3. ELECTRO CHEMISTRY

PREVIOUS EAMCET BITS

1. At 25^0C the molar conductances at infinite dilution for the strong electrolytes NaOH, Nacl, and $Bacl_2$ are 248 $\times$ 10^{-4}, 126 $\times$ 10^{-4} and 280 $\times$ 10^{-4} S m^2 $mole^{-1}$ respectively. λ_m^0 $Ba(OH)_2$ in S m^2 mol^{-1} **(2009 E)**

1) 52.4×10^{-4} 2) 524×10^{-4} 3) 402×10^{-4} 4) 202×10^{-4}

Ans : 2

Sol: $\mu Ba(OH)_2 = \mu Bacl_2 + 2\mu NaOH - 2\mu Nacl$

$= 280\times10^{-4} + 2\left(248\times10^{-4}\right) - 2\left(126\times10^{-4}\right)$

$= 524\times10^{-4}$

2. The standard potentials at 25^0C for the half reactions are given against them below **(2009 M)**

$Zn^{2+} + 2e^- \rightarrow Zn \quad E^0 = -0.762V$

$Mg^{2+} + 2e^- \rightarrow Mg \quad E^0 = -2.37V$

Zinc duct is added to $Mgcl_2$ solution

1) Magnesium is precipitated 2) Zinc dissolves in the solution

3) Zin chloride in formed 4) No reaction takes place

Ans : 2

Sol: Zn cannot displace Mg from solution so no reaction occurs.

3. Which of the following reactions occur at the cathode? **(2008 M)**

1) $2OH^- \rightarrow H_2O + \frac{1}{2}O_2 + 2e^-$ 2) $Ag \rightarrow Ag + e^-$

3) $Fe^{+2} \rightarrow Fe^{3+} + e^-$ 4) $Cu^{+2} + 2e^- \rightarrow Cu$

Ans : 4

Sol: At cathode reduction takes place.

Gain of electrons is reduction

4. The cell potential of the following cell at 25^0C (in volts) is

Pt, H_2 (1 atm) $| H^+ \left(0.01M\right) || Cu^{2+} \left(0.1M\right) |$ Cu $\left(E^0_{Cu^{2+}/Cu} = +0.337V\right)$ **(2008 M)**

1) 0.308 2) 0.427 3) -0.308 4) 0.337

Ans : 2

Sol:

$$E_{H_2} = E^0 + \frac{0.059}{n}\log c$$

$$E_{H_2} = 0.00 + \frac{0.06}{1}\log 10^{-2}$$

$= 0.00 + 0.06 \times (-2)$

= -0.12 V

$$E_{Cu} = E^0 + \frac{0.059}{n}\log c$$

$$E_{Cu} = 0.337 + \frac{0.06}{2}\log 10^{-1}$$

$E_{Cu} = 0.337 + 0.03 \times (-1)$

$= 0.337 - 0.030 = 0.307V$

E = $E_{Cathode} - E_{Anode}$

$= +0.307 - (-0.12)$

= + 0.427 V

5. When electric current is passed through acidified water for 1930 seconds, 1120 ml of H_2 gas is collected (at STP) at the cathode. What is the current passed in amperes?

(2008 E)

1) 0.05 2) 0.50 3) 5.0 4) 50

Ans : 3

Sol: Wt of H_2 gas = $\frac{1120}{22400}\times 2 = 0.1gm$

As per 1st law of Faraday

Current strength $C = \frac{m}{et}$

$= \frac{0.1\times 96500}{1\times 1930}$ = 5 amp

6. When same quantity of electricity is passed through aqueous $AgNO_3$ and H_2SO_4 solutions connected in series, 5.04×10^{-2} gram of H_2 is liberated. What is the mass of silver (in grams) deposited? (Eq wts of Hydrogen = 1.008, silver = 108) **(2008 E)**

1) 54 2) 0.54 3) 5.4 4) 10^{-8}

Ans : 3

Sol: $\frac{wt.of\ Ag\ deposited}{wt.of\ H_2\ liberated} = \frac{Eq.wt\ of\ Ag}{Eq.wt\ of\ H_2}$

