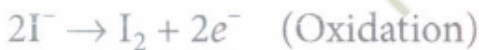
$$\alpha = 4.008 \%$$

17. Which of the following is the cell reaction that occurs when the following half-cells are combined?



- a) $2\text{Br}^- + \text{I}_2 \rightarrow \text{Br}_2 + 2\text{I}^-$ b) $\text{I}_2 + \text{Br}_2 \rightarrow 2\text{I}^- + 2\text{Br}^-$ c) **$2\text{I}^- + \text{Br}_2 \rightarrow \text{I}_2 + 2\text{Br}^-$** d) $2\text{I}^- + 2\text{Br}^- \rightarrow \text{I}_2 + \text{Br}_2$

Solution : -



18. Using the data given in find out in which option the order of reducing power is correct

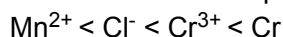
$$E_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}}^{\circ} = 1.33\text{V}; E_{\text{Cl}_2/\text{Cl}^-}^{\circ} = 1.36\text{V}$$

$$E_{\text{MnO}_4^-/\text{Mn}^{2+}}^{\circ} = 1.51\text{V}; E_{\text{Cr}^{3+}/\text{Cr}}^{\circ} = -0.74\text{V}$$

- a) $\text{Cr}^{3+} < \text{Cl}^- < \text{Mn}^{2+} < \text{Cr}$ b) **$\text{Mn}^{2+} < \text{Cl}^- < \text{Cr}^{3+} < \text{Cr}$** c) $\text{Cr}^{3+} < \text{Cl}^- < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$
 d) $\text{Mn}^{2+} < \text{Cr}^{3+} < \text{Cl}^- < \text{Cr}$

Solution : -

Lower the reduction potential, higher is the reducing power



19. If a current of 1.5 ampere flows through a metallic wire for 3 hours, then how many electrons would flow through the wire?

- a) 2.25×10^{22} electrons b) 1.13×10^{23} electrons **c) 1.01×10^{23} electrons** d) 4.5×10^{23} electrons

Solution : -

$$Q = I \times t = 1.5 \times 3 \times 60 \times 60 = 16200 \text{ C}$$

$$\text{Charge on 1 electron} = 1.602 \times 10^{-19} \text{ C}$$

$$16200 \text{ C charge is on } \frac{1 \times 16200}{1.602 \times 10^{-19}} \text{ electrons}$$
$$= 1.01 \times 10^{23} \text{ electrons}$$

20. While charging the lead storage battery_____.

- a) PbSO_4 anode is reduced to Pb** b) PbSO_4 cathode is reduced to Pb
c) PbSO_4 cathode is oxidised to Pb d) PbSO_4 anode is oxidised to PbO_2

Solution : -

On charging the battery the reaction is reversed and $\text{PbSO}_{4(s)}$ is converted into Pb at anode and PbO_2 at cathode.

21. **Assertion:** In mercury cell, the cell potential is approximately 1.35 V and remains constant during its life.

Reason : The overall reaction in mercury cell is represented as $\text{Zn(Hg)} + \text{HgO}_{(s)} \rightarrow \text{ZnO}_{(s)} + \text{Hg}_{(l)}$

- a) If both assertion and reason are true and reason is the correct explanation of assertion.**
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

Overall reaction does not involve any ion in solution whose concentration can change during its life time.

22. Given below are the standard electrode potentials of few half-cells. The correct order of these metals in increasing reducing power will be $\text{K}^+ | \text{K} = -2.93 \text{ V}$, $\text{Ag}^+ | \text{Ag} = 0.80 \text{ V}$, $\text{Mg}^{2+} | \text{Mg} = -2.93 \text{ V}$, $\text{Ag}^+ | \text{Ag} = 0.80 \text{ V}$, $\text{Mg}^{2+} | \text{Mg} = -2.37 \text{ V}$, $\text{Cr}^{3+} | \text{Cr} = -0.74 \text{ V}$.

