

## Chapter 8. Electrolysis & Electrolytic conductance

**Q1.**

**Sol:**  $I = 0.5$  amp,  $W_{Al} = 27.0$  g

$$(i) \text{ gm eq of Al} = \frac{wt_{Al}}{\text{gm eq. wt}_{Al}} = \frac{27}{27/3} = 3 \quad \text{Ans} \quad (\because \text{v.f. of Al in } Al^{3+} + 3e^- \rightarrow Al = 3)$$

$$(ii) \text{ no. of gm atoms} = \text{no. of moles} \times \frac{wt}{Atwt} = \frac{27}{27} = 1 \quad \text{Ans}$$

$$(ii) \text{ no. of atoms} = \text{no. of moles} \times \text{Avogadro's no.} = 1 \times 6.023 \times 10^{23} = 6.023 \times 10^{23} \quad \text{Ans}$$

$$(iv) \text{ no. of } e^- \text{ required} = 3 \times \text{no. of atoms deposited} = 3 \times \text{Avogadro's constant}$$

$$(v) \text{ no. of Faraday of electricity consumed} = \text{no. of gm eq} = 3 \text{ Faraday} \quad \text{Ans}$$

$$(vi) W = Z \cdot I \cdot t$$

$$27 = \frac{9}{16500} \times 0.5 \times t$$

$$t = \frac{27 \times 96500}{9 \times \frac{1}{2}} = 6 \times 96500 \text{ sec} = 6 \times 96500 \text{ sec}$$

$$= \frac{579000}{3600} = 160 \text{ hr } 83 \times 60 \text{ min} = 160 \text{ hr } 49.8 \text{ min} \quad \text{Ans}$$

$$(vii) \text{ gm equation of } Cl_2 \text{ produced} = \text{gm equation of Al}$$

$$\frac{V_{Cl_2}}{22.4/2} = 3$$

$$V_{Cl_2} = 3 \times 11.2 \text{ lit} = 33.6 \text{ lit} \quad \text{Ans}$$

**Q2.**

**Sol:**  $I = 2$  amp,

Mass increases by 8 g ; so wt of Cr deposited = 8 g

$$\therefore W = Z \cdot I \cdot t$$

$$8g = \frac{\text{gm eq. wt}}{96500} \times 2 \times t$$

$$8g = \frac{(52/3)g}{96500} \times 2 \times t \therefore Cr^{3+} + 3e^- \rightarrow Cr \quad (\text{gm eq wt} = \frac{\text{At wt of Cr}}{3})$$

$$\frac{8 \times 96500 \times 3}{52 \times 2} = t$$

$$t = 22269.23 \text{ sec} = 6.186 \text{ hr} \quad \text{Ans}$$

**Q3.**

**Sol:**  $I = 0.2$  amp

$$t = 1 \text{ hr} = 3600 \text{ sec}$$

(a) If  $w$  is the wt of silver deposited, then



$$W = Z \cdot I \cdot t = \frac{(\text{gmeq wt})Ag}{96500} \times I \times t$$

$$W = \frac{108}{96500} \times 0.2 \times 3600 = 0.806 \text{ g} \quad \text{Ans}$$

(b) no. of  $e^-$  = no. of moles of  $e^- \times N_A$   
 = no. of moles of Ag deposited  $\times N_A$   
 $\therefore Ag^+ + e^- \rightarrow Ag$   
 (1 mole of Ag is deposited by 1 moles of  $e^-$ )

$$= \frac{0.806}{108} \times 6.023 \times 10^{23} e^- = 4.49 \times 10^{21} e^- \quad \text{Ans}$$

(c) gm eq of Cu deposited = gm eq of Ag deposited

$$\frac{W_{Cu}}{63.5/2} = \frac{0.806}{108/1} \Rightarrow W_{Cu} = 0.237 \text{ g} \quad \text{Ans}$$

**Q4.**

**Sol:**  $W = 0.5 \text{ g}; t = 1 \text{ hr}$

$$W = Z \cdot Q = \frac{\text{gmeq wt} \cdot Q}{96500}$$

$$\text{No. of coulombs} = \frac{0.5 \times 96500}{108} \text{ coulomb} = 444.676 \text{ coulombs}$$

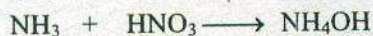
$$\text{Gm eq. of } H_2 \text{ produced} = \frac{Q}{96500} = \frac{444.676}{96500}$$

$$\frac{V_{H_2}}{\text{molar volume}} = \frac{444.676}{96500} \quad \left[ \text{For } H_2, \text{ eq. volume} = \frac{\text{molar volume}}{2} \right]$$

$$V_{H_2} = 4.64 \times 10^{-3} \times \frac{\text{molar volume}}{2}$$

$$= 4.64 \times 10^{-3} \times \frac{0.0821 \times 300}{750/760 \times 2} = 0.0578 \text{ lit} = 57.8 \text{ ml} \quad \text{Ans}$$

**Q5.**



$$\text{Weight produced of } NH_4NO_3 \text{ per day} = 5000 \text{ kg} = 5 \times 10^6 \text{ g}$$

$$\text{Moles of } NH_4NO_3 \text{ produced per day} = \frac{5 \times 10^6}{80} = 6.25 \times 10^4$$

$$\therefore \text{Moles of } NH_3 \text{ \& moles of } HNO_3, \text{ each should be } 6.25 \times 10^4 \text{ moles/day.}$$

$$\begin{array}{cc} NH_3 & \& HNO_3 \\ 6.25 \times 10^4 & & 6.25 \times 10^4 \end{array}$$



So moles of hydrogen atom =  $3 \times \text{moles of } \text{NH}_3 + 1 \times \text{moles of } \text{HNO}_3$   
 $= 3 \times 6.25 \times 10^4 + 1 \times 6.25 \times 10^4 = 4 \times 6.25 \times 10^4$

$$\therefore \text{moles of } \text{H}_2 \text{ produced} = \frac{4 \times 6.25 \times 10^4}{2} = 12.5 \times 10^4$$

$$\therefore \text{moles of } e^- \text{ required per day} = 2 \times \text{moles of } \text{H}_2 \text{ produced} \\ = 25 \times 10^4$$

$$\therefore \text{Charge required per day} = 25 \times 10^4 \times 96500$$

$$\therefore \text{Current per day} = \frac{25 \times 10^4 \times 96500}{24 \times 3600} = 2.79 \times 10^5 \text{ amp/day} \quad \text{Ans}$$

**Q6.**

**Sol:** From Faraday's second law

$$\frac{W_{\text{Au}}}{E_{\text{Au}}} = \frac{W_{\text{Cu}}}{E_{\text{Cu}}} \Rightarrow \frac{9.85}{\frac{197}{3}} = \frac{W_{\text{Cu}}}{\frac{63.5}{2}} \Rightarrow 0.15 = \frac{W_{\text{Cu}}}{\frac{63.5}{2}}$$

$$W_{\text{Cu}} = 4.7625 \text{ g} \quad \text{Ans}$$

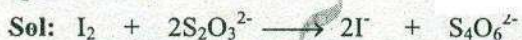
Also gm equivalent of substance deposited = no. of Faraday

$$0.15 = \text{no. of Faraday} = \frac{Q}{96500}$$

$$0.15 = \frac{I \times 5 \times 3600}{96500}$$

$$I = \frac{0.15 \times 965}{180} = 0.804 \quad \text{Ans}$$

**Q7.**



Milimole of  $\text{I}_2 \equiv 2$  milimoles of  $\text{S}_2\text{O}_3^{2-}$

$2 \times \text{milimole of } \text{I}_2 = \text{milimoles of } \text{S}_2\text{O}_3^{2-}$

$$\text{milimole of } \text{I}_2 = \frac{21.75 \times 0.0831}{2} = 0.9037$$

$$\therefore \text{milimole of } e^- \text{ emitted out} = 0.9037 \times 2 = 1.8074$$

$$\therefore \text{Charge flown} = 1.8074 \times 10^{-3} \times 96500$$

$$\therefore \text{It} = 1.8074 \times 96.5$$

$$I = \frac{1.8074 \times 96.5}{2 \times 3600} = 0.0242 \text{ amp} \quad \text{Ans}$$

