

TOPIC: ELECTRO CHEMISTRY
CHEMISTRY

- The amount of ion discharged during electrolysis is not directly proportional to
 - current
 - Time
 - Resistance
 - Chemical equivalent of the ion
- Three Faraday of electricity are passed through molten Al_2O_3 , aqueous solution of $CuSO_4$ and molten NaCl taken in three different electrolytic cells. The amount of Al, Cu, and Na deposited at the cathodes will be in the ratio of :
 - 1 mole : 2 mole : 3 mole
 - 3 mole : 2 mole : 1 mole
 - 1 mole : 1.5 mole : 3 mole
 - 1.5 mole : 2 mole : 3 mole
- What is the amount of chlorine evolved when 2 amperes of current is passed for 30 minutes in an aqueous solution of NaCl?
 - 66 g
 - 33 g
 - 1.32 g
 - 99 g
- The minimum equivalent conductance in fused state is shown by
 - $MgCl_2$
 - $BeCl_2$
 - $CrCl_2$
 - $SrCl_2$
- Two Pt electrodes fitted in a conductance cell are 1.5 cm apart and the cross-sectional area of each electrode is $0.75cm^2$. The cell constant is
 - 1.25
 - 0.5cm
 - $2.0cm^{-1}$
 - $0.2cm^{-1}$
- $\lambda_{ClCH_2COONa} = 224ohm^{-1}cm^2 gmeq^{-1}$, $\lambda_{NaCl} = 38.2ohm^{-1}cm^2 gmeq^{-1}$, $\lambda_{HCl} = 203ohm^{-1}cm^2 gmeq^{-1}$, What is the value of λ_{ClCH_2COOH} .
 - $288.5 ohm^{-1}cm^2 gmeq^{-1}$
 - $289.5 ohm^{-1}cm^2 gmeq^{-1}$
 - $388.8 ohm^{-1}cm^2 gmeq^{-1}$
 - $59.5 ohm^{-1}cm^2 gmeq^{-1}$
- Specific conductance of 0.1 M nitric acid is $6.3 \times 10^{-2}ohm^{-1}cm^{-1}$. The molar conductance of solution is
 - $630 ohm^{-1}cm^2mole^{-1}$
 - $315 ohm^{-1}cm^2mole^{-1}$
 - $100 ohm^{-1}cm^2mole^{-1}$
 - $6300 ohm^{-1}cm^2mole^{-1}$
- Given, for Sn^{+4} / Sn^{+2} , standard reduction potential is 0.15 V and for Au^{+3} / Au , standard reduction potential is 1.5V. For the reaction, $3Sn^{+2} + 2Au^{+3} \rightarrow 3Sn^{+4} + 2Au$ the value of E_{cell}^0 is
 - + 1.35
 - + 2.55
 - 1.35
 - 2.55
- What is the electrode potential (in volt) of the following electrode at $25^\circ C$? $Ni^{+2}(0.1M)|Ni(s)$
(Standard reduction potential of $Ni^{+2}|Ni$ is $-0.25V$, $\frac{2.303RT}{F} = 0.06$)
 - 0.82V
 - 0.28V
 - 0.22V
 - 0.34V
- E_1, E_2 and E_3 are the emfs of the following three galvanic cells respectively
 - $Zn_{(s)}|Zn^{+2}(0.1M)||Cu^{+2}(1M)|Cu_{(s)}$
 - $Zn_{(s)}|Zn^{+2}(1M)||Cu^{+2}(1M)|Cu_{(s)}$
 - $Zn_{(s)}|Zn^{+2}(1M)||Cu^{+2}(0.1M)|Cu_{(s)}$
 Which one of the following is true?
 - $E_3 > E_1 > E_2$
 - $E_2 > E_1 > E_3$
 - $E_3 > E_2 > E_1$
 - $E_1 > E_2 > E_3$