- a) $\text{K} < \text{Mg} < \text{Cr} < \text{Ag}$ **b) $\text{Ag} < \text{Cr} < \text{Mg} < \text{K}$** c) $\text{Mg} < \text{K} < \text{Cr} < \text{Ag}$ d) $\text{Cr} < \text{Ag} < \text{Mg} < \text{K}$

Solution : -

Higher the oxidation potential, more easily it is oxidised and hence greater is the reducing power. Hence, increasing order of reducing power is $\text{Ag} < \text{Cr} < \text{Mg} < \text{K}$

23. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to :

- a) increase in ionic mobility of ions** b) 100% ionisation of electrolyte at normal dilution
c) increase in both i.e. number of ions and ionic mobility of ions d) increase in number of ions

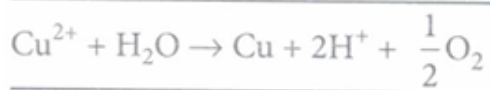
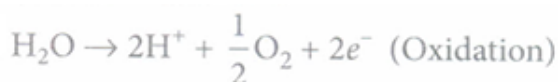
Solution : -

Strong electrolytes dilution increases ionisation, hence ionic mobility of ions increases which in turn increases equivalent conductance of the solution.

24. An acidic solution of Cu^{2+} containing 0.4 g of Cu^{2+} ions is electrolysed until all the copper is deposited. What is the volume of oxygen evolved at NTP?

- a) 141 cc** b) 31.75 cc c) 64 cc d) 32 cc

Solution : -



25. Two solutions of X and Y electrolytes are taken in two beakers and diluted by adding 500 mL of water. A_m of X increases by 1.5 times while that of Y increases by 20 times, what could be the electrolytes X and Y?
- a) $X \rightarrow NaCl, Y \rightarrow KCl$ b) $X \rightarrow NaCl, Y \rightarrow CH_3COOH$ c) $X \rightarrow KOH, Y \rightarrow NaOH$
 d) $X \rightarrow CH_3COOH, Y \rightarrow NaCl$

Solution : -

Electrolyte X is strong electrolyte as on dilution the number of ions remain same, only interionic attraction decreases and hence not much increase in A_m is seen. While A_m for a weak electrolyte increases significantly.

26. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as
- a) Electrolytic cell b) Dynamo c) Ni-Cd Cell d) **Fuel cell**

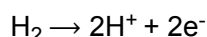
Solution : -

The device through which the energy of combustion of fuels is converted directly into electrical energy is called as fuel cell.

27. 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 1 atm pressure. The oxidation potential of electrode would be :
- a) 0.118 V b) 1.18 V c) 0.059 V d) **0.59 V**

Solution : -

Oxidation half reaction is



(1 atm) (At pH 10)

If pH = 10, $[H^+] = 10^{-10}$

From Nernst Equation

$$E_{cell} = E_{cell}^0 - \frac{0.0591}{2} \log \frac{[H^+]^2}{P_{H_2}}$$

For hydrogen electrode $E_{cell}^0 = 0$

$$E_{cell} = -\frac{0.0591}{2} \log \frac{[10^{-10}]^2}{1}$$

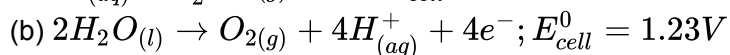
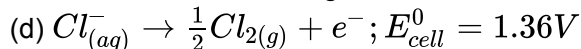
$$= 0.0591 \log 10^{10}$$

$$E_{cell} = 0.591 \text{ V}$$

28. In the electrolysis of aqueous sodium chloride solution which of the half cell reaction will occur at anode?
- a) $Na_{(aq)}^+ + e^- \rightarrow Na_{(s)}$; $E_{cell}^0 = -2.71V$ b) $2H_2O_{(l)} \rightarrow O_{2(g)} + 4H_{(aq)}^+ + 4e^-$; $E_{cell}^0 = 1.23V$
 c) $H_{(aq)}^+ + e^- \rightarrow \frac{1}{2}H_{2(g)}$; $E_{cell}^0 = 0.00V$ d) $Cl_{(aq)}^- \rightarrow \frac{1}{2}Cl_{2(g)} + e^-$; $E_{cell}^0 = 1.36V$