**Q8.**

**Sol:** gm eq of Cr deposited = gm eq of  $\text{Cl}_2$  produced = no of faraday

$$\text{No. of faraday passed} = \frac{6 \times 1 \times 3600}{96500} = 0.224$$

$$\therefore \text{gm eq. of Cr deposited} = \frac{W_{\text{Cr}}}{E_{\text{Cr}}} = 0.024$$



$$W_{t_{Cr}} = 0.024 \times \frac{52}{2} = 3.88 \text{ g} \quad \text{Ans}$$

$$\text{Gm eq of Cl}_2 \text{ produced} = 0.024$$

$$\frac{V_{Cl_2}}{\text{Eq. volume}} = 0.024 \Rightarrow \frac{V_{Cl_2}}{\frac{22.4}{2}} = 0.024$$

$$V_{Cl_2} = 0.024 \times \frac{22.4}{2} = 2.508 \text{ lit} \quad \text{Ans}$$

**Q9.**

**Sol:** O<sub>2</sub> in second cell has produced due to oxidation of oxygen present in water.



∴ At anode in 2<sup>nd</sup> cell oxidation happen, so wt of anode won't change in 2<sup>nd</sup> cell.

In 2<sup>nd</sup> cell

$$\frac{W_{Ag}}{E_{Ag}} = \frac{V_{O_2}}{\text{Eq. vol.}} = \frac{40 \text{ ml}}{\frac{22400}{4}} = \frac{16}{2240}$$

$$W_{Ag} (\text{produced}) = \frac{16}{2240} \times 108 \text{ g} = 0.772 \text{ g}$$

So wt of cathode will increase by 0.772 g.

**In 1<sup>st</sup> cell**

Again Cu<sup>2+</sup> will reduce at cathode, so wt of cathode will increase & at anode Cu will oxidise to form Cu<sup>2+</sup>, so wt of anode decreases.

Also.

$$\frac{W_{Cu}}{E_{Cu}} = \frac{W_{Ag}}{E_{Ag}} = \frac{16}{2240}$$

$$W_{Cu} = \frac{16}{2240} \times \frac{63.5}{2} = 0.227 \text{ g Cu}$$

∴ At cathode, 0.227 g Cu deposit, so wt. will increases

At anode, 0.227 g Cu oxidise, so wt. of anode will decreases.

**Q10.**

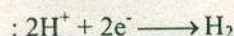
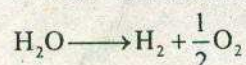
$$\text{Sol: } W_{H_2O} = \frac{18}{2} \times 100 \times 12 \times 3600 \left( \text{eq. wt. of water} = \frac{\text{Mol. wt}}{2} \right)$$

$$= 402.4 \text{ g} \approx 403 \text{ g} \quad \text{Ans}$$

**Q11.**

**Sol:** I = 1.30 amp

$$t = 5 \text{ hr} = 5 \times 3600 \text{ sec}$$







$$= Z_{\text{H}_2} \cdot I \cdot t = \frac{1}{96500} \times 1.3 \times 5 \times 3600 = 0.244 \text{ g} \quad \text{Ans}$$

$$W_{\text{O}_2} = Z_{\text{O}_2} \cdot I \cdot t = \frac{8}{96500} \times 1.3 \times 5 \times 3600 = 1.94 \text{ g} \quad \text{Ans} \quad \left( \text{eq. wt of } \text{O}_2 = \frac{\text{Mol. wt}}{4} \right)$$

$$V_{\text{H}_2} = n_{\text{H}_2} \times 22.4 \text{ lit} = \frac{0.244}{1} \times 22.4 \text{ lit} = 2.733 \text{ lit} \quad \text{Ans}$$

$$V_{\text{O}_2} = n_{\text{O}_2} \times 22.4 \text{ lit} = \frac{1.94}{32} \times 22.4 \text{ lit} = 1.358 \text{ lit} \quad \text{Ans}$$

**Q12.**

**Sol:**  $W_{\text{H}_2} = Z_{\text{H}_2} \cdot Q$  ----- (1)

$W_{\text{O}_2} = Z_{\text{O}_2} \cdot Q$  ----- (2)

$$(1) \Rightarrow W_{\text{H}_2} = \frac{\text{gm eq wt of } \text{H}_2}{96500} \times Q = \frac{\text{mole wt}}{2} \times Q$$

$$\Rightarrow \frac{W_{\text{H}_2}}{M_{\text{H}_2}} = \frac{Q}{2 \times 96500} \Rightarrow n_{\text{H}_2} = \frac{Q}{96500 \times 2} \Rightarrow V_{\text{H}_2} = \frac{Q}{96500 \times 2} \times 22400 \text{ mL}$$

**For O<sub>2</sub>**

$$\Rightarrow W_{\text{O}_2} = \frac{\text{gm. eq. wt } \text{O}_2}{96500} \times Q = \frac{\text{Mol. wt } \text{O}_2}{4} \times Q$$

$$\Rightarrow \frac{W_{\text{O}_2}}{M_{\text{O}_2}} = \frac{Q}{96500 \times 4} \therefore n_{\text{O}_2} = \frac{Q}{96500 \times 4}$$

$$\Rightarrow V_{\text{O}_2} = n_{\text{O}_2} \times 22400 \text{ ml} = \frac{Q \times 22400}{96500 \times 4}$$

$$\Delta/q, V_{\text{H}_2} + V_{\text{O}_2} = \frac{Q \times 22400}{96500 \times 2} + \frac{Q \times 22400}{96500 \times 4}$$

$$16.8 = \frac{Q}{965} (112 + 56) = \frac{Q}{965} \times 168$$

$$Q = \frac{16.8 \times 965}{16.8} = 96.5 \text{ Coulomb}$$

**Ans**

**Q13.**

**Sol:** Surface area = 800 cm<sup>2</sup>

$I = 0.2 \text{ amp for } t = 3 \text{ hr} = 3 \times 3600 \text{ sec}$

Let  $t$  is the thickness of Ag deposited, then it will happen on the one side of plate

$\therefore \text{Volume} = A \cdot t = 800 \times t \text{ cm}^3 = 800 t \text{ cm}^3$

