Previous Years' CBSE Board Questions

3.1 Electrochemical Cells

SA I (2 marks)

1. Define electrochemical cell. What happens if external potential applied becomes greater than $E°_{cell}$ of electrochemical cell? *(2/5, AI 2016)*

3.2 Galvanic Cells

VSA (1 mark)

2. Represent the galvanic cell in which the reaction
$Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ takes place.
(1/3, Delhi 2013C)

3. What is the necessity to use a salt bridge in a Galvanic cell? *(Delhi 2011C)*

SA I (2 marks)

4. On the basis of standard electrode potential values stated for acid solutions, predict whether Ti^{4+} species may be used to oxidise Fe^{II} to Fe^{III}.
Reactions :
$Ti^{4+} + e^- \rightarrow Ti^{3+}$; + 0.01
$Fe^{3+} + e^- \rightarrow Fe^{2+}$; + 0.77 *(AI 2007)*

5. Two half-reactions of an electrochemical cell are given below :
$MnO^-_{4(aq)} + 8H^+_{(aq)} + 5e^- \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$, $E°$ = + 1.51V
$Sn^{2+}_{(aq)} \rightarrow Sn^{4+}_{(aq)} + 2e^-$, $E°$ = + 0.15 V
Construct the redox equation from the standard potential of the cell and predict if the reaction is reactant favoured or product favoured.
(Delhi 2011, AI 2010, 2009)

6. Given that the standard electrode potential ($E°$) of metals are :
K^+/K = –2.93 V, Ag^+/Ag = 0.80 V,
Cu^{2+}/Cu = 0.34 V,
Mg^{2+}/Mg = –2.37 V, Cr^{3+}/Cr = –0.74 V,
Fe^{2+}/Fe = –0.44 V.
Arrange these metals in an increasing order of their reducing power *(AI 2010)*

7. Formulate the galvanic cell in which the following reaction takes place :
$Zn_{(s)} + 2Ag^+_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)}$
State :
(i) Which one of its electrodes is negatively charged.
(ii) The reaction taking place at each of its electrode.
(iii) The carriers of current within this cell.
(Delhi 2008)

SA II (3 marks)

8. A cell is prepared by dipping copper rod in 1 M copper sulphate solution and zinc rod in 1 M zinc sulphate solution. The standard reduction potential of copper and zinc are 0.34 V and –0.76 V respectively.
(i) What will be the cell reaction?
(ii) What will be the standard electromotive force of the cell?
(iii) Which electrode will be positive?
(Delhi 2011C)

9. Depict the galvanic cell in which the reaction $Zn_{(s)} + 2Ag^+_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)}$ takes place. Further show :
(i) Which of the electrode is negatively charged?
(ii) The carriers of the current in the cell.
(iii) Individual reaction at each electrode.
(Delhi 2010C)

3.3 Nernst Equation

SA I (2 marks)

10. Calculate $\Delta_r G°$ for the reaction :
$Mg_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + Cu_{(s)}$
Given $E°_{cell}$ = +2.71 V, 1 F = 96500 C mol^{-1}
(2/3,AI 2014)

11. Equilibrium constant (K_c) for the given cell reaction is 10. Calculate $E°_{cell}$.
$A_{(s)} + B^{2+}_{(aq)} \rightleftharpoons A^{2+}_{(aq)} + B_{(s)}$
(2/3,Foreign 2014)

12. The standard electrode potential ($E°$) for Daniell cell is +1.1 V. Calculate the $\Delta G°$ for the reaction.
$Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$
(1 F = 96500 C mol^{-1}) *(AI 2013)*

13. The standard electrode potential for Daniell cell is 1.1 V. Calculate the standard Gibbs energy for the cell reaction.
(F = 96,500 C mol^{-1}) *(Delhi 2013C)*

14. A zinc rod is dipped in 0.1 M solution of $ZnSO_4$. The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential.
[$E^\circ_{Zn^{2+}/Zn}$ = – 0.76 V] *(Delhi 2012C)*

