Fill Ups & True False of Electrochemistry , Past year Questions JEE Advance

Fill in the Blanks

1. Of the halide ions, _____ is the most powerful reducing agent. (1978)

Ans: I^-

Solution: ($\because$ I_2 is weakest oxidising agent)

2. The more ..... the standard reduction potential, the ..... is its ability to displace hydrogen from acids. (1986 - 1 Mark)

Ans: negative, greater

Solution: negative, greater; Among the various metals, since sodium has the minimum reduction potential, it must be strongest reducing agent. In general, more the reduction potential
lesser is its reducing action.

3. The electrical conductivity of a solution of acetic acid will be ..... if a solution of sodium hydroxide is added. (1987 - 1 Mark)
Ans: increased

TRUE/FALSE

The dependence of electrode potential for the electrode M^{n+} /M with concentration under STP conditions is given by the expression:

$$E = E^\circ + \frac{0.0591}{n}\log_{10}[M^{n+}]$$ **(1993 - 1 Mark)**

Ans: False

Solution : False : When the temperature is 273, the value of the factor will come out as 0.0541 instead of 0.0591. The value 0.0591 comes out at 298 K and not at 273 K.

Match the following of Electrochemistry, Past year Questions JEE Advance

Direction : question contains statements given in two columns, which have to be matched. The statements in Column-I are labelled A, B, C and D, while the statements in Column-II are labelled p, q, r, s and t.

Q. Match the reactions in Columns I with nature of the reactions/type of the products in Column II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

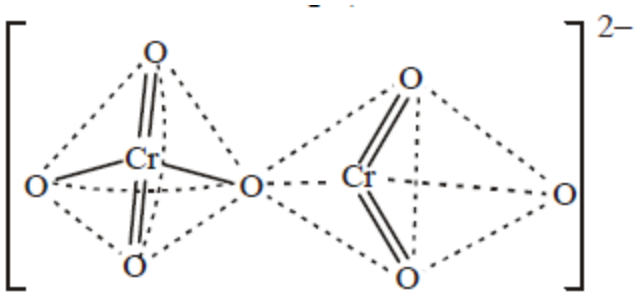
Column I	Column II
(A) $O_2^- \rightarrow O_2 + O_2^{2-}$ (B) $CrO_4^{2-} + H^+ \rightarrow$ (C) $MnO_4^- + NO_2^- + H^+ \rightarrow$ (D) $NO_3^- + H_2SO_4 + Fe^{2+} \rightarrow$	**(p) redox reaction** **(q) one of the products has trigonal planar structure** **(r) dimeric bridged tetrahedral metal ion** **(s) disproportionation**

Ans: A - p, s); (B - r); (C - p, q); (D - p).

Solution : A→ p, s; The reaction is redox reaction because the O.N. of O in O_2^- is –0.5 and that in $O_2$is zero. In O_2^{2-} is –1.0. It

involves reduction oxidation reaction. Since here a part of molecule is oxidised and a part is reduced so it is disproportionation.

B → r; The structure of $Cr_2O_7^{2-}$ is given below



[NOTE: In any solution dichromate ions and chromate ions exist in equilibrium. In alkali solution, dichromate ions are converted into chromate ions and on acidification chromate ions are converted back into dichromate ion.]

C → p, q; The reaction is $2MnO_4^- + 6H^+ + 5NO_2^- \rightarrow 2Mn^{2+} + 3H_2O + 5NO_3^-$ In involves change in O.N of Mn $(\text{from} + 7 \text{ in } MnO_4^-)$ to

+ 2(in Mn^{2+}), So Mn is reduced and NO_2^- is oxidised to NO_3^- it is a redox reaction. The structure of NO_3^- it is a redox reaction.