$d_{\text{Ag}} = 10.47 \text{ g/cc}$





$$= Z_{\text{H}_2} \cdot I \cdot t = \frac{1}{96500} \times 1.3 \times 5 \times 3600 = 0.244 \text{ g} \quad \text{Ans}$$

$$W_{\text{O}_2} = Z_{\text{O}_2} \cdot I \cdot t = \frac{8}{96500} \times 1.3 \times 5 \times 3600 = 1.94 \text{ g} \quad \text{Ans} \quad \left( \text{eq. wt of } \text{O}_2 = \frac{\text{Mol. wt}}{4} \right)$$

$$V_{\text{H}_2} = n_{\text{H}_2} \times 22.4 \text{ lit} = \frac{0.244}{1} \times 22.4 \text{ lit} = 2.733 \text{ lit} \quad \text{Ans}$$

$$V_{\text{O}_2} = n_{\text{O}_2} \times 22.4 \text{ lit} = \frac{1.94}{32} \times 22.4 \text{ lit} = 1.358 \text{ lit} \quad \text{Ans}$$

**Q12.**

**Sol:**  $W_{\text{H}_2} = Z_{\text{H}_2} \cdot Q$  ----- (1)

$W_{\text{O}_2} = Z_{\text{O}_2} \cdot Q$  ----- (2)

$$(1) \Rightarrow W_{\text{H}_2} = \frac{\text{gm eq wt of } \text{H}_2}{96500} \times Q = \frac{\text{mole wt}}{\frac{2}{96500}} \times Q$$

$$\Rightarrow \frac{W_{\text{H}_2}}{M_{\text{H}_2}} = \frac{Q}{2 \times 96500} \Rightarrow n_{\text{H}_2} = \frac{Q}{96500 \times 2} \Rightarrow V_{\text{H}_2} = \frac{Q}{96500 \times 2} \times 22400 \text{ mL}$$

**For O<sub>2</sub>**

$$\Rightarrow W_{\text{O}_2} = \frac{\text{gm. eq. wt } \text{O}_2}{96500} \times Q = \frac{\text{Mol. wt } \text{O}_2}{4} \times \frac{Q}{96500}$$

$$\Rightarrow \frac{W_{\text{O}_2}}{M_{\text{O}_2}} = \frac{Q}{96500 \times 4} \therefore n_{\text{O}_2} = \frac{Q}{96500 \times 4}$$

$$\Rightarrow V_{\text{O}_2} = n_{\text{O}_2} \times 22400 \text{ ml} = \frac{Q \times 22400}{96500 \times 4}$$

$$\Delta/q, V_{\text{H}_2} + V_{\text{O}_2} = \frac{Q \times 22400}{96500 \times 2} + \frac{Q \times 22400}{96500 \times 4}$$

$$16.8 = \frac{Q}{965} (112 + 56) = \frac{Q}{965} \times 168$$

$$Q = \frac{16.8 \times 965}{16.8} = 96.5 \text{ Coulomb} \quad \text{Ans}$$

**Q13.**

**Sol:** Surface area = 800 cm<sup>2</sup>

$I = 0.2 \text{ amp for } t = 3 \text{ hr} = 3 \times 3600 \text{ sec}$

Let  $t$  is the thickness of Ag deposited, then it will happen on the one side of plate

$\therefore \text{Volume} = A \cdot t = 800 \times t \text{ cm}^3 = 800 t \text{ cm}^3$

$d_{\text{Ag}} = 10.47 \text{ g/cc}$



$$\therefore m_{Ag} = d_{Ag} \cdot V_{Ag} = 800t \times 10.47 = 8376t$$

$$m_{Ag} = Z_{Ag} \cdot I \cdot t = \frac{108}{96500} \times 3 \times 3600 \times 0.2$$

$$8376t = \frac{108 \times 108}{965} \times \frac{2}{10} = 12.087 \times \frac{2}{10}$$

$$t = \frac{12.087}{8376} \times \frac{2}{10}$$

$$\text{Thickness of Ag deposited in the vessel} = 2.88 \times 10^{-4} \text{ cm} \quad \text{Ans}$$

**Q14.**

**Sol:**  $I = 0.5 \text{ amp}$

$$t = 12 \text{ min} \& 20 \text{ sec} = 12 \times 60 + 20 = 740 \text{ sec}$$

$$V_{H_2} \text{ collected} = 50 \text{ ml}$$

$$T = 23^\circ\text{C} = 273 + 23 = 296 \text{ K}$$

$$P = 740 \text{ mm of Hg} = \frac{740 \text{ mm}}{760 \text{ mm}} = \frac{74}{76} \text{ atm}$$

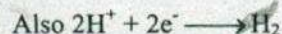
$$\Rightarrow PV = nRT$$

$$\therefore \text{No. of moles of } H_2 \text{ evolved} = \frac{74/76}{0.0821 \times 296} \times 50 \times 10^{-3} = 2 \times 10^{-3}$$

$$\text{Charge transferred} = 0.5 \times 740 = 370 \text{ coulombs}$$

$$\text{Charge on single } e^- = 1.6 \times 10^{-19} \text{ coulomb}$$

$$\text{So no. of } e^- \text{ transferred} = \frac{370}{1.6 \times 10^{-19}} = 2.3125 \times 10^{21}$$



$$\text{moles of } e^- \text{ required to transfer} = 2 \times \text{moles of } H_2 \text{ evolved}$$

$$\Rightarrow \frac{\text{no. of } e^-}{N_A} = 2 \times 2 \times 10^{-3}$$

$$N_A = \frac{2.3125 \times 10^{21}}{4 \times 10^{-3}} = 5.78 \times 10^{23} \quad \text{Ans}$$

**Q15.**

**Sol:**  $I = 0.5 \text{ amp}, t = 20 \text{ min} = 20 \times 60 = 1200 \text{ sec}$

$$(i) W_{Cu} = Z_{Cu} \cdot I \cdot t$$

$$= \frac{63.5}{96500} \times 0.5 \times 1200 = \frac{63.5}{2 \times 96500} \times \frac{1200}{2} = 0.1975 \text{ g}$$

$$(2) \text{ no. of Cu atoms deposited} = \frac{0.1975}{63.5} \times N_A = 1.87 \times 10^{21} \quad \text{Ans}$$

**Q16.**

**Sol:** 1 mole of  $e^-$  has charge = 96500 coulomb

$$\text{Time} = 1 \text{ hr} = 3600 \text{ sec}$$



$$\therefore I = \frac{Q}{t} = \frac{96500}{3600} = 26.8 \text{ amp}$$

$$W_{\text{At}} = Z_{\text{At}} Q = \frac{27}{16500} \times 96500 = 9 \text{ g} \quad \text{Ans}$$

$$W_{\text{Cd}} = Z_{\text{Cd}} \cdot Q = \frac{112.4}{2 \times 96500} = 56.2 \text{ g} \quad \text{Ans}$$

**Q17.**

**Sol:**  $I = 3 \text{ amp}$

wt. of water decompose = 18 g

$$W_{\text{H}_2\text{O}} = Z_{\text{H}_2\text{O}} \cdot I \cdot t.$$

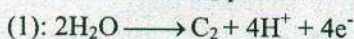
$$18 = \frac{18}{2 \times 96500} \times 3 \times t \Rightarrow t = \frac{96500 \times 2}{3} \text{ sec} = 64333.33 \text{ sec} = 17.89 \text{ hr} \quad \text{Ans}$$

**Q18.**

**Sol:** 50 ml of 0.1 M  $\text{CuSO}_4$

Time = 12 minutes and  $I = 0.06 \text{ amp}$ .

