Ravi Maths Tuition

Electrochemistry

12th Standard

Chemistry

Fill up / 1 Marks 35 x 1 = 35

1) The arrangement which converts chemical energy of a redox reaction into electrical energy is called ----------

2) The arrangement in which electrical energy supplied brings about a redox reaction is called ----------

3) Electrolysis of an aqueous solution of sodium chloride produces ---------- at the cathode and ---------- at the anode.

4) Electrolysis of an aqueous solution of copper sulphate using platinum electrodes produces --------- at the cathode and ---------- at the anode.

5) The mass of the substance deposited when one coulomb of electricity is passed through its solution is called --------- of the substance.

6) In terms of SI base a units, ohm (Ω) = ----------

7) Conductivity is the conductance of ---------- of the solution and its units are ----------

8) If k is the specific conductivity of a solution with volume V containing 1 g eq of the electrolyte and $\wedge$ is the equivalent conductivity, then k, $\wedge$ and V are related as ----------

9) If every quantity is expressed in SI units, then molar conductivity ($\wedge_m$), conductivity (k) and molarity (M) are related as ----------

10) Conductivity (k), conductance (G) and all constant (G^*) are related as ---------

11) The units of cell constant are ----------

12) Out of specific, equivalent and molar conductivities, the quantity which decreases with dilution is ----------

13) According to Debye-Huckel-Onsager equation $\wedge_m{}^c =$ ----------

14) According to Kohlrausch's law, $\wedge_m{}^\circ$ for electrolyte A_x B_y = ----------

15) Ionic mobility = Ionic conductance/ ----------

16) In a galvanic cell, the electrode which acts as anode is a ------- pole.

17) In an electrochemical cell, the conventional current flows from -------- to ----------

18) KCl, KNO_3 etc. are preferred in a salt bridge because they have equal ----------

19) The electrode reaction (reduction reaction) occuring in the calomel electrode is ----------

20) EMF of a cell is equal to the potential difference between the two electrodes when the current flowing in the circuit is ----------

21) Out of Fe, Cu, Sn, and Hg, the most reactive metal is ---------- and least reactive metal is ----------.

22) If $E^\circ_{Red} \quad for \quad Ag^+ + e^- \longrightarrow Ag$ is 0.80 V, then for the reaction $2Ag^+ + 2e^- \longrightarrow 2Ag$, E°_{Red} will be ----------

23) Nernst equation gives the effect of -------- and ---------- on the EMF of a cell

24) In the electrolysis of aqueous NaCl solution, Cl_2 is produced at the anode and not O_2 . This is due to ---------- shown by water for oxidation to O_2 .

25) In Leclanche cell, MnO_2 acts as a --------

26) Mercury cell (Ruben-Mallory cell) gives a constant voltage of ----------

27) In lead storage battery, the cathode consists of ----------

28) Efficiency of a fuel cell is given by the expression, η = ----------

29) Protection of iron by coating with zinc is called ----------

30) The energy of one joule per second given out by a source is called ---------

31) Λ_m°,for weak electrolyte is determined by _____.

32) The quantity of change required to obtain 1 mole of Al from Al_2O_3 is _____.

33) $\frac{2}{3}\mathrm{Al_2O_3} \longrightarrow \frac{4}{3}\mathrm{Al} + 2\mathrm{O_2}$, number of moles of electrons gained or lost = _____.

34) $\mathrm{Cr_2O_7^{2-}} \longrightarrow 2\mathrm{Cr^{3+}}$, number of Faradays required = _____.

35) Dil. HNO3 , on electrolysis liberates _____ at anode.

True or False 7 x 1 = 7

36) If $\mathbf{E}^\circ_{\mathrm{Cell}}$ is -ve, cell will not work.

(a) True (b) False

37) If external emf opposing Daniel cell is less than 1.10 V, cell will keep in working.