– (one of the products is trigonal planar)

D → p, It is a redox reaction

Direction : questions have matching lists. The codes for the lists have choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q. An aqueous solution of X is added slowly to an aqueous solution of Y as shown in List I. The variation in conductivity of these reactions is given in List II. Match list I with List II and select the correct answer using the code given below the lists (JEE Adv. 2013)

List I	List II
P. $(C_2H_5)_3N + CH_3COOH$ (X, Y) Q. $KI\,(0.1M) + AgNO_3\,(0.01M)$ (X, Y) R. $CH_3COOH + KOH$ (X, Y) S. $NaOH + HI$ (X, Y)	1. Conductivity decreases and then increases 2. Conductivity decreases and then does not change much 3. Conductivity increases and then does not change much 4. Conductivity does not change much and then increases

Codes:

	P	Q	R	S
(a)	3	4	2	1
(b)	4	3	2	1
(c)	2	3	4	1
(d)	1	4	3	2

Ans: a

Solution : (a)

(p)

$$\underset{X}{(C_2H_5)_3N} + \underset{Y}{CH_3COOH} \longrightarrow (C_2H_5)_3NH^+CH_3COO^-$$

Initially conductivity increases because on neutralisation ions are created. After that it becomes practically constant because X alone cannot form ions.

Q. $\underset{x}{KI(0.1M)} + \underset{y}{AgNO_3(0.01M)} \longrightarrow AgI\downarrow + KNO_3$

Number of ions in the solution remains constant as only $AgNO_3$ precipitated as AgI. Thereafter conductance increases due to increase in number of ions.

(R) Initially conductance decreases due to the decrease in the number of $\overline{OH}$ ions as OH^- is getting replaced by CH_3COO^- which has poorer conductivity thereafter it slowly increases due to the increase in number of H^+ ions.

(S) Initially it decreases due to decrease in H^+ ions and then increases due to the increase in OH^- ions.

Q. The standard reduction potential data at 25°C is given below : (JEE Adv. 2013)
$E°(Fe^{3+}, Fe^{2+})$ = + 0.77 V; $E°(Fe^{2+}, Fe)$ = – 0.44 V; $E°(Cu^{2+}, Cu)$ = + 0.34 V; E°(Cu+, Cu) = + 0.52 V
$E°[O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O]$ = + 1.23 V; $E°[O_2(g) + 2H_2O + 4e^- \rightarrow 4OH^-]$ = + 0.40 V
$E°(Cr^{3+}, Cr)$ = – 0.74 V; $E°(Cr^{2+}, Cr)$ = – 0.91 V

Match E° of the redox pair in List I with the values given in List II and select the correct answer using the code given below the lists :

List I	List II
P. $E^\circ(Fe^{3+}, Fe)$ Q. $E^\circ(4H_2O \rightleftharpoons 4H^+ + 4OH^-)$ R. $E^\circ(Cu^{2+} + Cu \rightarrow 2Cu^+)$ S. $E^\circ(Cr^{3+}, Cr^{2+})$	1. – 0.18 V 2. – 0.4 V 3. – 0.04 V 4. – 0.83 V

Codes :

	P	Q	R	S
(a)	4	1	2	3
(b)	2	3	4	1
(c)	1	2	3	4
(d)	3	4	1	2

Ans: d

Solution :

(P) $Fe^{3+} \xrightarrow[n=1]{+0.77V} Fe^{2+} \xrightarrow[n=2]{-0.44V} Fe$

$x\,V \qquad\qquad n = 3$

$$\Delta G^\circ_{Fe^{3+}/Fe} = \Delta G^\circ_{Fe^{3+}/Fe^{2+}} + \Delta G^\circ_{Fe^{2+}/Fe}$$

$$\Rightarrow \quad -3 \times FE^\circ_{(Fe^{+3}/Fe)} = -1 \times FE^\circ_{(Fe^{+3}/Fe^{+2})} + \left(-2 \times FE^\circ_{(Fe^{+2}/Fe)}\right)$$

$$\Rightarrow \quad 3 \times x = 1 \times 0.77 + 2 \times (-0.44)$$

$$\Rightarrow \quad x = -\frac{0.11}{3} V \simeq -0.04\,V.$$

(Q)
$$2H_2O \longrightarrow O_2 + 4H^+ + 4e^- \quad E^\circ = -1.23\,V$$
$$4e + O_2 + 2H_2O \longrightarrow 4OH^- \quad E^\circ = +0.40\,V$$
$$4H_2O \longrightarrow 4H^+ + 4OH^- \quad E^\circ = -0.83\,V$$