Solution : -

At the anode, the following oxidation reactions are possible:

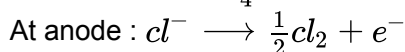
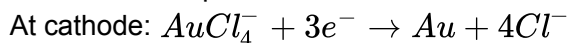


The reaction at anode with lower value of E^0 is preferred and therefore, water should get oxidised in preference to $Cl_{(aq)}^-$. However, on account of overpotential of oxygen, reaction (d) is preferred.

29. How long will it take for a uniform current of 6.00 A to deposit 78 g of gold from a solution of $AuCl_4^-$? What mass of chlorine gas will be formed simultaneously at anode of the cell? (Atomic mass of Au = 197)
- a) $t = 3010 \text{ sec}, w = 35.50 \text{ g}$ b) $t = 20306 \text{ sec}, w = 45.54 \text{ g}$ c) $t = 19500 \text{ sec}, w = 54.5 \text{ g}$
 d) **$t = 19139.16 \text{ sec}, w = 42.24 \text{ g}$**

Solution : -

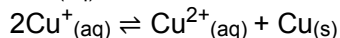
Reactions take place at electrodes are:



For the deposition of 197 g (1 mole) of Au = 3F of charge is required thus, for the deposition of 78 g of Au, charge required $\frac{3}{197} \times 78 = 1.19 F = 1.19 \times 96500$ coulombs

From $Q = I \times t$

30. $Cu^+_{(aq)}$ is unstable in solution and undergoes simultaneous oxidation and reduction according to the reaction :

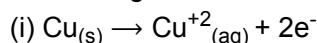


Choose the correct E^0 for above reaction if $E^0_{Cu^{2+}/Cu} = 0.34 V$ and $E^0_{Cu^+/Cu} = 0.15 V$

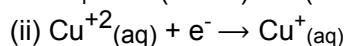
- a) - 0.38 V b) - 0.49 V c) **0.38 V** d) - 0.19 V

Solution : -

From the given data

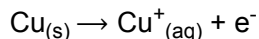


$$\Delta G^0_1 = -2(-0.34) \times F \text{ (As, } \Delta G^0 = -nFE^0)$$



$$\Delta G^0_2 = -1 \times (0.15) \times F$$

On adding (i) and (ii), we get



$$\Delta G^0_3 = -1 \times E^0 \times F$$

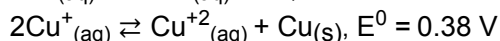
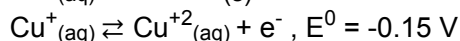
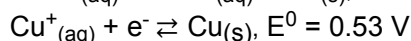
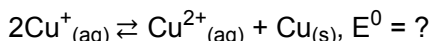
$$\Delta G^0_3 = \Delta G^0_1 + \Delta G^0_2$$

$$-n_3FE^0 = -n_1FE^0_1 - n_2FE^0_2$$

$$-E^0 = -2(-0.34) - 1(0.15) = 0.53$$

$$E^0 = -0.53 V$$

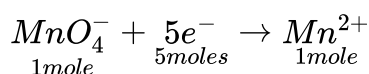
So reaction,



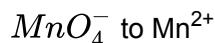
31. The charge required for reducing 1 mole of MnO_4^- to Mn^{2+} is:

- a) **$1.93 \times 10^5 C$** b) $2.895 \times 10^5 C$ c) $4.28 \times 10^5 C$ d) $4.825 \times 10^5 C$