No. of moles of  $\text{O}_2$  produced



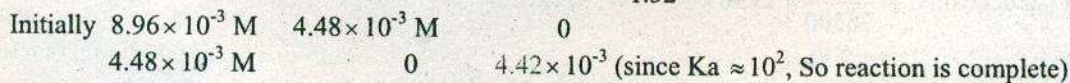
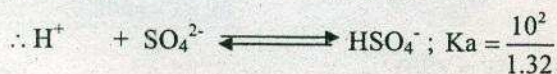
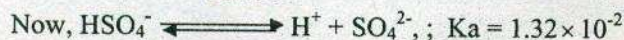
$$\text{no}_2 = \frac{\text{no. of faraday of charge}}{\text{v.f.}} = \frac{0.06 \times 12 \times 60}{96500 \times 4} = 1.12 \times 10^{-4}$$

$\therefore$  From reaction (1)

$$\begin{aligned} \text{Moles of } \text{H}^+ \text{ produced} &= 4 \times \text{no. of moles of } \text{O}_2 \text{ produced} \\ &= 4 \times 1.12 \times 10^{-4} = 4.48 \times 10^{-4} \end{aligned}$$

$$\therefore M_{\text{H}^+} = \frac{4.48 \times 10^{-4}}{50 \times 10^{-3}} = 8.96 \times 10^{-3} \text{ M}$$

$$\begin{aligned} [\text{SO}_4^{2-}] &= \frac{\text{moles of Cu deposited}}{\text{Volume}} \quad (\because \text{moles of } \text{SO}_4^{2-} = \text{moles of } \text{Cu}^{2+} \text{ removed from solution}) \\ &= \frac{1}{2} \times \frac{0.06 \times 12 \times 60}{96500} = \frac{2.24 \times 10^{-4}}{50 \times 10^{-3}} = 4.48 \times 10^{-3} \text{ M}. \end{aligned}$$



$$\therefore \text{pH} = -\log \text{H}^+ = -\log(4.48 \times 10^{-3}) = 2.35 \quad \text{Ans}$$



**Q19.**



(i) To, produce 1 mole of  $\text{ClO}_4^-$ , 3 mole of  $\text{e}^-$  are required  
 $\therefore$  no. of Faraday for production of 1 mole of  $\text{NaClO}_4 = 2\text{F}$

$$(ii) \Rightarrow \frac{W_{\text{NaClO}_4}}{E_{\text{NaClO}_4}} = \frac{V_{\text{H}_2}}{\text{eq. Vol. H}_2}$$

$$\Rightarrow \frac{12.25}{122.5/2} = \frac{V_{\text{H}_2}}{22.4/2} \Rightarrow V_{\text{H}_2} = 2.24 \text{ lit}$$

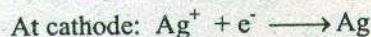
**Ans**

**Q20.**

**Sol:** (i) **In cell A:**

$\text{Ag}_2\text{SO}_4$  solution, so we have ions  $\text{Ag}^+$  &  $\text{H}^+$  for reduction at cathode.

Since  $\text{Hg}^+$  has higher reduction potential, so it will reduce first.



At anode,  $\text{SO}_4^{2-}$  &  $\text{O}^{2-}$  ions are for oxidation since reduction potential of  $\text{SO}_4^{2-}$  is higher,  $\text{O}^{2-}$  will oxidise first. So



**In cell B:**

At cathode:  $\text{Cu}^{2+} + 2\text{e}^- \longrightarrow \text{Cu}$  (again  $\text{Cu}^{2+}$  has higher R.P. than  $\text{H}^+$  so reduce first)

At anode:  $\text{Cu} \longrightarrow \text{Cu}^{2+} + 2\text{e}^-$  (In presence of Cu electrode, we will oxidise as well as reduce first)

(ii)

$$\frac{W_{\text{O}_2}}{\text{Eq. wt. O}_2} = \frac{W_{\text{Ag}}}{\text{Eq. wt. Ag}} = \frac{W_{\text{Cu}}}{\text{Eq. wt. Cu}}$$

$$\frac{1.6}{8} = \frac{W_{\text{Ag}}}{108/1}$$

$$\Rightarrow W_{\text{Ag}} \text{ deposited} = 21.6 \text{ g} \quad \text{Ans}$$

$$\Rightarrow W_{\text{Cu}} \text{ deposited} = 0.2 \times \frac{63.5}{2} = 6.35 \text{ g}$$

**Ans**

**Q21.**

**Sol:**  $V = 100 \text{ ml}$ ,  $M = 0.8 \text{ M}$   $\text{CuSO}_4$  solution

time = 30 min with current  $I = 5 \text{ amp}$

$$\begin{aligned} \text{Wt of Cu deposited} &= \frac{63.5}{96500} \times 5 \times 30 \times 60 \quad (W = Z.I.t) \\ &= 2.96 \text{ g} \end{aligned}$$

$$\therefore \text{Initially the wt of } \text{CuSO}_4 \text{ in solution} = 100 \times 10^{-3} \times 0.8 \times 159.4 = 12.76 \text{ g}$$

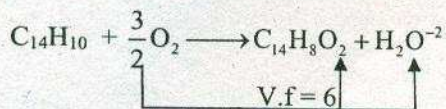


$$\therefore \text{wt of } \text{SO}_4^{2-} \text{ combined with 296 g of Cu} = \left( \frac{2.96}{63.5} \right) \times 96 = 4.37 \text{ g}$$

$$\therefore \text{wt of } \text{CuSO}_4 \text{ remaining in the solution} = 12.76 - (2.96 + 4.37) = 5.31 \text{ g} \quad \text{Ans}$$

**Q22.**

$$\text{Sol: } I = 1 \text{ amp, } t = 60 \text{ min} = 60 \times 60 \text{ sec}$$



$$\text{Eq. wt of } \text{C}_{14}\text{H}_8\text{O}_2 = \frac{\text{Mol. wt}}{6}$$

$$\therefore \text{wt deposited} = \frac{\text{Eq. wt. of } \text{C}_{14}\text{H}_8\text{O}_2}{96500} \times 1 \times 3600 = \frac{208}{6 \times 96500} \times 3600 = 1.2932 \text{ g} \quad \text{Ans}$$

**Q23.**



$$20 \text{ g} \quad (\text{v.f.} = 6 \text{ since oxid. No. of N changes from } +3 \text{ to } -3)$$

$$\text{Current passed} = 26.5 \text{ amp.hr}$$

It W is the critical wt. produced, then

$$W = Z.I.t$$

$$= \frac{93}{6} \times 26.5 \times 3600 = \frac{93 \times 26.5 \times 36}{6 \times 965} = 15.323 \text{ g}$$

$$\text{Actual wt produced} = 12.76 \text{ g}$$

$$\text{Current yield} = \frac{\text{wt. actually produced}}{W} \times 100 = \frac{12.76}{15.323} \times 100 = 83.28\% \quad \text{Ans}$$

**Q24.**

$$\text{Sol: wt of Cu deposited} = 0.2964 \text{ g}$$

$$I = 0.5 \text{ am for } 30 \text{ min} = 30 \times 60 \text{ sec}$$

$$W = Z.I.t$$

$$\Rightarrow 0.2964 = \frac{\text{gm. eq. wt}}{96500} \times 0.5 \times 30 \times 60$$

$$\Rightarrow 0.2964 = \frac{\text{At. wt.}}{2 \times 965} \times \frac{18.9}{2} \left( \text{gm eq. wt. of Cu} = \frac{\text{At. wt.}}{2} \right)$$

$$\text{At. wt. cu} = \frac{0.2964 \times 2 \times 965}{9} \text{ g} = 63.56 \text{ g} \quad \text{Ans}$$