(a) True (b) False

38) Salt bridge completes internal circuit and prevents accumulation of charges. [True/False]

(a) True (b) False

39) Inert electrolyte in salt bridge reacts with solution of half cells.

(a) True (b) False

40) Agar - Agar is gum like substance which holds inert electrolyte.

(a) True (b) False

41) KCl is used in salt bridge because K^+ and Cl^- have almost equal mobility.

(a) True (b) False

42) Anode is on left side and cathode is on right side of galvanic cell.

(a) True (b) False

Match the following 32 x 1 = 32

43) E_{cell}	(1) m^{-1}
44) G^*	(2) metal ion which is the weakest oxidising agent
45) k	(3) rechargeable
46) Lead storage battery	(4) No effect on EMF
47) Rusting	(5) EMF of cell becomes equal to standard EMF
48) Q	(6) unreactive metal
49) Lechlanche cell	(7) I x t
50) Ni-Cd cell	(8) Conductivity decreases and then does not change much
51) Fuel cell	(9) depends upon number of ions/volume
52) Mercury cell	(10) maximum efficiency
53) Li	(11) anion which is the weakest reducing agent
54) Au^{3+}	(12) Conductivity decreases and then increases
55) Br^-	(13) S cm^2 mol^{-1}
56) Au	(14) prevented by galvanisation
57) Li^+	(15) anion that can be oxidised by Au^{3+}
58) F^-	(16) reaction at anode,
59) Copper	(17) EMF of the cell increases
60) Silver	(18) 0.00112

61) Zinc

62) Aluminium

63) Concentration of copper sulphate solution is doubled

64) Concentrations of zinc sulphate solution is doubled

65) Concentrations of both the solutions are doubled

66) Concentrations of both the solutions are kept equal

67) $(C_2H_5)_3N$ + CH_3COOH (X, Y)

68) KI (0.1 M) + $AgNO_3$ (0.01 M) (X, Y)

69) CH_3COOH + KOH (X, Y)

70) NaOH + HI (X, Y)

71) E^0 (Fe^{3+}, Fe)

72) A_m

73) K

74) $\Delta_r G_{Cell}$

(19) Conductivity does not change much and then increases

(20) Pb is anode, $PbSO_4$ is cathode

(21) 0.000093

(22) 0.000339

(23) S cm^{-1}

(24) EMF of the cell decreases

(25) metal is the strongest reducing agent

(26) 0.00029

(27) gives steady potential

(28) extensive property

(29) - 0.04 V

(30) metal ion which is an oxidising agent

(31) V

(32) Conductivity increases and then does not change much

2 Marks

313 x 2 = 626

75) Can you store copper sulphate solutions in a zinc pot?

76) How much electricity is required in coulomb for the oxidation of
(i) 1 mole of H_2O to O_2
(ii) 1 mole of FeO to Fe_2O_3?

77) A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode?

78) Consult the table of standard electrode potentials and suggest three substances that can oxidize ferrous ions under suitable conditions.

79) Suggest a way to determine the Λ_m^o value of water.

80) If a current of 0.5 ampere flows through a metalic wire for 2 hours, then how many electrons flow through the wire?

81) The electrical resistance of a column of 0.05 mol L^{-1} NaOH solution of diameter 1 cm and length 50 cm is 5.55×10^3 ohm. Calculate its resistivity, conductivity and molar conuctivity.

82) The conductivity of 0.001028 mol L^{-1} acetic acid is $4.95 \times 10^{-5} Scm^{-1}$ Calculate its dissociation constant if Λ_m^o for acetic os 390.5 S cm^2 mol^{-1}.

83) How much charge is required for the following reduction?
(i) 1 mol of Al^{3+} to Al.
(ii) 1 mol of Cu^{2+} to Cu.
(iii) 1 mol of MnO^-_4 to Mn^{2+}

84) Λ_m^0 for NaCl, HCl and NaAc are 126.4, 425.9, and 91.0 S cm^2 mol^{-1} respectively. Calculate Λ^0 for HAc.