$wt.of\ Ag\ deposited = \frac{wt.of\ H_2\ liberated \times Eq.wt\ of\ Ag}{Eq.wt\ of\ H_2}$

$\frac{5.04\times 10^{-2}\times 108}{1.008}$ = 5.4 gm

7. When 3.86 amperes current is passed through an electrolyte for 50 minutes, 2.4 grams of a divalent metal is deposited. The gram atomic weight of the metal (in grams) is

(2007 M)

1) 24 2) 12 3) 64 4) 40

Ans : 4

Sol: $m = \frac{Ect}{96500}$

Eq. Wt of metal E = $\frac{96500\times m}{ct}$

Eq. Wt of metal E = $\frac{96500\times m}{ct}$ = 20

$At.wt = 2\times 20 = 40$

8. The e.m.f. of the cell $Ni\,|\,Ni^{2+}(1M)\,||\,Cl^-(1M)\,|\,+Cl_2.Pt$ is

$\left(E^0_{Ni^{2+}/Ni} = -0.25V; E^0_{1/2Cl/Cl^-} = +1.36V\right)$

(2007 E)

1) +1.11V 2) -1.11 v 3) +1.61 v 4) -1.61 v

Ans : 3

Sol: Cell $Ni\,|\,Ni^{2+}(1M)\,||\,Cl^-(1M)\,|\,+Cl_2.Pt$

EMF of the cell = $E_{Cathode} - E_{Anode}$

Or

$E = E_{Right} - E_{left}$

= 1.36 – (-0.25)

= 1.36 + 0.25

EMF = +1.61 V

9. The pH of aqueous KCl solution is 7.0. This solution was electrolysed for a few seconds using Pt electrodes. Which of the following is correct? **(2006 M)**

1) The pH of solution decreases
2) The pH of solution increases
3) Cl_2 is liberated at cathode
4) The pH of solution remains the same

Ans : 2

Sol: Electrolysis of aqueous solution of Hcl

Anode reaction $2cl^- \to cl_2 + 2e^-$

Cathode reaction $2H_2O + 2e^- \to H_2 + 2OH^-$

$\therefore$ pH value increases.

10. What is the electrode potential (in V) of the following electrode at 25^{0}C?

$Ni^{2+}(0.1M) | Ni(s)$

(Standard reduction potential of Ni^{2+}|Ni is -0.25 V; $\frac{2.303RT}{F} = 0.06$)**(2006 M)**

1) -0.25
2) -0.28
3) +0.25
4) -0.31

Ans : 2

Sol: Nernst equation for metal electrode

$$E = E^0 + \frac{0.059}{n}\log\left[M^{n+}\right]$$

$$= -0.25 + \frac{0.6}{2}\log 0.1$$

$$= -0.25 - 0.3 = -0.28$$

11. **Assertion(A):** A current of 96.5 amperes is passed into aquesous $AgNO_3$ solution for 100seconds. The weight of silver deposited is 10.8g (At.wt. of Ag=108).

Reson (R): The mass of a substance deposited during the electorlysis of an electrolyte is inversely propotional to the quantity of electricity passing through the electrolyte. **[2006 E]**

The correct answer is:

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true and R is not the correct explanation of A
3. A is true but R is not true
4. A is not true but R is true

Ans : 3

Sol: m = ect = $\frac{108 \times 96.5 \times 100}{96500}$

= 10.8 gm

Reason (R) is wrong (not true)

12. What is the time (in sec) required for deposition all the silver present in 125ml of 1M AgNO3 solution by passing a current of 241.25 amperes? (1F=96500 coulombs) **[2006 E]**

1) 10
2) 50
3) 1000
4) 100

Ans : 2

Sol: Number of moles of Ag^+ ion

Present in solution = $125 \times 10^{-2} \times 1 = 0.125$

Number of Faradays = 0.125

Number of Coulombs = 0.125×96500

Time required = $\frac{0.125\times96500}{241.25}$ = 50 sec

13. The standard reduction potentials of $Zn^{2+}|Zn, Cu^{2+}|Cu\ and\ Ag^{+}|Ag$ are respectively -0.76, 0.34 and 0.8V. The following cells were constructed.

a) $Zn|Zn^{2+}||Cu^{2+}|Cu$

b) $Zn|Zn^{2+}||Ag^{+}|Ag$

c) $Cu|Cu^{2+}||Ag^{+}|Ag$ **[E2006]**

What is the correct order E^0 cell of these cells?