11. The standard emf of Daniell cell is 1.10V. The maximum electrical work obtained from the cell is
 (1) 106.15kJ (2) 212.3kJ (3) 350.8kJ (4) 175.4kJ
12. $Zn^{+2} \rightarrow Zn_{(s)}; E^\circ = -0.76V; Cu^{+2} \rightarrow Cu_{(s)}; E^\circ = -0.34V$ Which of the following is spontaneous?
 (1) $Zn^{+2} + Cu \rightarrow Zn + Cu^{+2}$ (2) $Cu^{+2} + Zn \rightarrow Cu + Zn^{+2}$
 (3) $Zn^{+2} + Cu^{+2} \rightarrow Zn + Cu$ (4) None of these
13. When compared to ΔG° for the formation of Al_2O_3 the ΔG° for the formation of Cr_2O_3 is
 (1) Same (2) Unpredicted (3) Higher (4) Lower
14. If the ΔG of a cell reaction $AgCl + e^- \rightarrow Ag + Cl^-$ is $-21.20kJ$; the standard e.m.f., of cell is
 (1) 0.229 V (2) 0.220V (3) $-0.220V$ (4) $-0.110V$
15. Standard reduction potentials at $25^\circ C$ of $Li^+ | Li, Ba^{+2} | Ba, Na^+ | Na$ and $Mg^{+2} | Mg$ are $-3.05, -2.90, -2.71$ and -2.37 volt respectively. Which one of the following is the strongest oxidising agent?
 (1) Na^+ (2) Li^+ (3) Ba^{+2} (4) Mg^{+2}
16. When lead storage battery discharges
 (1) SO_2 is evolved (2) $PbSO_4$ is consumed
 (3) H_2SO_4 is consumed (4) Lead is formed
17. What is correct Nernst equation for reaction taking place in the following cell?
 $Mg_{(s)} | Mg^{+2}_{(aq)} || Cl^-_{(aq)} | Cl_{2(g)} (1 atm) / pt$
 (1) $E_{cell} = E^\circ_{cell} - \frac{0.0592}{n} \times \log \frac{[Cl^-]^2}{[Mg^{+2}]}$ (2) $E_{cell} = E^\circ_{cell} - \frac{0.0592}{n} \times \log \frac{[Mg^{+2}]}{[Cl^-]}$
 (3) $E_{cell} = E^\circ_{cell} - \frac{0.0592}{n} \times \log [Mg^{+2}] [Cl^-]^2$ (4) $E_{cell} = E^\circ_{cell} - \frac{0.0592}{n} \times \log \frac{[Mg^{+2}]}{[Cl^-]^2}$
18. The cell potential of the following cell at $25^\circ C$ (in volts) is
 $(Pt)H_{(1atm)} | H^+_{(0.01M)} || Cu^{+2}_{(0.1M)} | Cu (E_{Cu^{+2}/Cu} = 0.337V)$
 (1) 0.308 (2) 0.427 (3) -0.308 (4) 0.337
19. The reduction potential at $p^H=14$ for the Cu^{+2} / Cu couples is
 [Given, $E^\circ_{Cu^{+2}/Cu} = 0.34V; K_{sp} [Cu(OH)_2] = 1 \times 10^{-19}$]
 (1) 0.34V (2) -0.34 (3) 0.22V (4) $-0.22V$
20. The equilibrium constant for the following redox reaction at 298 K is 1×10^8 .
 $2Fe^{+3}_{(aq)} + 2I^-_{(aq)} \rightleftharpoons 2Fe^{+2}_{(aq)} + I_{2(s)}$ If the standard reduction potential of iodine becoming iodide is $+0.54 V$, What is the standard reduction potential of Fe^{+3} / Fe^{+2} ?
 (1) $-0.652V$ (2) $+0.77V$ (3) $+1.006 V$ (4) $-1.006V$
 (5) $-0.77V$
21. The charge in coulomb on 1 gm ion of N^{3-} is $x \times 10^5$ coulombs. The value of 'x' is
22. A current of 3 ampere was passed for 2 hour through a solution of $CuSO_4$. 3gm of Cu^{+2} ions were discharged at cathode. Calculate the current efficiency.
23. $E^\circ = 0.059$ and $K_c = 10^a$ for a cell reaction involving the change $2A + 3B^{+2} \rightarrow 2A^{+3} + 3B$. What is the value of 'a'?