15. Determine the value of equilibrium constant (K_c) and ΔG° for the following reactions :
$Ni_{(s)} + 2Ag^+_{(aq)} \rightarrow Ni^{2+}_{(aq)} + 2Ag_{(s)}$, E° = 1.05 V
(1 F = 96500 C mol^{-1})
(Delhi 2011, Foreign 2011)

16. Calculate the emf for the given cell at 25° C :
$Cr|Cr^{3+}$ (0.1 M) || Fe^{2+} (0.01 M)| Fe
Given :
$$E^\circ_{Cr^{3+}/Cr} = -0.74 \text{ V}, E^\circ_{Fe^{2+}/Fe} = -0.44\text{V}$$
(2/5, Delhi 2009C)

SA II (3 marks)

17. Calculate e.m.f. of the following cell at 298 K
$2Cr_{(s)} + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe_{(s)}$
Given : $E^\circ_{(Cr^{3+}|Cr)} = -0.74$ V, $E^\circ_{(Fe^{2+}|Fe)} = -0.44$ V
(Delhi 2016)

18. Calculate E°_{cell} for the following reaction at 298 K.
$2Al_{(s)} + 3Cu^{2+}(0.01M) \rightarrow 2Al^{3+}(0.01M) + 3Cu_{(s)}$
Given : E_{ccll} = 1.98 V *(3/5,AI 2016)*

19. Calculate emf of the following cell at 25°C:
$Fe|Fe^{2+}(0.001\text{ M})||H^+(0.01\text{ M})|H_{2(g)}(1\text{ bar})|Pt_{(s)}$
$E^\circ(Fe^{2+}|Fe) = -0.44$ V, $E^\circ(H^+|H_2) = 0.00$ V
(Delhi 2015)

20. Calculate the emf of the following cell at 25°C
$Zn|Zn^{2+}$ (0.001 M) || H^+(0.01M)| $H_{2(g)}$ (1 bar) | $Pt_{(s)}$
$$E^\circ_{(Zn^{2+}/Zn)} = -0.76 \text{ V}, E^\circ_{(H^+/H_2)} = 0.00 \text{ V}$$
(Foreign 2015)

21. For the cell reaction
$Ni_{(s)}|Ni^{2+}_{(aq)}||Ag^+_{(aq)}|Ag_{(s)}$
Calculate the equilibrium constant at 25°C. How much maximum work would be obtained by operation of this cell?
$$E^\circ_{(Zn^{2+}/Zn)} = -0.25 \text{ V and } E^\circ_{Ag^+/Ag} = 0.80\text{V}$$
(3/5, Delhi 2015C)

22. Calculate the standard cell potential of the galvanic cell in which the following reaction takes place :
$Fe^{2+}_{(aq)} + Ag^+_{(aq)} \rightarrow Fe^{3+}_{(aq)} + Ag_{(s)}$
Calculate the $\Delta_r G^\circ$ and equilibrium constant of the reaction also,
$$\left(E^\circ_{Ag^+/Ag} = 0.80 \text{ V} ; E^\circ_{Fe^{3+}/Fe^{2+}} = 0.77 \text{ V}\right)$$
(3/5, Delhi 2015C)

23. Calculate the emf of following cell at 298 K :
$Mg_{(s)}$ | Mg^{2+}(0.1 M) || Cu^{2+}(0.01 M)|$Cu_{(s)}$
[Given : E°_{cell} = + 2.71 V, 1 F = 96500 C mol^{-1}]
(3/5, Delhi 2014)

24. Estimate the minimum potential difference needed to reduce Al_2O_3 at 500°C. The Gibbs energy change for the decomposition reaction
$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$ is 960 kJ.
(F = 96500 C mol^{-1}) *(3/5,Delhi 2014C)*

25. Calculate the emf of the following cell at 298 K :
$Fe_{(s)}|Fe^{2+}(0.001\text{ M})||H^+(1\text{ M})|H_{2(g)}$ (1 bar), $Pt_{(s)}$
(Given E°_{cell} = + 0.44 V) *(Delhi 2013)*