1) b > c > a 2) b > a > c 3) a > b > c 4) c > a > b

Ans : 2

Sol: Cell (a) E^0 = 0.34 – 0.76 = +1.10 V

Cell (b) E^0 = 0.80 – 0.76 = +1.56 V

Cell (c) E^0 = 0.80 – 0.34 = +0.46 V

14. What is the electrochemical equivalent (in g coulomb-1) of silver?

(Ag = 108; F = Faraday) **[2005 M]**

1) 108F 2) $\frac{108}{F}$ 3) $\frac{F}{108}$ 4) $\frac{1}{108F}$

Ans : 2

Sol: Eq. Wt of Ag = 108

e.c.e = $\frac{108}{F}$

15. The standard reduction potentials of $Zn^{2+}|Zn$ and $Cu^{2+}|Cu$ are -0.76V and +0.34 V respectively. What is the cell e.m.f (inV) of the following cell?

$\left(\frac{RT}{F}=0.059\right)Zn|Zn^{2+}$ (0.05M)//Cu2+(0.005M)|Cu **[2005 M]**

1) 1.1295 2) 1.0705 3) 1.1 4) 1.041

Ans : 2

Sol: E^0 of $Zn^{2+}|Zn$ = -0.76 V

E^0 of $Cu^{2+}|Cu$ = +0.34 V

Nernst equation

$$E_{Zn}=E^0+\frac{0.059}{n}\log c$$

$$E_{Zn}=-0.76+\frac{0.059}{2}\log 0.05$$

$$= -0.76+\frac{0.06}{2}\times(1,3)$$

$$= -0.76-0.039$$

$$E_{Zn}=-0.799V \qquad E_{Cu}=E^0+\frac{0.059}{n}\log c$$

$$E_{Cu}=0.34+\frac{0.06}{2}\log 0.005$$

$$= +0.34+(0.03\times(-2.3))$$

= +0.34 – 0.069

$E_{Cu} = +0.271V$

E of cell = E cathode – E anode

= +0.271 – (-0.799)

= +1.07 V

16. Which of the following is not correct? **[E2005]**

1) Aqueous solution of NaCl is an electrolyte

2) The units of electrochemical equivalent are g. coulomb

3) In the Nernst equation, 'n' represents the number of electrons transferred in the electrode reaction

4) Standard reducation potential of hydrogen electrode is zero volts.

Ans : 2

Sol: Units of electrochemical equivalent are gram per coulomb

17. What is the quantity of electricity (in coulombs) required to deposit all the silver $Ag = 108$ from 250ml of 1M AgNO3 solution? **[E2005]**

1) 2412.5 2) 24125 3) 4825.0 4) 48250

Ans : 2

Sol: Number of mole of $AgNO_3$ = $\frac{250}{1000} \times 1M = \frac{1}{4} mole$

1 mole of Ag^+ is deposited by 1 Faraday

(96500 C) charge

$\frac{1}{4}$ mole of Ag+ deposited by 1 Faraday

= $\frac{96500 \times 1}{4} = 24125$ coulombs

18. The standard reduction potentials of Ag, Cu, Co and Zn 0.799,0.337,-0.277-0.762V respectively. Which of the following cells will have maximum cell e.m.f ? **[M 2004]**

1) $Zn \mid Zn^{+2}(1M) \parallel Cu^{2+}(1M) \mid Cu$ 2) $Zn \mid Zn^{2+}(1M) \parallel Ag^{+}(1M) \mid Ag$

3) $Cu \mid Cu^{2+}(1M) \parallel Ag^{+}(1M) \mid Ag$ 4) $Zn \mid Zn^{2+}(1M) \parallel Co^{2+}(1M) Co$

Ans : 2

Sol: Electrode with most negative reduction potential acts as anode (LHS) and the electrode with most positive reduction potential acts as cathode (RHS).