(R)
$$Cu^{2+} + 2e \longrightarrow Cu \quad E^\circ = +0.34\,V$$
$$2Cu \longrightarrow 2Cu^+ + 2e \quad E^\circ = -0.52\,V$$
$$Cu^{2+} + Cu \longrightarrow 2Cu^+ \quad E^\circ = -0.18\,V$$

(S)
$$Cr^{3+} \xrightarrow[n=1]{x} Cr^{2+} \xrightarrow[n=2]{-0.91V} Cr$$

– 0.74V, n = 3

x × 1 + 2 × (– 0.91) = 3 × (– 0.74)

x – 1.82 = – 2.22 ⇒ x = – 0.4V

Integer Type questions of Electrochemistry, Past year Questions JEE Advance

Integer Value Correct Type

1. All the energy released from the reaction $X \rightarrow Y$, $\Delta_r G^\circ = -193$ kJ mol^{-1} is used for oxidizing M^+ as $M^+ \rightarrow M^{3+} + 2e^-$, $E^\circ = -0.25$ V

Under standard conditions, the number of moles of M^+ oxidized when one mole of X is converted to Y is [F = 96500 C mol^{-1}] (JEE Adv. 2015)

Ans: 4

Solution:

$$X \longrightarrow Y; \qquad \Delta G^\circ = -193\ \text{kJ mol}^{-1}$$

$$M^+ \longrightarrow M^{3+} + 2e^- \qquad E^\circ = -0.25\text{V}$$

Hence DG° for oxidation will be

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

$= -2 \times 96500 \times (-0.25) = 48250\ \text{J} = 48.25\ \text{kJ}$

48.25 kJ energy oxidises one mole M^+

$\therefore$ 193 kJ energy oxidises $\frac{193}{48.25}$ mole $M^+ = 4$ mole M^+

2. The molar conductivity of a solution of a weak acid HX (0.01 M) is 10 times smaller than the molar conductivity of a solution of a weak acid HY (0.10 M).

If $\lambda^0_{x^-} \approx \lambda^0_{y^-}$ the difference in their pK_a values, $pK_a(HX) - pK_a(HY)$, is (consider degree of ionization of both acids to be <<1) (JEE Adv. 2015)

Ans: 3

Solution :

$1 \rightarrow HX$ $\qquad$ $2 \rightarrow HY$

$$\alpha_1 = \frac{(\lambda_m)_{HX}}{\lambda_m^\circ} \qquad \alpha_2 = \frac{(\lambda_m)_{HY}}{\lambda_m^\circ}$$

$$K_{a_1} = C_1\alpha_1^2 \qquad K_{a_2} = C_2\alpha_2^2$$

$$= 0.01\frac{(\lambda_m)^2_{HX}}{(\lambda_m^\circ)^2} \qquad = 0.1\frac{(\lambda_m)^2_{HY}}{(\lambda_m^\circ)^2}$$

$$\therefore \quad \frac{K_{a_1}}{K_{a_2}} = \frac{0.01(\lambda_m)^2_{HX}}{0.1(\lambda_m)^2_{HY}} = 0.1\left(\frac{(\lambda_m)_{HX}}{(\lambda_m)_{HY}}\right)^2$$

$$= 0.1\left(\frac{1}{10}\right)^2 = 10^{-3}$$

$$pK_a(HX) - pK_a(HY) = -\log\frac{K_{a_1}}{K_{a_2}} = -\log 10^{-3} = 3$$

Subjective Questions of Electrochemistry, Past year Questions (Part - 1)

1. The density of copper is 8.94 g/ml. Find out the number of coulombs needed to plate an area 10 cm × 10 cm to a thickness 10^{-2} cm using $CuSO_4$ solution as electrolyte. (1979)

Ans: 27171.96 coulombs

2. (a) 19 gm of molten $SnCl_2$ is electrolysed for some time. Inert electrodes are used. 0.119 gm of Sn is deposited at the cathode. No substance is lost during the electrolysis. Find the ratio of the weights of $SnCl_2$: $SnCl_4$ after electrolysis.
(b) A hot solution of NaCl in water is electrolysed. Iron electrodes are used. Diaphragm cell is not used. Give equations for all the chemical reactions that take place during electrolysis.
(c) Find the charge in coulombs of 1 gram ion of N^{3-} (1980)