24. How many of the following are strong electrolytes
 $NH_4Cl, CH_3COONa, H_3BO_3, NH_4OH, NaCl, NaCN$
25. If $\Delta G = -386.0KJ$ and $n=2$, What is cell potential
26. The p^H at which reduction potential of 1 atm H / H^+ will be equal to 0.059V
27. E^0 for a cell having 2 electrons involved in redox change is 0.2655V. The equilibrium constant for the redox change is 10^a . The value of 'a' is _____
28. 96.5 A current is passed for 10sec through 1 litre solution of 0.1 M $CuSO_4$. After 10sec, the p^H of solution is
29. For the Cell $\begin{matrix} Pt \ Cl_2 \\ P_1 \end{matrix} | \begin{matrix} HCl \\ P_2 \end{matrix} | Cl_2, \text{ if } E_{cell} \text{ is } 0.02644, \text{ the ratio of } \frac{P_2}{P_1} \text{ is } \underline{\hspace{2cm}}$
30. Total charge required to convert some mole of Mn_3O_4 to MnO_4^{2-} is 40f. How many mole of Mn_3O_4 were converted.

CHEMISTRY										
61-70	3	3	3	2	2	3	1	1	2	4
71-80	2	2	3	2	4	3	3	2	4	2
81-90	3	42	6	4	2	1	9	2	8	4

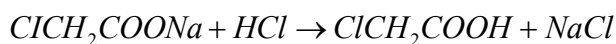
CHEMISTRY

- The amount of ion discharged during electrolysis is not directly proportional to resistance.
 - It is proportional to current, time and electro chemical equivalent of the ion.
 - $m = z \times i \times t$
 m = the amount of ion discharged
 z = electrochemical equivalent
 i = current
 t = time
- Equivalent of Al = Equivalent of Cu
 = Equivalent of Na
 or $\frac{1}{3}$ mole Al = $\frac{1}{2}$ mole Cu = 1 mole Na or 2 : 3 : 6 or 1 : 1.5 : 3 mole ratio
- According to Faraday's 1st law
 $m = Eit$

$$m = \frac{Eit}{96500} = E = \frac{\text{Atomic mass of chlorine}}{\text{Valency of chlorine}}$$

$$i = 2, t = 30 \times 60 = E = \frac{35.5}{1} = 35.5$$

$$\therefore m = \frac{35.5 \times 2 \times 30 \times 60}{96500} = 1.324g$$
- $BeCl_2$ has higher covalent character hence it ionizes in least extent in the fused state.
- Cell constant $\frac{1}{a} = \frac{1.5}{0.75} = 2.0cm^{-1}$



$$6. \quad \lambda_{ClCH_2COONa} + \lambda_{HCl} = \lambda_{ClCH_2COOH} + \lambda_{NaCl}$$

$$224 + 203 = \lambda_{ClCH_2COOH} + 38.2 \Rightarrow \lambda_{ClCH_2COOH} = 427 - 38.2 = 388.8 \text{ ohm}^{-1} \text{ cm}^2 \text{ gmeq}^{-1}$$

$$7. \quad \Delta_m = \frac{1000 \times k}{\text{molarity}} = \frac{1000 \times 6.3 \times 10^{-2}}{0.1} = 630 \text{ ohm}^{-1} \text{ cm}^2 \text{ mole}^{-1}.$$

$$8. \quad E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} = 1.5 - 0.15 = 1.35V.$$

$$E_{Ni^{+2}/Ni} = E_{Ni^{+2}/Ni}^{\circ} - \frac{2.303RT}{nF} \log \left[\frac{Ni^{+2}}{N} \right]$$

$$9. \quad = -0.25 - \frac{0.06}{2} \log \left(\frac{1}{0.1} \right) \quad (\because n = 2)$$

$$= -0.25 - 0.03 \times 1$$

$$E_{Ni^{+2}/Ni} = -0.28V$$

$$E_{\text{cell}} = E_{\text{Cell}}^{\circ} + \frac{0.0591}{n} \log \left[\frac{Cu^{+2}}{Zn^{+2}} \right]$$