26. Calculate the emf of the following cell at 25°C :
$Ag_{(s)}|Ag^+(10^{-3}\text{ M})||Cu^{2+}(10^{-1}\text{ M})|Cu_{(s)}$
Given : E°_{cell} = + 0.46 V and log $10^n = n$.
(AI 2013)

27. In the button cell, widely used in watches, the following reaction takes place.
$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)} + 2OH^-_{(aq)}$
Determine E° and ΔG° for the reaction.
(Given : $E^\circ_{Ag^+/Ag}$ = + 0.80 V, $E^\circ_{Zn^{2+}/Zn}$ = – 0.76 V)
(3/5, Delhi 2012)

28. A voltaic cell is set up at 25°C with the following half cells :
Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)
Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.
$E^\circ_{Ni^{2+}/Ni}$ = – 0.25 V and $E^\circ_{Al^{3+}/Al}$ = – 1.66 V.
(log 8 × 10^{-6} = – 5.09) *(3/5, AI 2012, 2011, 3/5, Foreign 2011, 3/5, Delhi 2009)*

29. The cell in which the following reaction occurs :
$2Fe^{3+}_{(aq)} + 2I^-_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + I_{2(s)}$
has E°_{cell} = 0.236 V at 298 K, Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.
(Antilog of 6.5 = 3.162×10^6 ; of 8.0 = 10×10^8 ; of 8.5 = 3.162×10^8)
(Delhi 2012C)

30. Calculate the potential for half-cell containing 0.10 M $K_2Cr_2O_{7(aq)}$, 0.20 M $Cr^{3+}_{(aq)}$ and 1.0×10^{-4} M $H^+_{(aq)}$. The half cell reaction is :
$Cr_2O^{2-}_{7(aq)} + 14H^+_{(aq)} + 6e^- \rightarrow 2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$
and the standard electrode potential is given as E° = 1.33 V. *(3/5, AI 2011)*

31. For the cell
$Zn_{(s)} \mid Zn^{2+}$ (2 M) || Cu^{2+} (0.5 M) $\mid Cu_{(s)}$
(a) Write equation for each half-reaction.
(b) Calculate the cell potential at 25°C
Given :

$$E^\circ_{Zn^{2+}/Zn} = -0.76 \text{ V}; E^\circ_{Cu^{2+}/Cu} = +0.34\text{V}$$

(Delhi 2011C)

32. Calculate the equilibrium constant, K for the reaction at 298 K,
$Zn_{(s)} + Cu^{2+}_{(aq)} \rightleftharpoons Zn^{2+}_{(aq)} + Cu_{(s)}$
Given : $\Delta G^\circ = -212.300 \text{ kJ mol}^{-1}$

$$E^\circ_{Zn^{2+}/Zn} = -0.76 \text{ V}; E^\circ_{Cu^{2+}/Cu} = +0.34 \text{ V}$$

(AI 2011C)

33. A copper-silver cell is set up. The copper ion concentration is 0.10 M. The concentration of silver ion is not known. The cell potential when measured was 0.422 V. Determine the concentration of silver ions in the cell.
Given :

$$E^\circ_{Ag^+/Ag} = +0.80 \text{ V}, E^\circ_{Cu^{2+}/Cu} = +0.34 \text{ V}$$

(3/5, Delhi 2010, AI 2009)

34. A voltaic cell is set up at 25° with the following half cells :
Ag^+(0.001 M) | Ag and Cu^{2+} (0.10 M) | Cu
What would be the voltage of this cell?
(E°_{cell} = 0.46 V) *(AI 2009)*

35. A voltaic cell is set up at 25°C with the following half-cells :
Al | Al^{3+} (0.001 M) and Ni |Ni^{2+} (0.50 M)
Calculate the cell voltage

$$[E^\circ_{Ni^{2+}|Ni} = -0.25 \text{ V}, E^\circ_{Al^{3+}|Al} = -1.66 \text{ V}]$$

(3/5, Delhi 2009)