Then the emf is highest.

19. The electrochemical equivalent of a metal is 'x' gram-coulomb^{-1}. The equivalent weight of metal is **(2004 E)**

1) x 2) $x \times 96500$ 3) $\frac{x}{96500}$ 4) $1.6 \times 10^{-19} \times x$

Ans : 2

Sol: e.c.e = $\frac{Eq.wt}{96500} = x$

Eq. Wt = 96500 $\times$ x

20. The Cell reaction of the galvanic celle : $Cu(s) / Cu^{2+}(aq) \parallel Hg^{2}(aq) \mid Hg(l)$ is **(2003 M)**

1) $Hg + Cu^{2+} \rightarrow Hg^{2+} + Cu$ 2) $Hg + Cu^{2+} \rightarrow Hg^{2+} + Cu^{+}$

3) $Cu + Hg \rightarrow CuHg$ 4) $Cu + Hg^{2+} \rightarrow Cu^{2+} + Hg$

Ans : 4

Sol: Cell reaction is $Cu(s) + Hg^{2+} \rightarrow Cu^{2+} + Hg$

21. If the standard electrode potential of Cu^{2+}/Cu electrode is 0./34 V, what is the electrode potential at 0.01M concentration of Cu^{2+} ? (T=298 K) **(2003 M)**

1) 0.399 V 2) 0.281 V 3) 0.222 V 4) 0.176 V

Ans : 2

Sol:
$$E = E^0 + \frac{0.059}{n}\log\left[M^{n+}\right]$$
$$= 0.34 + \frac{0.059}{2}\log\left[0.01\right]$$
$$= 0.34 + \frac{0.059}{2}\times(-2)$$
= 0.34 – 0.059

E = 0.281 V

22. When X amperes of current is passed through molten $AlCl_3$ for 96.5 seconds. 0.09 grams of aluminium is deposited. What is the value of X? **(2003 M)**

1) 10 2) 20 3) 30 4) 40

Ans : 1

Sol:
$$m = \frac{Ect}{96500}$$
$$C = \frac{96500\times 0.09}{9\times 96.5}$$ = 10 amp

23. Consider the following four electrodes **(2002 M)**

$A = Cu^{2+}\left(0.0001M\right)Cu_{(s)}$

$B = Cu^{2+}\left(0.1M\right)Cu_{(s)}$

$C = Cu^{2+}\left(0.01M\right)Cu_{(s)}$

$D = Cu^{2+}\left(0.001M\right)Cu_{(s)}$

If the standard reduction potential of Cu^{+2}/Cu is +0.34 V, the reduction potentials (in volts) of the above electrodes follow the order

1) A>D>C>B 2) B>C>D>A 3) C>D>B>A 4) A>B>C>D

Ans : 2

Sol: According Nernst equation
$$E = E^0 + \frac{0.059}{n}\log\left[M^{n+}\right]$$
Log [Cu^{2+}] values, A = log (0.0001) = -4

B = log (0.1) = -1

C = log (0.01) = -2

D = log (0.001) = -3

$\therefore$ E values are in the order

B > C > D > A

24. 0.066 gram of metal was deposited when a current of 2 amperes is passed through a metal ion solution for 100 seconds. What is the electrochemical equivalent (in gram coulomb^{-1}) of the metal? **(2002 E)**

1) 3.3×10^{-6} 2) 3.3×10^{-4} 3) 0.033 4) 3.3

Ans : 2

Sol: $e=\frac{m}{ct}=\frac{0.066}{2\times 100}$

= 3.3 $\times 10^{-4}$ gm coulomb^{-}

25. What is the reduction electrode potential (in volts) of copper electrode when [Cu2+] = 0.01M in a solution at 250C ? (E0 of Cu2+/Cu electrode is +0.34V) **[2002 E]**