**Q25.**

$$\text{Sol: } Z_{\text{Cu}} = 0.00033 \text{ g / coulomb}$$

$$\text{If wt of Cu deposited} = 1 \text{ kg} = 1000 \text{ g}$$



$$\text{Then } Q = \frac{W}{Z_u} = \frac{1000}{0.00033} = 3 \times 10^6 \text{ coulomb}$$

Cost of electricity = 0.25 Rs per Kwh.

$$\text{In 1 Kwh, } E = 1 \times 10^3 \frac{\text{J}}{\text{sec}} \cdot 3600 \text{ sec} = 3.6 \times 10^6 \text{ J}$$

Now,  $QV = E$

$$Q = \frac{E}{V} = \frac{3.6 \times 10^6 \text{ J}}{0.2} = 1.8 \times 10^7 \text{ coulomb}$$

Now,  $\therefore 1.8 \times 10^7$  coulomb cost 0.25 rupees

$$\therefore 1 \text{ } \frac{0.25 \text{ rupees}}{1.8 \times 10^7}$$

$$\therefore 3 \times 10^6 \text{ } \frac{0.25 \times 3 \times 10^6}{18 \times 10^6} = \frac{0.25}{6} = 0.0416 \text{ rupees} = 4.16 \text{ paise} \quad \text{Ans}$$

**Q26.**

**Sol:** Let time  $t$  sec required for pH to become equal to 12

$$\text{pH} = 12$$

$$[\text{H}^+] = 10^{-12} \text{ M}$$



$$\therefore \text{No. of moles of } \text{H}^+ \text{ present} = \text{Molarity} \times \text{volume (in lit)}$$

$$= 10^{-12} \times 50 \times 10^{-3} = 5 \times 10^{-10}$$

$$\therefore \text{No. of moles of } \text{e}^- \text{ required} = 5 \times 10^{-10} \text{ [From reaction(1)]}$$

$$\therefore \text{Charge required} = 5 \times 10^{-10} \times 96500 \text{ coulomb}$$

$$\Rightarrow 0.5 \times t = 5 \times 10^{-10} \times 96500$$

$$\Rightarrow t = \frac{5 \times 10^{-10} \times 96500}{0.5} = 96.5 \mu \text{sec} \quad \text{Ans}$$

**Q27.**

$$\text{Sol: } V = 8.2 \times 10^{12} \text{ lit} = 8.2 \times 10^{15} \text{ mL}$$

$$\text{Rate of charge production} = 1.5 \times 10^6 \text{ coulomb per sec}$$

$$\text{Density of water} = 1 \text{ gm/cc}$$

$$\text{Mass of water} = v \times d = 8.2 \times 10^{15} \text{ g}$$

$$\Rightarrow m_w = Z_w \cdot Q \cdot T$$

$$\Rightarrow 8.2 \times 10^{15} \text{ g} = \frac{18 \text{ g}}{2 \times 96500} \times 1.5 \times 10^6 \times t$$

$$\Rightarrow t = \frac{8.2 \times 10^{15} \times 2 \times 96500}{18 \times 1.5 \times 10^6} = 6.07 \times 10^{13} \text{ sec}$$

$$= 1.687 \times 10^{10} \text{ hr} = 7.03 \times 10^8 \text{ days}$$

$$= 1.925 \times 10^6 \text{ years} = 1.925 \text{ million years.} \quad \text{Ans}$$



28.

Sol: Energy delivered per sec = 200 J/sec

$$\text{Charge delivered per sec} = \frac{E}{V} = \frac{200 \text{ J}}{110} = \frac{20}{11} \text{ coulomb/sec}$$

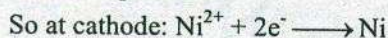
$$\therefore W = Z_{\text{Zn}} \cdot \frac{Q}{t_{\text{sec}}}$$

$$W = \frac{63.5}{2 \times 96500} \times \frac{20}{11} \times 30 \times 60$$

$$\text{wt. produced} = 1.0768 \text{ g} \quad \text{Ans}$$

Q29.

Sol: At. Cathode:  $\text{Ni}^{2+}$  &  $\text{H}_2\text{O}$  ions are present, but  $\text{Ni}^{2+}$  will reduce because it has higher reduction potential



At Anode:  $\text{SO}_4^{2-}$  &  $\text{H}_2\text{O}$  are present to oxidise in the  $\text{H}_2\text{O}$  will oxidise first because of less reduction potential



$$(ii) \text{ no. of coulombs passed} = 0.05 \times 40 \times 60 = 120 \quad \text{Ans}$$

$$(iii) W_{\text{Ni}} = Z_{\text{Ni}} \cdot I \cdot t = \frac{58.7}{2 \times 96500} \times 120 = 0.037 \text{ g} \quad \text{Ans}$$

$$(iv) \text{ moles of Ni present} = 40 \times 10^{-3} \times 0.125 = 5 \times 10^{-3}$$

$$\therefore n_{\text{Ni}} = \frac{1}{2 \times 96500} \times 0.05 \times t$$

$$t = \frac{5 \times 10^{-3} \times 2 \times 96500}{0.05} = \frac{965}{0.05} = 19300 \text{ s}$$

$$(v) \text{ wt. produced at cathode} = n_{\text{Ni}} \times \text{At. wt.} \\ = 5 \times 10^{-3} \times 58.7 = 0.293 \text{ g}$$

wt. produced at anode :-

$$W_{\text{O}_2} = \frac{\text{gm. eq. wt of O}_2}{96500} \times 0.05 \times 19300$$

$$= \frac{8}{96500} \times \frac{19300 \times 5}{100} = 0.08 \text{ g}$$

Q30.

Sol: From Faraday's 2<sup>nd</sup> law

$$\Rightarrow \frac{W_{\text{Ag}}}{\text{Eg wt}_{\text{Ag}}} = \frac{W_{\text{Cu}}}{\text{Eg. wt}_{\text{Cu}}} \Rightarrow \frac{1.307 \text{ g}}{(108/1) \text{ g}} = \frac{W_{\text{Cu}}}{63.5/2}$$

$$\Rightarrow W_{\text{Cu}} = \frac{63.5 \times 1.307 \text{ g}}{2 \times 108} = 0.384 \text{ g}$$

Now wt. present initially = (moles of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ). At wt cu



$$= \frac{10}{249.5} \times 63.5 \text{ g} = 2.545 \text{ g}$$

$\therefore$  Amount of  $\text{Cu}^{2+}$  remained in the solution =  $2.545 \text{ g} - 0.384 \text{ g} = 2.16 \text{ g}$

$$\therefore \text{wt. of Cu / lit present now} = \frac{2.16}{500} \times 1000 = 4.32 \text{ g / lit} \quad \text{Ans}$$