85) Represent the cell in which the following reaction takes place:
Mg(s) + $2Ag^+$ (0.0001 M) $\longrightarrow$ Mg^{2+} (0.130 M) +2 Ag(s)
Calculate its $E_{(cell)}$ if $E^{\ominus}_{(cell)}$ = 3.17 V.

86) Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.

87) Calculate the emf of the cell in which the following reaction takes place :
$Ni(s) + 2Ag^+(0.002M) \longrightarrow Ni^{2+}(0.160M) + 2Ag(s)$
Given that $E^{\ominus}_{(cell)}$ = 1.05 V

88) Suggest a list of metals that are extracted electrolytically.

89) Consider the reaction :
$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$
What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$?

90) Arrange the following metals in the order in which they displace each other from the solution of their salts : Al, Cu, Fe, Mg and Zn

91) Given the standard electrode potentials
K^+ /K = - 2.93 V, Ag^+ /Ag = 0.80 V,
$Hg^{2+}{}_2$/ Hg = 0.79 V,
Mg^{2+} /Mg = - 2.37 V, Cr^{2+} /Cr = - 0.74 V
Arrange these metals in their increasing order of reducing power.

92) The conductivity of 0.20 M solution of KCl at 298 K is 0.0248 S cm^{-1} Calculate its molar conductivity.

93) The resistance of a conductivity cell containing 0.001M KCl solution at 298 K is 1500 Ω. What is the cell constant if conductivity of 0.001M KCl solution at 298 K is 0.146 x 10^{-3} S cm^{-1} ?

94) Conductivity of 0.00241 M acetic acid is 7.896 x 10^{-5} S cm^{-1} Calculate its molar conductivity and if $\wedge^0$ for acetic acid is 390.5 S cm^2 mol^{-1} , what is its dissociation constant ?

95) Why does the conductivity of a solution decrese with dilution?

96) Calculate the equilibrium constant of the reaction: Cu(s) + 2Ag^+ (aq) → Cu^{2+}(aq) + 2Ag(s) $\mathrm{E}^{\ominus}_{(\mathrm{cell})}$ = 0.46 V

97) Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

98) Represent the galvanic cell in which the reactions is $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ takes place.

99) What is meant by 'limiting molar conductivity'?

100) What is primary cell? Give an example.

101) Rusting of iron is quicker in saline water than in ordinary water. Why is it so?

102) Define specific conductivity (specific conductance).

103) What is meant by cell constant?

104) The standard reduction potential for Zn^{2+} (aq)/Zn(s) is - 0.76 V. Write the reactions occurring at the electrodes when coupled with NHE or SHE (standard hydrogen electrode).

105) E^o (reduction potential) of Cu and Zn are +0.34 V and - 0.76 V respectively. Which of them is stronger reducing agent?

106) Predict whether F_2 and Na will react with one another. Give reason.
$E^o_{F_2/F^-} = +2.87 \quad V, E^o_{Na^+Na} = -2.71 \quad V$

107) If E^o for the reaction $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ is + 0.77 V, what will be E^o value for the reaction $2Fe^{3+}(aq) + 2e^- \rightarrow 2Fe^{2+}(aq)$?

108) Zinc dissolves in dilute acids to give Zn^{2+}. The electrode potential of cell when it is coupled with SHE and acts as anode, is 0.76 V. What is the standard electrode potential of Zn^{2+} / Zn?

109) What products are obtained at cathode and anode when molten $PbBr_2$ is electrolysed?

110) What are the products obtained during electrolysis of $CuSO_4$ using Pt electrode?

111) Complete: $\Lambda^o Na_2SO_4 =$

112) Write the correct representation of cell: 2Cr(s)+3Cd^{2+} (aq) → 2Cr^{3+}(aq)+3Cd(s).