Solution : -



5 moles of electrons are needed for reduction of 1 mole

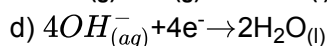
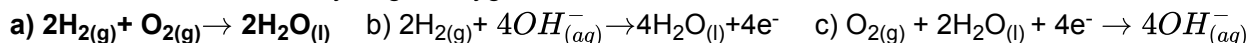


5 moles of electrons = 5 Faradays

Quantity of charge required = 5×96500

$$= 4.825 \times 10^5 \text{ Coulombs}$$

32. The overall reaction of a hydrogen-oxygen fuel cell is



Solution : -



33. For the reduction of silver ions with copper metal the standard cell potential was found to be + 0.46 V at 25°C.

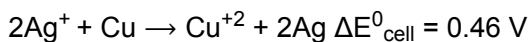
The value of standard Gibbs energy, ΔG^0 will be:

(F = 96500 C mol⁻¹)

a) - 89.0 kJ b) - 89.0 J c) - 44.5 kJ d) - 98.0 kJ

Solution : -

The relation between standard Gibbs free energy and E^0_{cell} is $\Delta G^0 = -nFE^0_{\text{cell}}$ For the cell reaction



$$\Delta G^0 = -nF E^0_{\text{cell}}$$

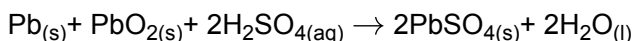
$$\Delta G^0 = -2 \times 96500 \times 0.46 = -88780 \text{ J}$$

$$\Delta G^0 = -89.0 \text{ kJ}$$

34. When a lead storage battery is discharged,

a) lead sulphate is consumed b) oxygen gas is evolved c) lead sulphate is formed
d) lead sulphide is formed.

Solution : -



35. A 5 current is passed through a solution of zinc sulphate for 40 min. The amount of zinc deposited at the cathode is :

a) 40.65 g b) 0.4065 g c) **4.065 g** d) 65.04 g

Solution : -

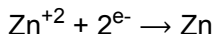
Given that

I = 5 ampere

t = 40 min = 40 x 60 = 2400 sec

Amount of electricity passed

$$Q = It = 5 \times 2400 = 12000 \text{ C}$$



From Faraday first law,

$$W = ZIt \quad (Z = \text{equivalent mass})$$

$$= \frac{\text{Mass}}{nF} \quad (\text{Mol. Mass of Zn} = 65.39)$$

$$= \frac{65.39}{2 \times 96500} \text{ g of Zinc}$$

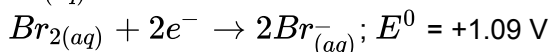
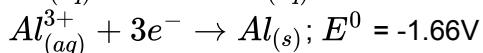
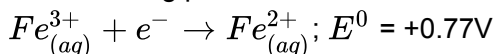
Therefore, 12000 C charge will deposit

$$= \frac{65.39 \times 12000}{2 \times 96500} \text{ 4.065 g of Zn}$$

36. Units of the properties measured are given below. Which of the properties has not been matched correctly?

a) Molar conductance = S m² mol⁻¹ b) Cell Constant = m⁻¹ c) **Specific conductance = S m²**
d) Equivalent conductance = S m² (g eq)⁻¹

37. Electrode potential data of few cells is given below. Based on the data, arrange the ions in increasing order of their reducing power.



a) **Br⁻ < Fe²⁺ < Al** b) Fe²⁺ < Al < Br⁻ c) Al < Br⁻ < Fe²⁺ d) Al < Fe²⁺ < Br⁻

Solution : -

Lower the reduction potential, more is the reducing power. Br⁻ < Fe²⁺ < Al

38. Which of the following reaction is possible at anode?

a) **2Cr³⁺ + 7H₂O → Cr₂O₇²⁻ + 14H⁺** b) F₂ → 2F⁻ c) (1/2)O₂ + 2H⁺ → H₂O d) None of these.