**Q31.**

**Sol:** Volume of  $\text{H}_2$  reacted at STP = 67.2 lit

$$\therefore n_{\text{H}_2} = \frac{67.2 \text{ lit}}{22.4 \text{ lit}} = 3$$

$$V \times \text{H}_2 = \frac{\text{gmeq of H}_2}{96500} \times I.t$$

$$W_{\text{H}_2} = \frac{\text{Mol.wt of H}_2}{v.f \times 96500} \times I.t.$$

$$n_{\text{H}_2} = \frac{W_{\text{H}_2}}{M_{\text{H}_2}} = \frac{1}{2 \times 96500} \times I \times 15 \times 60$$

$$I = \frac{3 \times 2 \times 96500}{15 \times 60} = 643.34 \text{ amp} \quad \text{Ans}$$

$$W_{\text{Cu}} = Z_{\text{Cu}} \cdot I.t$$

$$= \frac{63.5}{2 \times 96500} \times 643.34 \times 15 \times 60 = 190.5 \text{ g} \quad \text{Ans}$$

**Q32.**

**Sol:**  $I = 3 \text{ amp}$

wt of  $\text{Pd}^{n+}$  deposited = 2.977

$$W_{\text{Pd}} = Z_{\text{Pd}} \cdot I.t.$$

$$2.977 = \frac{\text{gmeq.wt pd}}{96500} \times 3 \times 1 \times 3600$$

$$2.977 = \frac{106.40}{n \times 96500} \times 3 \times 3600 \Rightarrow n = \frac{106.40 \times 108}{2.977 \times 965} = 4 \quad \text{Ans}$$

**Q33.**

**Sol:**  $W_M = Z_M \cdot I.t = Z_M \cdot Q$

$$37.7 \text{ g} = \frac{M}{3 \times 96500} \times 69500 \Rightarrow M = \frac{965 \times 3 \times 37.7}{695} = 157.0 \text{ g} \quad \text{Ans}$$

**Q34.**

**Sol:** Total wt precipitated = 0.175 g

% of Cu ppt = 72.8 %

$$\therefore \text{Wt of cu ppt} = 0.175 \times \frac{72.8}{100} = 0.1274 \text{ g}$$

% of Ni precipitated = 4.3%



$$\text{wt of Ni ppt} = 0.175 \times \frac{4.3}{100} = 7.5 \times 10^{-3} \text{ g}$$

$$\% \text{ of Zn precipitated} = 22.9\%$$

$$\text{wt Zn precipitated} = 0.175 \times \frac{22.9}{100} = 0.04 \text{ g}$$

For Cu

$$W_{\text{Cu}} = \frac{\text{gmeq Cu}}{96500} \times Q_{\text{Cu}}$$

$$Q_{\text{Cu}} = \frac{0.1274 \text{ g} \times 96500}{\frac{63.5}{1}} = 193.6 \text{ coulomb}$$

For Ni

$$W_{\text{Ni}} = \frac{\text{gmeq of Ni}}{96500} \times Q_{\text{Ni}}$$

For Zn

$$W_{\text{Zn}} = \frac{\text{Gmeq of Zn}}{96500} \times Q_{\text{Zn}}$$

$$\therefore Q_{\text{Zn}} = \frac{0.04 \times 96500}{\frac{65.4}{2}} = 118.04 \text{ coulomb}$$

$$\therefore Q_{\text{total}} = Q_{\text{Cu(I)}} + Q_{\text{Ni}} + Q_{\text{Zn}} \\ = 193.6 + 24.66 + 118.04 = 336 \text{ coulomb} \quad \text{Ans}$$

Q35.

$$\text{Sol: } WMg = ZMg \cdot Q$$

$$1 \times 10^3 \text{ g} = \frac{24}{2} \times \frac{Q}{96500}$$

$$Q = \frac{10^3 \times 96500}{12} = 8.04 \times 10^6 \text{ coulomb}$$

$$\text{Energy required} = QV \\ = 8.04 \times 10^6 \times 5 = 4.021 \times 10^7 \text{ J}$$

$$\text{In 1 Kwh} = 1 \times 10^3 \times 3600 \text{ J} = 3.6 \times 10^6 \text{ J}$$

$$\therefore \text{no. of Kwh} = \frac{4.04 \times 10^7}{3.6 \times 10^6} = 11.16 \text{ Kwh} \quad \text{Ans}$$

Q36.

$$\text{Sol: } W_{\text{Al}} = Z_{\text{Al}} \cdot I \cdot t = \frac{27}{3} \times \frac{9 \times 1.2 \times 3600}{96500} = 0.403 \text{ g} \quad \text{Ans}$$

$$\frac{W_{\text{O}_2}}{\text{Eq. wt O}_2} = \frac{W_{\text{t Al}}}{\text{Eq wt Al}} \Rightarrow W_{\text{O}_2} = \frac{0.403}{9} \times 8 = 0.358 \text{ g}$$

Now, 32 g of O<sub>2</sub> will form 44 g of CO<sub>2</sub>

$$\therefore 1 \text{ ————— } \frac{44}{32}$$

$$\therefore 0.358 \text{ g ————— } \frac{44 \times 0.358}{32} \text{ g} = 0.4924 \text{ g} \quad \text{Ans}$$



$$\text{Molarity} = \frac{0.624}{\frac{249.5}{\frac{100}{1000}}} = 2.5 \times 10^{-2} \cdot \lambda_m = \frac{2.95 \times 10^{-3}}{2.5 \times 10^{-2}} \times 1000 = 115 \text{ mho cm}^2 \quad \text{Ans}$$

**Q41.**

**Sol:**  $K = 0.0227 \text{ mho cm}^{-1} = 2.7 \times 10^{-3} \text{ mho cm}^{-1}$

$C = 2 \text{ volts}$

$l = 2 \times r = 2 \times 0.01 \text{ cm} = 2 \times 10^{-2} \text{ cm}$

$a = \pi r^2 l = 25 \times 3.14 \times 10^{-4} \text{ cm}^2$

$K = C \left( \frac{l}{a} \right) = \left( \frac{2 \times 10^{-2}}{25 \times 3.14 \times 10^{-4}} \right)$

$\Rightarrow \frac{2.7 \times 10^{-3} \times 25 \times 3.14 \times 10^{-4}}{2 \times 10^{-2}} = C$

$C = 1.059 \times 10^{-3} \text{ mho}$

$I = CV = 1.059 \times 10^{-3} \times 2 = 2.13 \times 10^{-3} \text{ amp} \quad \text{Ans}$

**Q42.**

**Sol:**  $\lambda^\infty \text{C}_3\text{H}_7\text{COONa} = 83 \text{ mho cm}^2$ ;  $\lambda^\infty \text{NaCl} = 127 \text{ mho cm}^2$

$\lambda^\infty \text{HCl} = 426 \text{ mho cm}^2$

$\lambda^\infty \text{C}_3\text{H}_7\text{COOH} = \lambda^\infty \text{C}_3\text{H}_7\text{COONa} + \lambda^\infty_{\text{HCl}} - \lambda^\infty_{\text{NaCl}} = 83 + 426 - 127 = 382 \text{ mho cm}^2 \quad \text{Ans}$

**Q43.**

**Sol:**  $l = 10 \text{ cm}$

$\Delta V = 6 \text{ volt}$

$\lambda^\infty \text{K}^+ = 73.52 \text{ mho cm}^2$

$\lambda^\infty \text{K}^+ = U^\infty_{\text{K}^+} \cdot F$

$U^\infty_{\text{K}^+} = \frac{\lambda^\infty_{\text{K}^+}}{F} = \frac{73.52}{96500} \Rightarrow \frac{V_{\text{K}^+}}{\Delta V / l} = \frac{73.52}{96500}$