36. Calculate the equilibrium constant for the reaction
$Fe_{(s)} + Cd^{2+}_{(aq)} \rightleftharpoons Fe^{2+}_{(aq)} + Cd_{(s)}$
Given :

$$[E^\circ_{Cd^{2+}|Cd} = -0.40 \text{ V}, E^\circ_{Fe^{2+}|Fe} = -0.44 \text{ V}]$$

(3/5, Delhi 2009, 2009C, 3/5, AI 2009)

37. One half-cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. Its other half-cell consists of a zinc electrode dipping in 1.0 M solution of $Zn(NO_3)_2$. A voltage of 1.48 V is measured for this cell. Use this information to calculate the concentration of silver nitrate solution used.

$$[E^\circ_{Zn^{2+}|Zn} = -0.76 \text{ V}, E^\circ_{Ag^+|Ag} = +0.80 \text{ V}]$$

(3/5, Delhi 2009)

38. Calculate the standard cell potential of a galvanic cell in which the following reaction takes place :
$2Cr_{(s)} + 3Cd^{2+}_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3Cd_{(s)}$
Calculate $\Delta_r G^\circ$ and equilibrium constant, K of the above reaction at 25°C.
Given :

$$E^\circ_{Cr^{3+}/Cr} = -0.74 \text{ V}, E^\circ_{Fe^{2+}/Fe} = -0.44 \text{ V}$$

(F = 96,500 C mol^{-1}) *(Delhi 2008C)*

39. (i) Formulate the electrochemical cell representing the reaction ;
$2Cr_{(s)} + 3Fe^{2+}_{(aq)} \longrightarrow 2Cr^{3+}_{(aq)} + 3Fe_{(s)}$
(ii) Calculate E°_{cell}.
(iii) Calculate E_{cell} at 25°C if
$[Cr^{3+}]$ = 0.1 M and $[Fe^{2+}]$ = 0.01 M
Given :

$$E^\circ_{Cr^{3+}/Cr} = -0.74 \text{ V}, E^\circ_{Fe^{2+}/Fe} = -0.44 \text{ V}$$

(3/5, AI 2008C)

LA (5 marks)

40. Calculate e.m.f and ΔG for the following cell
$Mg_{(s)} \mid Mg^{2+}$ (0.001 M) || Cu^{2+} (0.0001 M) $\mid Cu_{(s)}$

$$E^\circ_{(Mg^{2+}/Mg)} = -2 \cdot 37 \text{ V}, E^\circ_{(Cu^{2+}/Cu)} = +0.34 \text{ V}$$

(AI 2015)

41. Calculate the standard electrode potential of Ni^{2+}/Ni electrode if emf of the cell

$Ni_{(s)}|Ni^{2+}(0.01\,M)||Cu^{2+}(0.1M)|Cu_{(s)}$ is 0.059 V.

[Given : $E^{\circ}_{Cu^{2+}/Cu} = +0.34$ V] *(Delhi 2009C)*

42. Calculate the cell emf and $\Delta_r G^{\circ}$ for the cell reaction at 25°C

$Zn_{(s)} | Zn^{2+}$ (0.1 M) || Cd^{2+} (0.01 M)| $Cd_{(s)}$

Given :

$E^{\circ}_{Zn^{2+}/Zn} = -0.763$ V, $E^{\circ}_{Cd^{2+}/Cd} = -0.403$ V

1 F = 96,500 C mol^{-1}, R = 8.314 J K^{-1} mol^{-1}

(AI 2009C)

3.4 Conductance of Electrolytic Solutions

VSA (1 mark)

43. Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration? *(1/2, Delhi 2015)*

44. State Kohlrausch's law of independent migration of ions. Write its one application. *(1/2, Foreign 2015)*

45. Define the following term :

Molar conductivity (Λ_m) *(1/5, Delhi 2015C)*

46. Define the following term :

Kohlrausch's law of independent migration of ions. *(1/5, Delhi 2015C)*

47. Define the following term : Limiting molar conductivity *(1/5, Delhi 2014)*

48. State and explain Kohlrausch's law. *(1/3, Delhi 2013C)*

49. Express the relation between conductivity and molar conductivity of a solution held in a cell? *(Delhi 2011)*

50. Express the relation among the conductivity of solution in the cell, the cell constant and the resistance of solution in the cell. *(Delhi 2011)*