39. **Assertion:** To obtain maximum work from a galvanic cell charge has to be passed reversibly.
Reason: The reversible work done by a galvanic cell is equal to decrease in its Gibbs energy.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
 b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 c) If assertion is true but reason is false. d) If both assertion and reason are false.
40. Which of the following is not an application of electrochemical series?
 a) To compare the relative oxidising and reducing power of substances.
 b) To predict evolution of hydrogen gas on reaction of metal with acid.
 c) To predict spontaneity of a redox reaction **d) To calculate the amount of metal deposited on cathode.**

Solution : -

Faraday's law is used in calculating the amount of metal deposited on cathode.

41. Electrolysis of an aqueous solution of AgNO_3 with silver electrodes produces (i) at cathode while (ii) ions are dissolved from anode. When Pt electrodes are used (iii) is produced at anode and (iv) is cathode.

a)	b)	c)	d)
(i) (ii) (iii) (iv)	(i) (ii)(iii)(iv)	(i) (ii) (iii)(iv)	(i) (ii)(iii) (iv)
H_2 NO_3^- OH^- H_2	Ag H^+ O_2 H_2	Ag Ag^+ O_2 Ag	Ag H^+ Ag^+ O_2

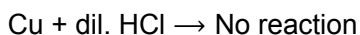
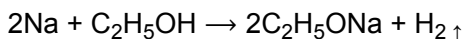
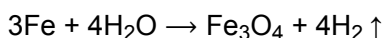
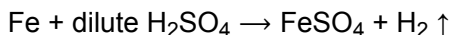
42. **Assertion:** Current stops flowing when $E_{\text{cell}} = 0$.

Reason : Equilibrium of the cell reaction is attained.

- a) If both assertion and reason are true and reason is the correct explanation of assertion.**
 b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 c) If assertion is true but reason is false. d) If both assertion and reason are false.
43. Which one of the following pairs of substances on reaction will not evolve H_2 gas?
 a) Iron and $\text{H}_2\text{SO}_4(\text{aq})$ b) Iron and steam **c) Copper and $\text{HCl}(\text{aq})$** d) Sodium and ethyl alcohol

Solution : -

As copper is placed below hydrogen in the electrochemical series, thus copper does not give hydrogen with dilute acids. While all other will give hydrogen.



44. Cell reaction is spontaneous when :

- a) E_{red}^0 is negative b) E_{red}^0 is positive **c) ΔG^0 is negative** d) ΔG^0 is positive

Solution : -

For spontaneous reaction $\Delta G^0 = -ve$ and $E_{\text{cell}}^0 = +ve$

$$\text{as } \Delta G^0 = -nFE_{\text{cell}}^0$$

where, n = number of electrons taking part

$$E^0 = \text{emf of cell}$$

F = Faraday constant

45. The weight of silver (at wt = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 , at STP will be:

- a) 5.4 g b) 10.8 g c) 54.9g **d) 108.0 g**

Solution : -

$$w_{\text{O}_2} = n_{\text{O}_2} \times 32$$

$$w_{\text{O}_2} = \frac{5600}{22400} \times 32 = 8 \text{ g}$$

= 1 equivalent of O_2

= 1 equivalent of Ag = 108

46. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15 V and that for the Cr^{3+}/Cr couple is - 0.74. These two couples in their standard state are connected to make a cell. The cell potential will be :

- a) + 0.89 V b) + 0.18 V c) + 1.83 V d) + 1.199 V

Solution : -

$$E^0_{\text{Sn}^{4+}/\text{Sn}^{2+}} = 0.15 \text{ V}$$

$$E^0_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$$

$$E^0_{\text{cell}} = E^0_{\text{cathode(RP)}} - E^0_{\text{anode(RP)}}$$

(RP = Reduction potential)

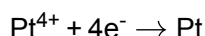
$$= 0.15 - (-0.74)$$

$$= 0.89 \text{ V}$$

47. How many moles of Pt may be deposited on the cathode when 0.80 F of electricity is passed through a 1.0 M solution of Pt^{4+} ?