$V_{\text{K}^+} = \frac{73.52}{96500} \times \frac{6}{10} = 4.57 \times 10^{-4} \text{ cm/sec}$

Distance in 2hr =  $V_{\text{K}^+} \cdot t = V_{\text{K}^+} \times 2 \times 3500 \text{ sec} = 4.57 \times 10^{-4} \times 7200 = 3.29 \text{ cm} \quad \text{Ans}$

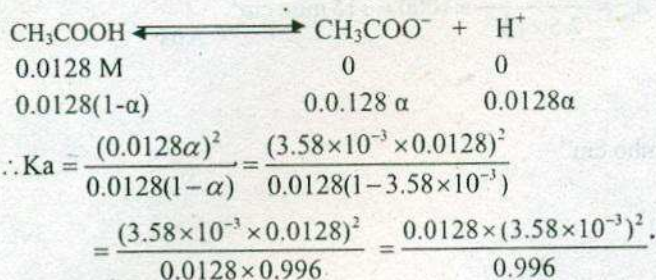
**Q44.**

**Sol:** At conc -<sup>n</sup> 0.0128 N of  $\text{CH}_3\text{COOH}$

$\lambda_{\text{CH}_3\text{COOH}} = 1.4 \text{ mho cm}^2 \text{ eg}^{-1}$ ;  $\lambda^\infty_{\text{CH}_3\text{COOH}} = 391 \text{ mho cm}^2 \text{ eg}^{-1}$

$\alpha = \frac{\lambda_{\text{CH}_3\text{COOH}}}{\lambda^\infty_{\text{CH}_3\text{COOH}}} = \frac{1.4}{391} = 3.58 \times 10^{-3}$





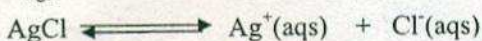
$$K_a = 1.647 \times 10^{-7} \text{ Ans.}$$

**Q45.**

**Sol:** Specific conductance of AgCl =  $1.828 \times 10^{-3} \text{ ohm}^{-1} \text{ cm}^{-1}$

$$K_{\text{AgCl}} = 1.826 \times 10^{-6} \text{ mho cm}^{-1}$$

$$\lambda_{\text{AgCl}}^\infty = 138.26 \text{ mho cm}^2$$



For S be the solubility of AgCl

$$K_{sp} = [\text{Ag}^+][\text{Cl}^-] = S \cdot S = S^2$$

$\therefore$  S will be the mole / lit ions present in the solution. Also since  $\text{Ag}^+$  &  $\text{Cl}^-$  have 1 unit charge on it. So mole / lit will be equal to eq / lit

$\therefore$  X eq of ions present in 1 lit of solution

$$\therefore 1 = \frac{1000 \text{ ml}}{x}$$

$$\therefore \lambda_{\text{AgCl}} = \text{sp. conductance} \times \text{volume containing 1 eq}$$

$$= 1.826 \times 10^{-6} \times \frac{1000}{x}$$

Also AgCl is sparingly soluble in water, so

$$\lambda_{\text{AgCl}} \square \lambda_{\text{AgCl}}^\infty (\because \text{dilution doesn't affect much})$$

$$\therefore \frac{1.826 \times 10^{-3}}{x} = 138.26$$

$$x = \frac{1.826 \times 10^{-3}}{138.26} = 1.32 \times 10^{-5} \text{ M}$$

$$\therefore \text{Solubility in g/lit} = 1.32 \times 10^{-5} \times 143.5$$

$$= 1.89 \times 10^{-3} \text{ g / lit} \quad \text{Ans}$$

**Q46.**

$$\text{Sol: } K_{\text{H}_2\text{O}} = 0.58 \times 10^{-7} \text{ mho cm}^{-1}$$

$$\lambda_{\text{H}^+}^\infty = 350 \text{ mho cm}^2; \lambda_{\text{OH}^-}^\infty = 198 \text{ mho cm}^2$$

Let  $\text{H}_2\text{O}$  dissociates to give x mole / lit of  $\text{H}^+$  &  $\text{OH}^-$  ions. The same amount of  $\text{H}^+$  &  $\text{OH}^-$  will be present as eq / lit



So,  $H^+ = x$  eq/lit &  $OH^- = x$  eq/lit

Volume contains 1 eq. of  $H^+$  or  $OH^- = \frac{1000}{x}$  ml

$$\therefore \text{Eq. conductance of water} = \text{Sp. conductance} \times \text{volume contain 1 eq of ions}$$

$$= 0.58 \times 10^{-7} \times \frac{1000}{x}$$

Since dissociation of  $H_2O$  doesn't change by taking less or more amount of water.

$$\text{So } \lambda_{H_2O} = \lambda_{H^+}^\infty + \lambda_{OH^-}^\infty$$

$$= 350 + 198 = 548$$

$$0.58 \times 10^{-7} \times \frac{1000}{x} = 548$$

$$X = \frac{5.8 \times 10^{-5}}{548} = 1.05 \times 10^{-7}$$

$$\therefore K_w = [H^+][OH^-] = x^2 = (1.05 \times 10^{-7})^2 = 1.1 \times 10^{-14} \quad \text{Ans.}$$

#### Objective Questions:-

**Q1: Ans - (c)**

because 1 faraday 96500 coulomb is the charge on one mole of electrons

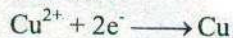
In other words;

$$n \times 1.6 \times 10^{-19} \text{ C} = 96500 \text{ C}$$

$$n = \frac{96500}{1.6 \times 10^{-19}} = 6.02 \times 10^{23}$$

Ans

**Q2: Ans - (c)**



$$63.5 \text{ g} = 1 \text{ mole}$$

For deposition of 1 mole of Cu, 2 mole of  $e^-$ s are required

$$\therefore \text{no. of } e^- \text{ s} = 12.044 \times 10^{23}$$

**Q3: Ans - (c)**

$$W = \frac{\text{gm eq wt}}{96500} \times Q \text{ (First law)}$$

$$\frac{W_1}{E_1} = \frac{W_2}{E_2} \text{ (2nd law : } E_1 \text{ \& } E_2 \text{ are eq.wt.)}$$

**Q4: Ans - (b)**

$$W = \frac{\text{gm eq.wt}}{96500} \times Q$$

$$\frac{W}{\text{gm eq wt}} = \frac{Q}{96500} = 1 \Rightarrow Q = 96500 \text{ coulomb}$$

**Q5: Ans - (b)**



$$W = Z - Q \Rightarrow Z = m \times 10^3$$

Q7: Ans - (b)

$$W = Z \cdot Q$$

$$13.5 = \frac{9}{96500} Q$$

$$\frac{Q}{96500} = \text{no. of faraday} = \frac{13.5}{9} = 1.5$$

Q8: Ans - (d)

$$W = \frac{\text{gm eq wt}}{96500} \times 0.1 \times 96500$$

$$\frac{3.17}{0.1} = \text{gm eq wt} \Rightarrow \text{gm eq wt} = 31.7$$

Q9: Ans - (b)

$$0.108 = \frac{\text{gm eq wt}}{96500} \times 0.5 \times 193$$

$$\text{gm eq wt} = 108 \text{ g}$$

Q10: Ans - (c)

pH is increased, so  $\text{OH}^-$  conc<sup>n</sup> increases at anode

Also, At anode, oxidation will happen &  $\text{Cl}^-$  will oxidise first than the  $\text{OH}^-$  ion

$\left. \begin{array}{l} \text{Cl}^- \\ \text{In} \\ \text{OH}^- \end{array} \right\} \rightarrow \text{Cl}^- \text{ will oxidise because it has less reduction potential}$

At cathode in  $\text{H}^+$ ,  $\text{K}^+ \rightarrow \text{H}^+$  will reduce because it has high reduction pot.

