

### 3. ELECTRO CHEMISTRY

#### PREVIOUS EAMCET BITS

1. At 25°C the molar conductances at infinite dilution for the strong electrolytes NaOH, NaCl, and BaCl<sub>2</sub> are 248 × 10<sup>-4</sup>, 126 × 10<sup>-4</sup> and 280 × 10<sup>-4</sup> S m<sup>2</sup> mole<sup>-1</sup> respectively.  $\lambda_m^0$  Ba(OH)<sub>2</sub> in S m<sup>2</sup> mol<sup>-1</sup> **(2009 E)**
- 1) 52.4 × 10<sup>-4</sup>      2) 524 × 10<sup>-4</sup>      3) 402 × 10<sup>-4</sup>      4) 202 × 10<sup>-4</sup>

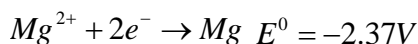
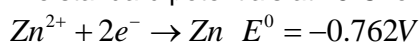
Ans : 2

Sol: 
$$\mu_{Ba(OH)_2} = \mu_{BaCl_2} + 2\mu_{NaOH} - 2\mu_{NaCl}$$

$$= 280 \times 10^{-4} + 2(248 \times 10^{-4}) - 2(126 \times 10^{-4})$$

$$= 524 \times 10^{-4}$$

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



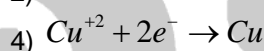
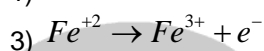
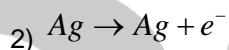
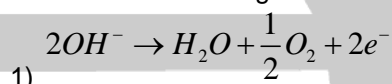
Zinc dust is added to MgCl<sub>2</sub> solution

- 1) Magnesium is precipitated      2) Zinc dissolves in the solution  
3) Zinc chloride is 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)**



Ans : 4

Sol: At cathode reduction takes place.  
Gain of electrons is reduction

4. The cell potential of the following cell at 25°C (in volts) is **(2008 M)**
- $$Pt, H_2 (1 \text{ atm}) | H^+ (0.01M) || Cu^{2+} (0.1M) | Cu \quad (E_{Cu^{2+}/Cu}^0 = +0.337V)$$
- 1) 0.308      2) 0.427      3) -0.308      4) 0.337

Ans : 2

Sol:

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

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

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

$$= -0.12 \text{ V}$$

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

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

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

$$= 0.337 - 0.030 = 0.307V$$

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

$$= +0.307 - (-0.12)$$

$$= +0.427 \text{ V}$$

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

As per 1<sup>st</sup> law of Faraday

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

Current strength

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

6. When same quantity of electricity is passed through aqueous  $AgNO_3$  and  $H_2SO_4$  solutions connected in series,  $5.04 \times 10^{-2}$  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: 
$$\frac{\text{wt. of Ag deposited}}{\text{wt. of } H_2 \text{ liberated}} = \frac{\text{Eq. wt of Ag}}{\text{Eq. wt of } H_2}$$

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

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

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

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

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

$$\text{At. wt} = 2 \times 20 = 40$$

8. The e.m.f. of the cell  $Ni | Ni^{2+} (1M) || Cl^- (1M) | +Cl_2.Pt$  is  
( $E_{Ni^{2+}/Ni}^0 = -0.25V$ ;  $E_{1/2Cl/Cl^-}^0 = +1.36V$ )

(2007 E)

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

Ans : 3

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

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

Or

$$E = E_{\text{Right}} - E_{\text{left}} = 1.36 - (-0.25)$$

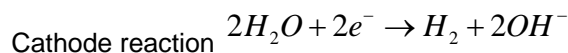
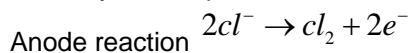
$$= 1.36 + 0.25$$

$$\text{EMF} = +1.61 \text{ V}$$

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)  $\text{Cl}_2$  is liberated at cathode  
4) The pH of solution remains the same

Ans : 2

Sol: Electrolysis of aqueous solution of HCl



$\therefore$  pH value increases.

10. What is the electrode potential (in V) of the following electrode at  $25^\circ\text{C}$ ?  
 $\text{Ni}^{2+} (0.1\text{M}) | \text{Ni}(s)$

$$\frac{2.303RT}{F} = 0.06$$

(Standard reduction potential of  $\text{Ni}^{2+} | \text{Ni}$  is  $-0.25 \text{ V}$ ; **(2006 M)**)

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

Ans : 2

Sol: Nernst equation for metal electrode

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

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

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

11. **Assertion(A):** A current of 96.5 amperes is passed into aqueous  $\text{AgNO}_3$  solution for 100 seconds. The weight of silver deposited is 10.8g (At.wt. of Ag=108).

**Reason (R):** The mass of a substance deposited during the electrolysis of an electrolyte is inversely proportional 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

$$\text{Sol: } m = \frac{z \times I \times t}{96500}$$

$$= \frac{108 \times 96.5 \times 100}{96500}$$

$$= 10.8 \text{ gm}$$

Reason ( R ) is wrong (not true)

12. What is the time (in sec) required for deposition all the silver present in 125ml of 1M  $\text{AgNO}_3$  solution by passing a current of 241.25 amperes? ( $1\text{F}=96500$  coulombs) **[2006 E]**
- 1) 10                      2) 50                      3) 1000                      4) 100

Ans : 2

Sol: Number of moles of  $\text{Ag}^+$  ion

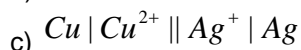
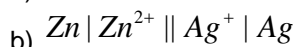
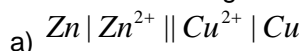
$$\text{Present in solution} = 125 \times 10^{-2} \times 1 = 0.125$$

$$\text{Number of Faradays} = 0.125$$

$$\text{Number of Coulombs} = 0.125 \times 96500$$

$$\text{Time required} = \frac{0.125 \times 96500}{241.25} = 50 \text{ sec}$$

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.