Ans: (a) 71.34: 1, (c) 2.06 × 104 coulombs

3. Complete and balance the following equations (1980)

(i) $KNO_3 + FeSO_4 + H_2SO_4(conc) \longrightarrow$
(ii) $H_2S + K_2CrO_4 + H_2SO_4 \longrightarrow$
(iii) $KI + H_2SO_4(conc) \xrightarrow{\Delta}$
(iv) $Mg_3N_2 + H_2O \longrightarrow$
(v) $Al + KMnO_4 + H_2SO_4 \longrightarrow$

4. Consider the cell (1982 - 2 Marks)
$Zn \mid Zn^{2+}$ (aq) (1.0 M) || Cu^{2+} (aq) (1.0 M) | Cu.
The standard reduction potentials are :
+0.350 volts for $2e^- + Cu^{2+}$ (aq) → Cu and –0.763 volts for $2e^- + Zn^{2+}$ (aq) → Zn
(i) Write down the cell reaction.
(ii) Calculate the emf of the cell.
(iii) Is the cell reaction spontaneous or not?

Ans: (ii) 1.113 volts, (iii) spontaneous

5. In an electrolysis experiment current was passed for 5 hours through two cells connected in series. The first cell contains a solution of gold and the second contains copper sulphate solution. 9.85 g of gold was deposited in the first cell. If

the oxidation number of gold is +3, find the amount of copper deposited on the cathode of the second cell. Also calculate the magnitude of the current in amperes.(1 faraday = 96,500 coulombs) (1983 - 3 Marks)

Ans: 4.7625 g, 0.8042 A

6. How long a current of 3 ampere has to be passed through a solution of silver nitrate to coat a metal surface of 80 cm^2 with a 0.005 mm thick layer? Density of silver is 10.5 g/cm^3. (1985 - 3 Marks)

Ans: 125.09 sec

7. The EMF of a cell corresponding to the reaction :
$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+} + (0.1\ M) + H_2\ (g)\ (1\ atm.)$ is 0.28 volt at 25°C.
Write the half-cell reactions and calculate the pH of the solution at the hydrogen electrode.

$E^{\circ}_{Zn^{2+}/Zn} = -0.76$ volt; $E^{\circ}_{H^+/H_2} = 0$ **(1986 - 4 Marks)**

Ans: 8.62

8. During the discharge of a lead storage battery, the density of sulphuric acid fell from 1.294 to 1.139 g/ml. Sulphuric acid of density 1.294 g/ml is 39% by weight and that of 1.139 g/ml is 20% H_2SO_4 by weight. The battery holds 3.5 litres of the acid and the volume remained practically constant during the discharge.
Calculate the number of ampere-hours for which the battery must have been used. The charging and discharging reactions are : (1986 - 5 Marks)

Anode :

$$Pb + SO_4^{2-} = PbSO_4 + 2e^- \text{ (discharging)}$$

Cathode :

$$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- = PbSO_4 + 2H_2O \text{ (discharging)}$$

Note : Both the reactions take place at the anode and cathode respectively during discharge. Both reaction get reverse during charging.

Ans: 265.02 Ah

9. A 100 watt, 110 volt incandescent lamp is connected in series with an electrolyte cell containing cadmium sulphate solution. What weight of cadmium will be deposited by the current flowing for 10 hours? (1987 - 5 Marks)

Ans: 19.06 g

10. A cell contains two hydrogen electrodes. The negative electrode is in contact with a solution of 10^{-6} M hydrogen ions. The EMF of the cell is 0.118 V at 25°C. Calculate the concentration of hydrogen ions at the positive electrode. (1988 - 2 Marks)