113) $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq), E^o = +0.77\ V$
$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq), E^o = +1.36\ V$
Write the reaction which could be feasible using above half cells.

114) Calculate the E^o_{cell} of the following electrode reactions:
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s), \quad E^o = -0.76 \quad V, Cd^{2+}(aq) + 2e^- \rightarrow Cd(s), \quad E^o = -0.40 \quad V$.

115) How many Faradays of charge are required to convert:
1 mole of MnO_4^- to Mn^{2+} ion,

116) What mass of zinc (II) ion will be reduced by 1 mole of electrons?

117) HCl does not give an acidic solution in benzene. Why?

118) Suggest two materials other than hytrogen that can be used as fuels in fuel cells.

119) Can absolute electrode potential of an electrode be measured?

120) Can E^o_{cell} or $\triangle_r G^o$ for a cell reaction ever be equal to zero?

121) Under what condition os E_{cell} = 0 or $\triangle_r G$ = 0?

122) What does the negative sign in expression $E^o_{Zn^{2+}/Zn}$ =-0.76 V mean?

123) How will pH of brine (aq.NaCl solution) be affected when it is electrolysed?

124) Consider a cell given below:
$Cu\left|Cu^{2+}\right||CI^-|\,CI_2, Pt$
Write reactions that occur at anode and cathode.

125) The conductivity of 0.20 M KCl at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity.

126) Ezpress the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of solution related to its conductivity.

127) The molar conductivity of 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1} . Calculete the conductivity of this solution.

128) 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.
Given $E^o_{Zn^{2+}/Zn}$ = -0.76 V

129) Write the overall reaction that occurs during use (discharging) of nickel-cadmium cell. Is it a primary or a secondary cell. Mention its one merit over the lead storage cell.

130) In the electrolysis of aqueous sodium bromide, there are two possible anodic reactions:
$2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-, E^o = 1.23V$
$2Br^-(aq) \rightarrow Br_2(g) + 2e^-, E^o = 1.08V$
Which rwaction occurs at anode and why?

131) Mention the reactions occuring at (i) anode, (ii) cathode, during working of a mercury cell. Why does the voltage of a mercury cell remain constant during its operation?

132) What are fuel cells?How do they resemble and differ from galvanic cells?

133) Calculate the equilibrium constant for the following reaction at 298 K:
$Cu(s) + Cl_2(g) \rightarrow CuCl_2(aq)$
$R = 8.314 \quad JK^{-1}mol^{-1}, E^o_{Cu^{2+}/Cu} = 0.34V, E^o_{\frac{1}{2}Cl_2/Cl^-} = 1.36V, 1F = 96500 \quad Cmol^{-1}$

134) The same quantity of electrical charge deposited 0.583 g of Ag when passed through $AgNO_3$, $AuCl_3$ solution. Calculate the weight of gold formed.
(At weight of Au = 197 g mol^{-1}).

135) How long a current of 3 amperes 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 Ag is 10.5 g cm^{-3}. At wt. of Ag = 108.0 u.

136) What is relationship between Gibb's free energy of cell reaction in a galvanic cell and the emf of the cell? When will the maximum wirk be obtained from a galvanic cell.

137) Value of, standard electrode potential for oxidation of Cl^- ions is more positive than water, even then in electrolysis of NaCl, why is Cl^- oxidised at anode instead of water?

138) The $\wedge_m^o$ values for Nacl and KCl are 126.5 and 149.9 Ω^{-1} cm^2 mol^{-1} respectively. The ionic conductances of Na^+ at infinite dilution is 50.1 Ω^{-1} cm^2 mol^{-1}.Calculate the ionic conductance at infinite dilution for K^+ ion.

139) On electrolysis of an aqueous solution of NaCl, why H_2 and not Na is liberated at the cathode ?

140) An aqueous solution of copper sulphate is electrolysed using platinum electrodes in one case and copper electrodes in another case. Will the products of electrolysis be same or different ? Give reason.