1) 0.3991 2) 0.2809 3) 0.3105 4) 0.3695

Ans : 2

Sol: $E=E^0+\frac{0.059}{n}\log\left[M^{n+}\right]$

$=+0.34+\frac{0.059}{2}\log[0.01]$

$=+0.34+\frac{0.059}{2}\times[-2]$

= +0.34 – 0.059 = 0.281 V

26. One ampere of current is passed for 9650 seconds through molten $AlCl_3$. What is the weight in grams of Al deposited at cathode? (Atomic weight of Al=27) **(2001 E)**

1) 0.9 2) 9.0 3) 0.09 4) 90.0

Ans : 1

Sol: $e=\frac{27}{3\times 96500}$

c = 1 ampere t = 9650 sec

weight of Al deposited = e.c.t

= $\frac{27\times 1\times 9650}{3\times 96500}=0.9gm$

27. Molten $CuCl_2$ is electrolysed using platinum electrodes. The reaction occurring at anode is ……………

(2001 E)

1) $2Cl^-\rightarrow Cl_{2(g)}+2e^-$ 2) $Cl_{2(g)}+2e^-\rightarrow 2Cl^-$

3) $Cu^{2+}+2e^-\rightarrow Cus$ 4) $Cu(s)\rightarrow Cu^{2+}+2e^-$

Ans : 1

Sol: At anode chloride ion are oxidized to chlorine gas

$2Cl^-\rightarrow Cl_2+2e^-$

28. One faraday of electricity is passed separately through one litre of one molar aqueous solution of i) AgNO3, ii) SnCl4 and iii) CuSO4. The number of moles of Ag, Sn and Cu deposited at cathode are respectively

[2001 M]

1) 1.0, 0.25, 0.5 2) 1.0, 0.5, 0.25 3) 0.5, 1.0, 0.25 4) 0.25, 0.5, 1.0

Ans : 1

Sol: Electrode reaction :

i) $Ag^++1e^-\rightarrow Ag$

ii) $S_n^{4+}+4e^-\rightarrow S_n$

iii) $Cu^{2+}+2e^-\rightarrow C_u$

For 1 Faraday of electricity number of moles of ion deposited α

= $\frac{1}{number\ of\ electron\ required\ for\ 1\ mole}$

$\therefore$ 1: 0.25 : 0.5

29. Aqueous copper sulphate solution is electrolysed using platinum electrodes. The electrode reaction occurring at cathode is **[2001 M]**

    1) Cu2+(aq)+2e– $\rightarrow$ Cu(s)

    2) Cu(s) $\rightarrow$ Cu2+(aq)+2e–

    3) 2H2O(l) $\rightarrow$ O2(g)+4H+(aq)+4e–

    4) O2(g) + 4H+(aq)+4e– $\rightarrow$ 2H2O(l)

Ans : 1

Sol: At cathode reduction reaction takes place (gain of electron)

$$Cu^{2}_{(aq)} + 2e^{-} \rightarrow Cu_{(S)}$$

30. What is the approximate quantity of electricity (in couloms) required to deposit all the silver from 250ml of 1M AgNO3 aqueous solution ? (At. Wt. of Ag = 108) **(2000 E)**

    1) 96500 2) 24125 3) 48250 4) 12062.5

Ans : 2

Sol: Amount of Ag present in 250 ml 2 M $AgNO_3$ solution is

$$W = 1 \times 170 \times \frac{1000}{250} = 170 \times 4 = 680gm$$

According to Faradays First Law

$$W = \frac{Eq.wt}{96500} \times Q$$

$$Q = \frac{380 \times 96500}{180}$$ = 24125 coulombs

31. Which of the following aqueous solutions conducts electricity ? **(2000 M)**

    1) urea 2) glucose 3) sucrose 4) NaCl

Ans : 4

Sol: Nacl aqueous solution carry Na^+ and Cl^- ions.