51. Express the relation between the conductivity and the molar conductivity of a solution. *(AI 2008)*

SA I (2 marks)

52. Define the term degree of dissociation. Write an expression that relates the molar conductivity of a weak electrolyte to its degree of dissociation. *(2/5, Delhi 2015C)*

53. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration. *(2/5, AI 2015C)*

54. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution? *(AI 2014)*

55. Define the terms conductivity and molar conductivity for the solution of an electrolyte. Comment on their variation with temperature. *(Delhi 2014C)*

56. The resistance of 0.01 M NaCl solution at 25°C is 200 Ω. The cell constant of the conductivity cell used is unity. Calculate the molar conductivity of the solution. *(2/3, AI 2014C)*

57. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with change in temperature. *(AI 2014C)*

58. The conductivity of 0.20 M solution of KCl at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity. *(Delhi 2013, 2008, AI 2007)*

59. The conductivity of 0.001 M acetic acid is 4×10^{-5} S/cm. Calculate the dissociation constant of acetic acid, if molar conductivity at infinite dilution for acetic acid is 390 S cm^2/mol. *(2/3, Delhi 2013C, 2012C)*

60. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity? *(AI 2012, 2010, 2/5,Delhi 2009)*

61. The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution. *(AI 2012, 2010C)*

62. The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1}? *(Delhi 2010C, 2009C, 2008, 2007)*

63. Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?
(2/5, Delhi 2009)

64. Define the term molar conductivity. How is it related to conductivity of the related solution?
(2/5, Delhi 2009)

65. State Kohlrausch's law of independent migration of ions. How can the degree of dissociation of acetic acid in a solution be calculated from its molar conductivity data? *(2/5, AI 2008C)*

66. Explain with examples the terms weak and strong electrolytes. *(Delhi 2007)*

SA II (3 marks)

67. The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is 3.905×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).
Given : $\lambda°\ (H^+) = 349.6$ S cm^2 mol^{-1} and $\lambda°(CH_3COO^-) = 40.9$ S cm^2 mol^{-1}
(3/5, AI 2016)

68. The conductivity of 0·20 mol L^{-1} solution of KCl is 2.48×10^{-2} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).
Given $\lambda^\circ\ (K^+) = 73.5$ S cm^2 mol^{-1}
and $\lambda^\circ\ (Cl^-) = 76.5$ S cm^2 mol^{-1}. *(AI 2015)*

69. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is 1.29×10^{-2} Ω^{-1} cm^{-1}. *(3/5, AI 2014)*

70. The value of $\Lambda°_m$ of $Al_2(SO_4)_3$ is 858 S cm^2 mol^{-1}, while $\lambda^\circ\ SO_4^{2-}$ is 160 S cm^2 mol^{-1} calculate the limiting ionic conductivity of Al^{3+}.
(AI 2013C)

71. The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.
(AI 2012)

72. When a certain conductance cell was filled with 0.1 M KCl, it has a resistance of 85 ohms at 25°C. When the same cell was filled with an aqueous solution of 0.052 M unknown electrolyte, the resistance was 96 ohms. Calculate the molar conductance of the electrolyte at this concentration.
[Specific conductance of 0.1 M KCl $= 1.29 \times 10^{-2}$ ohm^{-1} cm^{-1}]
(AI 2012C)

73. Calculate the degree of dissociation of acetic acid at 298 K, given that :
$\Lambda_m\ (CH_3COOH) = 11.7$ S cm^2 mol^{-1}
$\Lambda°_m(CH_3COO^-) = 49.9$ S cm^2 mol^{-1}
$\Lambda°_m(H^+) = 349.1$ S cm^2 mol^{-1} *(Delhi 2011C)*