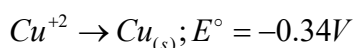
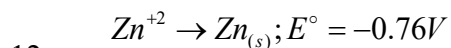
$$10. \quad E_1 = E_{\text{Cell}}^{\circ} + \frac{0.0591}{2} \log \frac{1}{0.1}; E_1 = E_{\text{Cell}}^{\circ} + 0.02955$$

$$E_2 = E_{\text{Cell}}^{\circ} + \frac{0.0591}{2} \log \frac{1}{1}; E_2 = E_{\text{Cell}}^{\circ}$$

$$E_3 = E_{\text{Cell}}^{\circ} + \frac{0.0591}{2} \log \frac{0.1}{1}; E_3 = E_{\text{Cell}}^{\circ} + 0.02955. \quad \therefore E_1 > E_2 > E_3$$

$$11. \quad \text{Electrical work} = nFE_{\text{cell}}^{\circ}$$

$$= 2 \times 96500 \times 1.1 = 212300J = 212.3kJ$$



A redox reaction is feasible if E_{cell} is positive.

13. Al acts as a good reducing agent and reduces oxides of metals like Cr, Fe, Mn etc.

$Cr_2O_3 + 2Al \rightarrow 2Cr + Al_2O_3 + \text{heat}$; Therefore ΔG° for the formation of Al_2O_3 is lower in comparison to ΔG° for the formation of Cr_2O_3 .

$$14. \quad \text{Given } \Delta G = -21.20k = -21200J$$

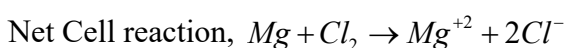
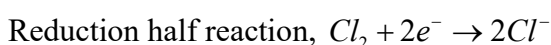
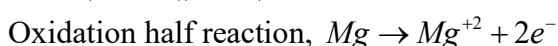
$$\therefore \Delta G = -nFE$$

$$E = \frac{21200}{1 \times 96500} = 0.2196V = 0.22V.$$

15. (i). More is the reduction potential of an oxidizing agent (i.e less ve value)

(ii). Mg^{+2} acts as the strongest oxidizing agent.

16. H_2SO_4 is consumed when lead storage battery is discharged.



$$\text{Nernst equation, } E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log [Cl^{-}]^2 [Mg^{+2}].$$

Here $n = 2$.

18. $(Pt)H_2 \left| \begin{matrix} H^+ \\ (0.01M) \end{matrix} \right| \left| \begin{matrix} Cu^{+2} \\ (0.1M) \end{matrix} \right| Cu$ For the above cell, the cell reaction is $H_2 + Cu^{+2} \rightarrow 2H^+ + Cu$

According to the Nernst equation

$$E_{cell} = E_{Cu^{+2}/Cu}^\circ - \frac{0.0591}{n} \log \frac{[H^+]^2}{[Cu^{+2}]}$$

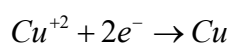
$$= 0.337 - \frac{0.0591}{2} \log \frac{(0.01)^2}{(0.1)} = 0.337 - 0.02955 \log 10^{-3} = 0.337 + 0.08865$$