Ans: 10^{-4} M

11. In a fuel cell hydrogen and oxygen react to produce electricity. In the process hydrogen gas is oxidised at the anode and oxygen at the cathode. If 67.2 litre of H_2 at STP react in 15 minutes, what is the average current produced? If the entire current is used for electro deposition of copper from copper (II) solution, how many grams of copper will be deposited? (1988 - 4 Marks)

$$\text{Anode reaction}: H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$$

$$\text{Cathode reaction}: \frac{1}{2}O_2 + H_2O + 2e^- \rightarrow 2OH^-.$$

Ans: 643.3 A, 190.50 g

12. An acidic solution of Cu^{2+} salt containing 0.4 g of Cu^{2+} is electrolysed until all the copper is deposited. The electrolysis is continued for seven more minutes with the volume of solution kept at 100 ml. and the current at 1.2 amp. Calculate the volume of gases evolved at NTP during the entire electrolysis. (1989 - 5 Marks)

Ans: 99.79 ml, 58.48 ml

13. The standard reduction potential at 25°C of the reaction, $2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ **is –0.8277V. Calculate the equilibrium constant for the reaction** $2H_2O \rightleftharpoons H_3O^+ + OH^-$ **at 25°C. (1989 - 3 Marks)**

Ans: 9.88×10^{-15}

14. The standard reduction potential of Cu^{++}/Cu and Ag^{+}/Ag electrodes are 0.337 and 0.799 volt respectively. Construct a galvanic cell using these electrodes so that its standard e.m.f. is positive. For what concentration of Ag+ will the e.m.f. of the cell, at 25°C, be zero if the concentration of Cu^{++} is 0.01 M? (1990 - 3 Marks)

Ans: 1.48×10^{-9} M

Subjective Questions of Electrochemistry, Past year Questions (Part - 2)

15. Calculate the quantity of electricity that would be required to reduce 12.3 g of nitrobenzene to aniline, if the current efficiency for the process is 50 per cent. If the potential drop across the cell is 3.0 volts, how much energy will be consumed? (1990 - 3 Marks)

Ans: 115800 C, 347.4 kJ

16. Zinc granules are added in excess to a 500 ml. of 1.0 M nickel nitrate solution at 25°C until the equilibrium is reached. If the standard reduction potential of Zn^{2+} | Zn and Ni^{2+}| Ni are –0.75 V and –0.24 V respectively, find out the concentration of Ni^{2+} in solution at equilibrium. (1991 - 2 Marks)

Ans: $5.128\acute{}10^{-18}$ mol l^{-1}

17. A current of 1.70 A is passed through 300.0 ml of 0.160 M solution of a $ZnSO_4$ for 230 sec. with a current efficiency of 90%. Find out the molarity of Zn^{2+} after the deposition of Zn. Assume the volume of the solution to remain constant during the electrolysis. (1991 - 4 Marks)

Ans: 0.154 M

18. For the galvanic cell. (1992 - 4 Marks)

$Ag|AgCl_{(s)}, KCl(0.2\,M)\,||\,KBr\,(0.001M), AgBr_{(s)}|Ag$ **Calculate the EMF generated and assign correct polarity to each electrode for a spontaneous process after taking into account the cell reaction at 25°C.**

$[K_{sp}(AgCl) = 2.8 \times 10^{-10}; K_{sp}(AgBr) = 3.3 \times 10^{-13}]$

Ans: – 0.037 V

19. An aqueous solution of NaCl on electrolysis gives $H_2(g)$, $Cl_2(g)$ and NaOH according to the reaction :

$$2Cl^-(aq) + 2H_2O = 2OH^-(aq) + H_2(g) + Cl_2(g).$$

A direct current of 25 amperes with a current efficiency of 62% is passed through 20 litres of NaCl solution (20% by weight). Write down the reactions taking place at the anode and the cathode. How long will it take to produce 1 kg of Cl_2? What will be the molarity of the solution with respect to hydroxide ion? (Assume no loss due to evaporation.) (1992 - 3 Marks)

Ans: 48.69 hrs., 1.408 M

20. The standard reduction potential for the half-cell $NO_3^-(aq) + 2H^+(aq) + e \rightarrow NO_2(g) + H_2O$ **is 0.78 V.**
(i) Calculate the reduction potential in 8 M H+
(ii) What will be the reduction potential of the half-cell in a neutral solution? Assume all the other species to be at unit concentration. (1993 - 2 Marks)