- a) 0.1 mol b) 0.2 mol c) 0.4 mol d) 0.6 mol

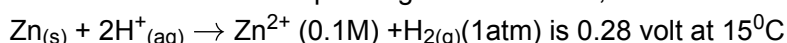
Solution : -



4 moles of electricity or 4 F of electricity is required to deposit 1 mole of Pt.

$$0.80 \text{ F of electricity will deposit } \frac{1}{4} \times 0.80 = 0.20 \text{ mol}$$

48. The EMF of a cell corresponding to the reaction;



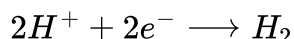
The pH of the solution at the hydrogen electrode is

(Given $E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ volt}$; $E^0_{\text{H}^+/\text{H}_2} = 0 \text{ volt}$)

- a) 7.05 b) 8.62 c) 8.75 d) 9.57

Solution : -

The half-cell reactions are



We know that

$$E^0_{\text{Zn}/\text{Zn}^{2+}} = E^0_{\text{Zn}/\text{Zn}^{2+}} - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Zn}]}$$

$$\therefore E^0_{\text{Zn}/\text{Zn}^{2+}} = 0.76 - \frac{2.303 \times 8.314 \times 298}{2 \times 96500} \log \frac{0.1}{1}$$

$$= 0.76 - (-0.03) = 0.79 \text{ V}$$

Also

$$E_{\text{H}^+/\text{H}_2} = E^0_{\text{H}^+/\text{H}_2} - \frac{RT}{nF} \ln \frac{[\text{H}_2]}{[\text{H}^+]^2}$$

$$\therefore 0 - \frac{2.303 \times 8.314 \times 298}{2 \times 96500} \log \frac{1}{[\text{H}^+]^2}$$

Also

$$E_{\text{cell}} = E_{\text{Zn}/\text{Zn}^{2+}} + E_{\text{H}^+/\text{H}_2}$$

$$\text{or } 0.28 = 0.79 - 0.0591 \text{ pH}$$

$$\text{or pH} = \frac{0.79 - 0.28}{0.0591} = \frac{0.51}{0.0591} = 8.62$$

49. In electrolysis of NaCl when Pt electrode is taken then H_2 is liberated at cathode while with Hg cathode it forms sodium amalgam. This is because:

- a) Hg is more inert than Pt b) More voltage is required to reduce H^+ at Hg than at Pt
c) Na is dissolved in Hg while it does not dissolved in Pt
d) Conc. of H^+ ions is larger when Pt electrode is taken

Solution : -

When Pt electrode in electrolysis of NaCl is taken then H_2 liberated at cathode while with Hg cathode it forms sodium amalgam as more voltage is needed to reduce H^+ at Hg than Pt

50. The formal potential of Fe^{3+}/Fe^{2+} in a sulphuric acid and phosphoric acid mixture ($E^0 = +0.61$ V) is much lower than the standard potential ($E^0 = +0.77$ V), This is due to

- (i) formation of the species $[FeHPO_4]^+$
- (ii) lowering of potential upon complexation
- (iii) formation of the species $[FeSO_4]^+$
- (iv) high acidity of the medium.

a) (i) and (ii) only b) (i), (ii) and (iv) only c) (iii) only d) all of these.

Solution : -

In the aqueous solution, if H_2SO_4 is present then iron will form hydrated iron sulphate rather than forming $[FeSO_4]^+$ solution. Moreover, tendency of formation of $FeSO_4$ or $Fe_2(SO_4)_3$ is even more. Formation of $[FeHPO_4]^+$ is reasonably fine. Due to the formation of complex, $[Fe^{3+}]$ decreases and accordingly, potential decreases.

$$E = E^0 - \frac{0.0591}{n} \log_{10} \frac{[Fe^{2+}]}{[Fe^{3+}]}$$