$$= 0.42565 \approx 0.427.$$

$$p^H = 14; p^{OH} = 0 \text{ and } [OH^-] = 1M$$

$$[Cu^{+2}][OH^-]^2 = K_{sp} = 1.0 \times 10^{-19}$$

19. Given, $\therefore [Cu^{+2}] = 1.0 \times 10^{-19} M$

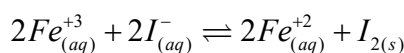


$$E_{Cu^{+2}/Cu} = E_{Cu^{+2}/Cu}^\circ - \frac{0.0591}{2} \log \frac{1}{[Cu^{+2}]} = 0.34 - \frac{0.0591}{2} \log 10^{19} = -0.22V$$

$$K_c = 1 \times 10^8$$

$$E_{(I_2/I^-)}^\circ = +0.54V$$

20. Given, $E_{(Fe^{+3}/Fe^{+2})}^\circ = ?$



Number of electrons involved (n) = 2

$$E_{cell}^\circ = \frac{0.0591}{n} \log K_c = \frac{0.591}{2} \log 1 \times 10^8 = 0.0591 \times 4 = 0.2364V$$

$$E_{cell}^\circ = E_{(Fe^{+3}/Fe^{+2})}^\circ - E_{(I_2/I^-)}$$

$$0.23 = E_{(Fe^{+3}/Fe^{+2})}^\circ - (+0.54)$$

$$E_{(Fe^{+3}/Fe^{+2})}^\circ = 0.23 + 0.54 = +0.77V$$

21. The charge on $1N^{3-} = 3 \times 1.602 \times 10^{-19} C$

$$\text{The charge on 1gm ion } N^{3-} = 3 \times 1.602 \times 10^{-19} \times 6.023 \times 10^{23}$$

$$= 2.89 \times 10^5 \text{ coulomb}$$

$$m_{cu} = \frac{E.i.t}{96500}$$

22. $3 = \frac{63.5 \times i \times 2 \times 60 \times 60}{2 \times 96500}$

$$i = 1.266 \text{ ampere}$$

$$\text{Current efficiency} = \frac{\text{Current passed actually}}{\text{Total current passed experimentally}} \times 100$$

$$= \frac{1.266}{3} \times 100$$

$$= 42.2\%$$

$$E^\circ = 0.059 = \frac{0.059}{6} 10g k_c$$

23. $\log k_c = 6$

$$k_c = 10^6$$

$$a = 6$$

24. Four salts are strong electrolytes

$$-\Delta g = -nf E_{cell}$$

25. $386 \times 10^3 = 2 \times E \times 96500$

$$E = 2 \text{ volt}$$

$$E = E^\circ + \frac{0.059}{1} 10g [H^+]$$

$$E^\circ = 0$$

26. $E = 0.059 10g [H^+]$

$$\text{If } [H^+] = 10^{-1} \text{ then } E = 0.059$$

$$p^H = 1$$

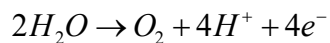
$$E_{cell} = E^\circ + \frac{0.059}{2} 10g k$$

27. $0.265 = 0.0295 10g k_c$

$$k_c = 10^9$$

$$a = 9$$

28. $Cu^{+2} + 2e^- \rightarrow Cu$

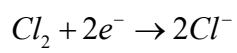
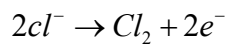


Equation of H^+ formed = equation of Cu^{+2} lost

$$= \frac{1t}{96500} = \frac{96.5 \times 10}{9650} = 0.01$$

$$[H^+] = \frac{0.01}{1} = 10^{-2}$$

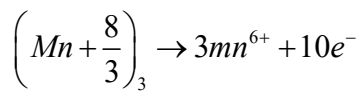
$$p^H = 2$$



$$29. \quad E_{cell} = \frac{0.059}{2} \log \frac{P_2}{P_1}$$

$$\therefore \frac{0.02664 \times 2}{0.059} = \log \frac{P_2}{P_1}$$

$$\frac{P_2}{P_1} = 8$$



$$30. \quad \begin{array}{l} 1 \text{ mole } Mn_3O_4 \text{ required } 10 f \\ ? \qquad \qquad \qquad 40 f \end{array}$$

$$\frac{40 \times 1}{10} = 4 \text{ mole}$$