$\therefore$  KOH remain in solution, so pH increases

Q11: Ans - (d)

Using Cu electrode, at anode:  $\text{Cu} \longrightarrow \text{Cu}^{2+} + 2\text{e}^-$

So same amount of Cu will go into the solution as the amount of Cu deposited at cathode.

Q12: Ans - (d)

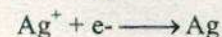
$$0.1 = \frac{I}{96500} \times 10 \times 1 \Rightarrow I = 965 \text{ amp}$$

Q13: Ans - (d)

$$Q \text{ per sec} = I = 10^{-16}$$

$$\text{no of } \text{e}^- \text{ passing per sec} = \frac{10^{-16}}{1.6 \times 10^{-19}} = \frac{10^3}{1.6}$$

Q14: Ans - (c)



$$107.9 \text{ gm} = 1 \text{ mole}$$

1 mole deposition will require 1 mole of  $\text{e}^-$

Q15: Ans - (c)



$$W = Z.I.t$$

$$22.2 \text{ g} = \frac{\text{gmeq. wt. of tin}}{96500} \times 2 \times 5 \times 3600$$

$$= \frac{118.7}{n \times 96500} \times 10 \times 3600$$

$$n = \frac{1187 \times 36}{965 \times 22.2} = 2 \quad \text{Ans}$$

**Q16: Ans - (b)**

$$1 \text{ Kwh} = 1 \times 10^3 \text{ J/s} \times 3600 = 3.6 \times 10^6 \text{ J}$$

$$Q \text{ in (8hr)} = 8 \times 3600 \times 15 = 4.32 \times 10^5 \text{ coulomb}$$

$$\therefore E = QV = 4.32 \times 10^5 \times 110 = 4.752 \times 10^7 \text{ J}$$

$$\therefore 3.6 \times 10^6 \text{ H cost 5 paise}$$

$$\therefore 1 \frac{5}{3.6 \times 10^{-6}}$$

$$\therefore 4.752 \times 10^7 \frac{5 \times 4.752 \times 10^7}{3.6 \times 10^6} = 66 \text{ paise}$$

**Q17: Ans - (a)**

1 faraday will deposit eq. wt of each metal

$$\text{For Ag}^+, \text{eq. wt} = \frac{108}{1} = 108$$

$$\text{For Cu}^{2+}, \text{eq. wt} = \frac{58.4}{2} = 29.59$$

$$\text{For Cr}^{3+}, \text{eq. wt} = \frac{52}{3} = 17.4$$

**Q18: Ans - (c)**

$$\frac{1}{4} \text{ moles of Ag} = \frac{1}{4} \times 0.2 \times 0.1 = \frac{0.02}{4} \text{ g eg of Ag}^+ \text{ because v.f} = 1)$$

$$\text{gm eq of Ag}^+ = \frac{1t}{96500} \Rightarrow t = \frac{96500 \times 2 \times 10^{-2}}{4 \times 10^{-1}} = \frac{311.6 \text{ min}}{4} = 80 \text{ minutes}$$

**Q19: Ans - (c)**



2.35 lit

$$\therefore \text{Volume of H}_2 \text{ liberated from reaction (2)} = 2 \times 2.35 \text{ lit} \\ = 4.7 \text{ lit}$$

Volume of H<sub>2</sub> evolved from reaction (1) = total volume evolved – volume of H<sub>2</sub> liberated from reaction(2)

$$= 9.72 - 4.7 = 5.02 \text{ lit}$$

Now for reaction (1)



Eq. of  $H_2$  evolved from reaction (1) = gm eq. of  $H_2S_2O_8$  produced

$$\frac{5.02}{22.4/2} = \text{g eq. of } H_2S_2O_8 \text{ produced.}$$

$\therefore 0.448 = \text{gm eq. of } H_2S_2O_8 \text{ produced,}$

**Q20: Ans - (d)**

gm eq of  $H_2$  evolved = gm eq of evolved

$$\frac{V_{H_2}}{\text{eq.vol. } H_2} = \frac{V_{O_2}}{\text{eq. Vol. } O_2} = \frac{V_{O_2}}{\frac{22.4}{4} \text{ lit}}$$

$$\Rightarrow V_{O_2} = 5.7 \text{ lit}$$

**Q21: Ans - (a)**

$10^{16} \times t = 96500 \text{ col. (charge on 1 mole of } e^-)$

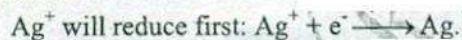
$$t = \frac{96500}{10^{16}} \Rightarrow 9.65 \times 10^{20} \text{ sec}$$

**Q22: Ans - (a)**

$$18 = \frac{18/2}{96500} \times 3 \times t \Rightarrow t = \frac{96500 \times 2 \text{ sec}}{3} = 18 \text{ hr}$$

**Q23: Ans - (a)**

At Pt cathode



but at Ag anode, the same amount of Ag will oxidise to produce to  $Ag^+$ .



So the amount of  $Ag^+$  in solution doesn't change effectively

**Q24: Ans - (a)**

For alkali metal & alkaline earth metal fused salt electrolysis is the way to get metal.

**Q25: Ans - (d)**

$\therefore Ag^+$  has higher reduction potential than  $H^+$  so it will reduce first so  $H_2$  can't produce similarly

$NO_3^-$  will oxidise first because it has lower reduction potential.

**Q26: Ans - (a)**

pH won't change if  $H_2O$  will reduce &  $H_2O$  doesn't oxidise. Which will happen increase of  $AgNO_3$ .

**Q27: Ans - (c)**

**Q28: Ans - (d)**  $\therefore K = C \left( \frac{1}{a} \right)$

Specific conductance = conductance  $\times$  cell constant

**Q29: Ans - (a)**

$$\lambda_{eq} = \frac{K}{N} \times 1000$$



$\lambda_{eg}$  will be lowest if N is maximum

Q30: Ans - (d)

$$\therefore \lambda_{eg} = \frac{K}{N} \times 1000$$

For 1 eq present in 1 cc

$$N = \frac{1}{1} \times 1000 = 1000 \quad \therefore \lambda_{eg} = \frac{K \times 1000}{1000} = K$$

Also for 1 cc,  $\frac{1}{a} = \frac{1}{2} = 1 \therefore C = K$

Q32: Ans (b)

Q33: Ans (d)

$$\text{For } N/10, \text{ Normality} = \frac{1}{10}$$

For 1 equation, 10 lit of solution require

$$V = 10 \text{ lit} = 10,000 \text{ ml}$$

Q34: Ans

$$\begin{aligned} \lambda_{NaCl}^{\infty} &= \lambda_{CH_3COONa}^{\infty} + \lambda_{HCl}^{\infty} - \lambda_{CH_3COOH}^{\infty} \\ &= 91 + 426 - 391 = 126 \text{ mho cm}^2 \quad \text{Ans} \end{aligned}$$