74. The resistance of a conductivity cell when filled with 0.05 M solution of an electrolyte *X* is 100 ohms at 40°C. The same conductivity cell filled with 0.01 M solution of electrolyte *Y* has a resistance of 50 ohms. The conductivity of 0.05 M solution of electrolyte *X* is 1.0×10^{-4} S cm^{-1}. Calculate
(i) Cell constant
(ii) Conductivity of 0.01 M *Y* solution
(iii) Molar conductivity of 0.01 M *Y* solution
(3/5, AI 2008C)

LA (5 marks)

75. (a) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.
(b) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1}? *(AI 2012)*

76. (a) State Kohlrausch's law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch's law.
(b) Calculate $\Lambda°_m$ for acetic acid.
Given that
$\Lambda°_m(HCl) = 426$ S cm^2 mol^{-1}
$\Lambda°_m(NaCl) = 126$ S cm^2 mol^{-1}
$\Lambda°_m(CH_3COONa) = 91$ S cm^2 mol^{-1}
(Delhi 2010)

77. Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1}. Calculate its molar conductivity if Λ°_m for acetic acid is 390.5 S cm^2 mol^{-1}. What is its dissociation constant? *(Delhi, AI 2008)*

3.5 Electrolytic Cells and Electrolysis

VSA (1 mark)

78. Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution :

$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$, $E^\circ = +0.80$ V

$H^+_{(aq)} + e^- \longrightarrow \frac{1}{2}H_{2(g)}$, $E^\circ = 0.00$ V

On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why? *(1/2, Delhi 2015)*

79. How much charge is required for the reduction of 1 mol of Zn^{2+} to Zn? *(Delhi 2015)*

80. Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution :

$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ $E^\circ = +0.34$ V

$H^+_{(aq)} + e^- \longrightarrow \frac{1}{2}H_{2(g)}$ $E^\circ = 0.00$ V

On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why? *(1/2, Foreign 2015)*

81. State the Faraday's first law of electrolysis. *(Delhi 2015C)*

82. How much charge is required for the reduction of 1 mole of Cu^{2+} to Cu? *(Delhi 2007)*

SA I (2 marks)

83. State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu. *(2/5, Delhi 2014)*

84. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5.0 ampere for 20 minutes. What mass of nickel will be deposited at the cathode?
(Given : At. mass of Ni = 58.7 g mol^{-1}, 1F = 96500 C mol^{-1}) *(Foreign 2014)*

85. Predict the products of electrolysis in each of the following :
(i) An aqueous solution of $AgNO_3$ with platinum electrodes.
(ii) An aqueous solution of H_2SO_4 with platinum electrodes. *(2/5, Delhi 2014C)*

86. How much electricity in terms of Faradays is required to produce 20 g of calcium from molten $CaCl_2$? *(2/3, Delhi 2013C)*

87. Silver is uniformly electrodeposited on a metallic vessel of surface area of 900 cm^2 by passing a current of 0.5 ampere for 2 hours. Calculate the thickness of silver deposited. Given : the density of silver is 10.5 g cm^{-3} and atomic mass of Ag = 108 amu. *(2/3, AI 2013C)*

88. How many coulombs are required to reduce 1 mole $Cr_2O_7^{2-}$ to Cr^{3+}? *(2/3, Delhi 2012C)*

89. How many moles of mercury will be produced by electrolysing 1.0 M $Hg(NO_3)_2$ solution with a current of 2.00 A for 3 hours? *(2/5, AI 2011)*

90. A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode? *(AI 2009)*

91. Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode. Write overall reaction.
Given :

$E^\circ_{Na^+/Na} = -2.71$ V, $E^\circ_{H_2O/H_2} = -0.83$ V,

$E^\circ_{Cl_2/Cl^-} = +1.36$ V, $E^\circ_{H^+/H_2/H_2O} = +1.23$ V

(2/5, Delhi 2009C)

92. Consider the reaction :
$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 8H_2O$
What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$? *(AI 2008)*

93. Explain why electrolysis of an aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode.

$E^\circ_{Na^+/Na} = -2.71$ V, $E^\circ_{H_2O/H_2} = -0.83$ V

$E^\circ_{Cl_2/2Cl^-} = +1.36$ V,

$E^\circ_{2H^+/\frac{1}{2}O_2/H_2O} = +1.23$ V

(2/5, Delhi 2008C)