141) State the products of electrolysis obtained on the cathode and the anode in the following cases :
(i) A dilute solution of $H_2 SO_4$ with platinum electrodes
(ii) An aqueous solution of $AgNO_3$ with silver electrodes.

142) How much amount of a substance is deposited by 1 coulomb ? What is it called ?

143) One faraday of electricity deposits one mol of Na from the molten salt but $\frac{1}{3}$ mol of Al from an aluminium salt. Why ?

144) A current of 2 ampere is passed for one hour between nickel electrodes in 0.5 L of 2 M Ni $(NO_3)_2$ solution. What will be the molarity of the solution at the end of the electrolysis?

145) Fill in the blanks :
(i) Equivalent wt. of a substance divided by 96500 gives..... of the substance
(ii) The weight deposited by one coulomb of electricity is called .... of the substance
(iii) One faraday is the charge present on..... of electrons
(iv) One faraday passed through $CuSO_4$ sol. deposits..... of Cu.

146) In each of the following pairs, which will allow greater conduction of electricity and why ?
(a) Silver wire at 20°C, Same silver wire at 50°C
(b) NaCl solution at 20°C, Same NaCl solution at 50°C
(c) NH_4 OH solution at 20°C, Same NH_4 OH solution at 50°C
(d) 0.1 M acetic acid solution, 1 M acetic acid solution.

147) Copper is conducting as such while copper sulphate is conducting only in molten state or in aqueous solution. Explain

148) Which will have greater molar conductivity and why ?
A.1 mol KCl dissolved in 200 cc of the solution.
B.1 mol KCl dissolved in 500 cc of the solution.

149) Solutions of two electrolytes A and B each having a concentration of 0.2 M have conductivities 2×10^{-2} and 4×10^{-4} S cm^{-1} respectively. Which will offer greater resistance to the flow of current and why ?

150) Taking the example of $Al_2 (SO_4)_3$, derive the relation between molar conductivity and equivalent conductivity.

151) Why alternating current is used in place of direct current in measuring the electrolytic conductance ?

152) A 0.1 M aqueous of Na_2SO_4 is diluted by adding water. What will happen to the values of its conductance (G), conductivity (k), molar conductivity $(\wedge_m)$ and equivalent conductivity $(\wedge_{eq})$?

153) Why in a concentrated solution, a strong electrolyte shows deviations from Debye-Huckel-Onsager equation ?

154) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with decrease in concentration ?

155) Why $\wedge_m^\circ$ for CH_3 COOH cannot be determined experimentally ?

156) Out of HCl and NaCl, which do you expect will have greater value for $\wedge_m^\circ$ and why ?

157) Write expressions for equivalent conductivity and molar conductivity of $Al_2 (SO_4)_3$ at infinite dilution in terms of their ionic conductivities.

158) What would happen if no salt bridge were used in an electrochemical cell (like Zn - Cu cell) ?

159) Why is it necessary to use a salt bridge in a Galvanic cell ?

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

161) What is the use of platinum foil in the hydrogen electrode ?

162) When silver electrode having reduction potential 0.80 volt is connected to NHE to make a cell, will it act as anode or cathode ? Give reason for your answer.

163) Is it safe to stir $AgNO_3$ solution with a copper spoon ? Why or why not ?
$E^{\circ}_{Ag^+/Ag} = 0.80volt$ and $E^{\circ}_{Cu^+/Cu} = 0.34volt$

164) I_2 and F_2 are added to a solution containing 1 M each of I^- and F^-. What reaction will take place ? Given that the reduction potentials of I_2 and F_2 are 0.54 volt and 2.87 volts respectively.

165) An electrochemical cell is made of aluminium and tin electrodes with their standard reduction potentials - 1.66 V and 0.14 V respectively. Select the anode and the cathode, represent the cell and write the cell reaction. Find the e.m.f of the cell.