Ans: (i) 0.887 V, (ii) 0.046 V

21. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation.
$CrO_3(aq)$ 6H (aq) 6e $\rightarrow$Cr(s) $3H_2O$
Calculate (i) how many grams of chromium will be plated out by 24,000 coulombs and (ii) how long will it take to plate out 1.5 g of chromium by using 12.5 amp current. (1993 - 2 Marks)

Ans: (i) 2.1554 g of Cr, (ii) 1336.15 sec

22. The standard reduction potential of the Ag^+ /Ag electrode at 298 K is 0.799 V. Given that for AgI, $K_{sp} = 8.7 \times 10^{-17}$, evaluate the potential of the Ag+/Ag electrode in a saturated solution of AgI. Also calculate the standard reduction potential of the I^-/ AgI/Ag electrode. (1994 - 3 Marks)

Ans: 0.325 V, – 0.149 V

23. The Edison storage cells is represented as
Fe(s) | FeO(s) | KOH(aq) | Ni_2O_3(s) | Ni(s)

The half-cell reactions are :

$$Ni_2O_3(s) + H_2O(l) + 2e^- \rightleftharpoons 2NiO(s) + 2OH^- ; \quad E^\circ = +0.40V$$

$$FeO(s) + H_2O(l) + 2e^- \rightleftharpoons Fe(s) + 2OH^- ; \quad E^\circ = -0.87V$$

(i) What is the cell reaction ?
(ii) What is the cell e.m.f ? How does it depend on the concentration of KOH?
(iii) What is the maximum amount of electrical energy that can be obtained from one mole of Ni_2O_3? (1994 - 4 Marks)

Ans: (ii) 1.27 V, (iii) 2.45×105J

24. Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water. Explain. (1994 - 1 Mark)

25. An excess of liquid mercury is added to an acidified solution of 1.0×10^{-3} M Fe^{3+}. It is found that 5% of Fe^{3+} remains at equilibrium at 25°C.

Calculate $E^\circ_{Hg_2^{2+}|Hg}$, assuming that the only reaction that occurs is

$$2Hg + 2Fe^{3+} \longrightarrow Hg_2^{2+} + 2Fe^{2+}.$$

(Given $E^\circ_{Fe^{3+}|Fe^{2+}} = 0.77\,V$.)

(1995 - 4 Marks)

Ans: 0.792 V

26. The standard reduction potential for $Cu^{2+}|$ Cu is +0.34 V. Calculate the reduction potential at pH = 14 for the above couple. K_{sp} of $Cu(OH)_2$ is 1.0×10^{-19} (1996 - 3 Marks)

Ans: – 0.22 V

Subjective Questions of Electrochemistry, Past year Questions (Part - 3)

27. How many grams of silver could be plated out on a serving tray by electrolysis of a solution containing silver in +1 oxidation state for a period of 8.0 hours at a current of 8.46 amperes? What is the area of the tray if the thickness of the silver plating is 0.00254 cm? Density of silver is 10.5 g/cm^3.
(1997 - 3 Marks)

Ans: 34.02 g, 1275.6 cm^2

28. Calculate the equilibrium constant for the reaction

$Fe^{2+} + Ce^{4+} \rightleftharpoons Fe^{3+} + Ce^{3+}$ *(1997 - 2 Marks)*

(given $E^\circ_{Ce^{4+}/Ce^{3+}} = 1.44\,V$; $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.68\,V$;)

Ans: 7.6 × 1012

29. Calculate the equilibrium constant for the reaction, $2Fe^{3+} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$. **The standard reduction potentials in acidic conditions are 0.77 V and 0.54 V respectively for** $Fe^{3+}|Fe^{2+}$ **and** $I_3^-|I^-$ **couples. (1998 - 3 Marks)**

Ans: 6.26 × 10^7

30. Find the solubility product of a saturated solution of Ag_2CrO_4 in water at 298 K if the emf of the cell Ag | Ag^+ (satd. Ag_2CrO_4soln.)||Ag+(0.1M)|Ag is 0.164 V at 298 K. (1998 - 6 Marks)

Ans: 2.44 × 10^{-12}

31. A cell, Ag | Ag^+||Cu^{2+}|Cu, initially contains 1 M Ag^+ and 1 M Cu^{2+} ions. Calculate the change in the cell potential after the passage of 9.65 A of current for 1 h. (1999 - 6 Marks)