94. Predict the products of electrolysis obtained at the electrodes in each if the electrodes used are of platinum?
(i) An aqueous solution of $AgNO_3$.
(ii) An aqueous solution of H_2SO_4. *(AI 2007)*

SA II (3 marks)

95. Calculate the strength of the current required to deposit 1.2 g of magnesium from molten $MgCl_2$ in 1 hour.
[1 F = 96,500 C mol^{-1} ;
Atomic mass : Mg = 24.0] *(3/5, Delhi 2009C)*

96. A solution of $CuSO_4$ is electrolysed for 16 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode? *(AI 2007)*

LA (5 marks)

97. Three electrolytic cells *A*, *B* and *C* containing solutions of zinc sulphate, silver nitrate and copper sulphate, respectively are connected in series. A steady current of 1.5 ampere is passed through them until 1.45 g of silver is deposited at the cathode of cell *B*. How long did the current flow? What mass of copper and what mass of zinc were deposited on the concerned electrodes? (Atomic masses of Ag = 108, Zn = 65.4, Cu = 63.5) *(Delhi, AI 2008)*

3.6 Batteries

VSA (1 mark)

98. Define : Secondary batteries *(1/5, Delhi 2015C)*

SA I (2 marks)

99. From the given cells :
Lead storage cell, Mercury cell, Fuel cell and Dry cell
Answer the following :
(i) Which cell is used in hearing aids?
(ii) Which cell was used in Apollo Space Programme?
(iii) Which cell is used in automobiles and invertors?
(iv) Which cell does not have long life? *(Delhi 2016)*

100. What type of battery is mercury cell? Why is it more advantageous than dry cell? *(2/5, AI 2015)*

101. What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it. *(2/5, Delhi 2012)*

102. Write the reactions taking place at cathode and anode in lead storage battery when the battery is in use. What happens on charging the battery? *(AI 2012C)*

103. What type of a battery is lead storage battery? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery. *(2/5, AI 2011, 2009, 2/5, Delhi 2009)*

104. Mention the reactions occurring at (i) anode, (ii) cathode, during working of a mercury cell. Why does the voltage of a mercury cell remain constant during its operation? *(Delhi 2011C)*

105. Write the anode and cathode reactions and the overall reaction occurring in a lead storage battery. *(2/5, Delhi 2010)*

SA II (3 marks)

106. What is a nickel-cadmium cell? State its one merit and one demerit over lead storage cell. Write the overall reaction that occurs during discharging of this cell. *(AI 2010C)*

3.7 Fuel Cells

VSA (1 mark)

107. Define : Fuel cell *(1/5, Delhi 2015C, 2014)*

108. Name the type of cell which was used in Apollo space programme for providing electrical power. *(1/3, AI 2014)*

SA I (2 marks)

109. Write two advantages of $H_2 — O_2$ fuel cell over ordinary cell. *(2/3, Foreign 2014)*

110. What are fuel cells? Explain the electrode reactions involved in the working of $H_2 — O_2$ fuel cell. *(2/3, Delhi 2013C, 2009)*

111. Give an example of a fuel cell and write the cathode and anode reactions for it. *(AI 2011C)*

3.8 Corrosion

VSA (1 mark)

112. Using the E° values of A and B predict which is better for coating the surface of iron

$\left[E^\circ_{(Fe^{2+}/Fe)} = -0.44\right]$

to prevent corrosion and why?

$E^\circ_{(A^{2+}/A)} = -2.37\ V; E^\circ_{(B^{2+}/B)} = 0.14\ V$

(AI 2016)

SA II (2 marks)

113. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere. *(Delhi 2011)*

114. Corrosion is essentially an electrochemical phenomenon. Explain the reactions occurring during corrosion of iron kept in an open atmosphere. *(2/5, AI 2009)*

SA II (3 marks)

115. What is corrosion? Explain the electrochemical theory of rusting of iron and write the reactions involved in the rusting of iron. *(Delhi 2012C)*