[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)  $E^0 = 0.34 - 0.76 = +1.10 \text{ V}$

Cell (b)  $E^0 = 0.80 - 0.76 = +1.56 \text{ V}$

Cell (c)  $E^0 = 0.80 - 0.34 = +0.46 \text{ V}$

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

(Ag = 108; F = Faraday)

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

[2005 M]

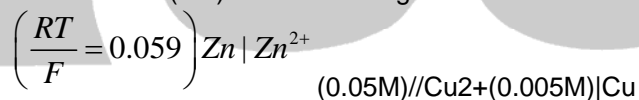
- 4)  $\frac{1}{108F}$

Ans : 2

Sol: Eq. Wt of Ag = 108

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

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?



- 1) 1.1295                      2) 1.0705                      3) 1.1

[2005 M]

- 4) 1.041

Ans : 2

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

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

Nernst equation

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

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

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

$$= -0.76 - 0.039$$

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

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

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

$$= +0.34 - 0.069$$

$$E_{Cu} = +0.271V$$

$$\begin{aligned} E \text{ of cell} &= E \text{ cathode} - E \text{ anode} \\ &= +0.271 - (-0.799) \\ &= +1.07 V \end{aligned}$$

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 reduction 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  $AgNO_3$  solution?

[E2005]

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

Ans : 2

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

1 mole of  $Ag^+$  is deposited by 1 Faraday  
(96500 C) charge

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

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

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)  $Zn | Zn^{2+} (1M) || Cu^{2+} (1M) | Cu$
- 2)  $Zn | Zn^{2+} (1M) || Ag^+ (1M) | Ag$
- 3)  $Cu | Cu^{2+} (1M) || Ag^+ (1M) | Ag$
- 4)  $Zn | Zn^{2+} (1M) || Co^{2+} (1M) | Co$

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<sup>-1</sup>. 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 × x

20. The Cell reaction of the galvanic cell:  $Cu(s) / Cu^{2+}(aq) || Hg^2+(aq) | Hg(l)$  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: 
$$E = E^0 + \frac{0.059}{n} \log [M^{n+}]$$

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

$$= 0.34 + \frac{0.059}{2} \times (-2)$$

$$= 0.34 - 0.059$$

$$E = 0.281 \text{ V}$$

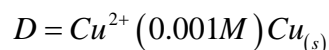
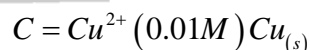
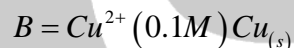
22. When X amperes of current is passed through molten  $AlCl_3$  for 96.5 seconds. 0.09 grams of aluminium is deposited. What is the value of X? **(2003 M)**

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

Ans : 1

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

$$C = \frac{96500 \times 0.09}{9 \times 96.5} = 10 \text{ amp}$$

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

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

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 &gt; C &gt; D &gt; 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<sup>-1</sup>) of the metal? **(2002 E)**

- 1)
- $3.3 \times 10^{-6}$
- 2)
- $3.3 \times 10^{-4}$
- 3) 0.033                      4) 3.3

Ans : 2

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

Sol:

$$= 3.3 \times 10^{-4} \text{ gm coulomb}^{-1}$$

25. What is the reduction electrode potential (in volts) of copper electrode when  $[\text{Cu}^{2+}] = 0.01\text{M}$  in a solution at  $25^\circ\text{C}$ ? ( $E^0$  of  $\text{Cu}^{2+}/\text{Cu}$  electrode is  $+0.34\text{V}$ ) [2002 E]
- 1) 0.3991                      2) 0.2809                      3) 0.3105                      4) 0.3695

Ans : 2

Sol:

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

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

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

$$= +0.34 - 0.059 = 0.281 \text{ V}$$

26. One ampere of current is passed for 9650 seconds through molten  $\text{AlCl}_3$ . 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:

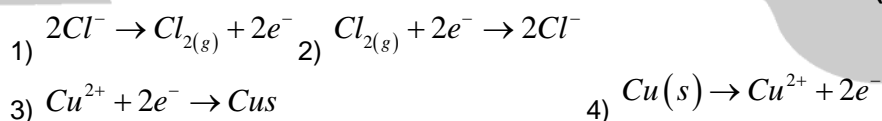
$$e = \frac{27}{3 \times 96500}$$

$c = 1$  ampere                       $t = 9650$  sec

weight of Al deposited =  $e \cdot c \cdot t$

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

27. Molten  $\text{CuCl}_2$  is electrolysed using platinum electrodes. The reaction occurring at anode is ..... (2001 E)



Ans : 1

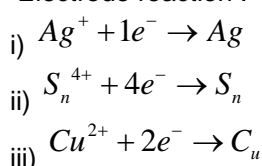
Sol: At anode chloride ion are oxidized to chlorine gas

$$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2e^-$$

28. One faraday of electricity is passed separately through one litre of one molar aqueous solution of i)  $\text{AgNO}_3$ , ii)  $\text{SnCl}_4$  and iii)  $\text{CuSO}_4$ . 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 :



For 1 Faraday of electricity number of moles of ion deposited  $\alpha$

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

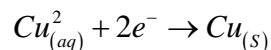
$\therefore 1: 0.25 : 0.5$

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

- 1)  $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
- 2)  $\text{Cu}(\text{s}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$
- 3)  $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$
- 4)  $\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$

Ans : 1

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



30. What is the approximate quantity of electricity (in coulombs) required to deposit all the silver from 250ml of 1M  $\text{AgNO}_3$  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 1 M  $\text{AgNO}_3$  solution is

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

According to Faradays First Law

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

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

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  $\text{Na}^+$  and  $\text{Cl}^-$  ions.