Ans: 0.010 V

32. Copper sulphate solution (250 mL) was electrolysed using a platinum anode and a copper cathode. A constant current of 2 mA was passed for 16 minutes. It was found that after electrolysis the absorbance of the solution was reduced to 50% of its original value. Calculate the concentration of copper sulphate in the solution to begin with. (2000 - 3 Marks)

Ans: 7.95×10^{-5} mol L^{-1}

33. The following electrochemical cell has been set up. $Pt(1)\,|Fe^{3+}, Fe^{2+}(a=1)|\,Ce^{4+}, Ce^{3+}(a=1)|\,Pt\,(2)$ $E^{\circ}(Fe^{3+}, Fe^{2+}) = 0.77\ V : E^{\circ}(Ce^{4+}/Ce^{3+}) = 1.61\ V$ **If an ammeter is connected between the two platinum electrodes, predict the direction of flow of current. Will the current increase or decrease with time? (2000 - 2 Marks)**

Ans: Ce electrode to iron electrode, decrease

34. The standard potential of the following cell is 0.23 V at 15°C and 0.21 V at 35°C. (2001 - 10 Marks)

Pt | H_2 (g) | HCl(aq) | AgCl(s) | Ag(s)
(i) Write the cell reaction.
(ii) Calculate DH° and DS° for the cell reaction by assuming that these quantities remain unchanged in the range 15°C to 35°C.
(iii) Calculate the solubility of AgCl in water at 25°C.
Given : The standard reduction potential of the Ag+(aq) /Ag(s) couple is 0.80 V at 25°C.

Ans: (ii) – 22195 J mole, –49987 J/mole; (iii) 1.24×10^{-5} mol/L

35. Two students use same stock solution of $ZnSO_4$ and a solution of $CuSO_4$. The emf of one cell is 0.03 V higher than the other. The conc. of $CuSO_4$ in the cell with higher emf value is 0.5 M. Find out the conc. of $CuSO_4$ in the other cell (2.203 RT/F = 0.06). (2003 - 2 Marks)

Ans: 0.05 M

36. Find the equilibrium constant for the reaction,
$In^{2+} + Cu^{2+} \rightarrow In^{3+} + Cu^{+}$ at 298 K
given :

$E_{Cu^{2+}/Cu^{+}} = 0.15V$; $E^{0}_{In^{2+}/In^{+}} = -0.40V$, $E^{0}_{In^{3+}/In^{+}} = -0.42V$ (2004 - 4 Marks)

Ans: 10^{10}

37. (a) For the reaction

$$Ag^{+}(aq) + Cl^{-}(aq) \rightleftharpoons AgCl(s)$$

Given :

Species	ΔG°_{f} (kJ/mol)
Ag^{+} (aq)	**+77**
Cl^{-} (aq)	**-129**
AgCl (s)	**-109**

Write the cell representation of above reaction and calculate E°_{cell} at 298 K. Also find the solubility product of AgCl.

(b) If 6.539×10^{-2} g of metallic zinc is added to 100 ml saturated solution of AgCl.

Find the value of $\log_{10}\frac{[Zn^{2+}]}{[Ag^{+}]^{2}}$ **How many moles of Ag will be precipitated in the above**

reaction. Given that
$Ag^{+} + e^{-} \rightarrow Ag$; $E^{o} = 0.80V$;
$Zn^{2+} + 2e^{-} \rightarrow Zn$; $E^{o} = -0.76V$ (2005 - 6 Marks)
(It was given that Atomic mass of Zn = 65.39)

Ans: (a) 0.59 V, 10^{-10} (b) 52.9, 10^{-6}

38. We have taken a saturated solution of AgBr. K_{sp} of AgBr is 12×10^{-14}. If 10^{-7} mole of $AgNO_3$ are added to 1 litre of this solution find conductivity (specific conductance) of this solution in terms of 10^{-7} S m^{-1} units. Given, Molar conductance of Ag^{+}, Br^{-} and NO^{3-} are 6×10^{-3} Sm^2mol^{-1}, 8×10^{-3} Sm^2mol^{-1} and 7×10^{-3} Sm^2mol^{-1}.

Ans: 55