166) On the basis of the standard electrode potential values stated for acid solution, predict whether Ti^{4+} species may be used to oxidize Fe^{II} to Fe^{III}

Reaction	E/V
$Ti^{IV} + e^- \longrightarrow Ti^{3+}$	+0.01
$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	+0.77

167) Two half cell reactions of an electrochemical cell are given below :
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l), \quad E^0 = +1.51V$
$Sn^{2+}(aq) \longrightarrow Sn^{4+}(aq) + 2e^-, \ E^0 = +0.15V$
Construct the redox reaction from the two half cell reactions and predict if this reaction favours formation of reactions or products shown in the equation.

168) How can the reduction potential of an electrode be increased ?

169) What is the difference between a chemical cell and a concentration cell ?

170) Why electrolysis of NaBr and NaI gives Br_2 and I_2 respectively while that of NaF gives O_2 instead of F_2?

171) Following two reactions can occur at cathode in the electrolysis of aqueous sodium chloride
$Na^+ + e^- \longrightarrow Na(s), E^0_{Red} = -2.71V$
$2H_2O(l) + 2e^- \longrightarrow H_2(g) + 2OH^-(aq) \quad E^0_{Red} = -0.83V$
Which reaction takes place preferentially and why?

172) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution :
$Ag^+(aq) + e^- \longrightarrow Ag(s), E^0 = +0.80V;$
$H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g), E^0 = +0.00V$
On the basis of their standard reduction electrode potential (E^0) values, which reaction is feasible at the cathode and why ?

173) Why fluorine cannot be obtained by electrolysis of aqueous HF solution, through it is a good conductor of electricity ?

174) What is the role of $ZnCl_2$ in a dry cell?

175) Why a mercury cell gives a constant voltage throughout its life ?

176) Which type of cells are rechargeable?

177) Give reason :
(a) Why does an alkaline medium inhibit the rusting of iron.
(b) Why does a dry cell become dead after a long time even if it has not been used.
(c) Why is zinc better than tin in protecting iron from corrosion ?

178) Give reason :
(i) Rusting of iron pipe can be prevented by joining it with a piece of magnesium.
(ii) Conductivity of an electrolyte solution decreases with the decrease in concentration.

179) Give reasons for the following :
(i) Copper displaces silver from silver nitrate solution.
(ii) Iron pipes are usually, coated with zinc.

180) Can you store copper sulphate solution in a zinc pot ?

181) Write the nernst equation and the e.m.f of the following cells at 298 K :
(i) $Mg(s)|Mg^{2+}(0.001M)||Cu^{2+}(0.0001M)|Cu(s)$
(ii) $Fe(s)|Fe^{2+}(0.001M)||H^{+}(1M)|H_2(g)(1bar)|Pt(s)$
(iii) $Sn(s)|Sn^{2+}(0.050M)||H^{+}(0.020M)|H_2(g)(1bar)|Pt(s)$
(iv) $Pt(s)|Br_2(l)|Br^{-}(0.010M)|H^{+}(0.030M)|H_2(g)(1bar)|Pt(s)$
Given $E^0_{Mg^{2+}/Mg} = -2.37V, E^0{}_{Cu^{2+}/Cu} = +0.34V, E^0{}_{Fe^{2+}/Fe} = -0.44V$
$E^0_{Sn^{2+}/Sn} = -0.14V, E^0{}_{1/2Br_2,Br} = +1.08V$

182) A solution of Ni $(NO_3)_2$ is electrolysed between platnium electrodes using a current of 5.0 ampere for 20 minutes. What mass of nickel will be deposited at the cathode ? (At.mass of Ni = 58.7)

183) Three electrolytic cells A, B and C containing electrolytes $ZnSO_4$, $AgNO_3$ and $CuSO_4$ respectively were connected in series. A steady current of 1.50 ampere was passed through them until 1.45 g of Ag were deposited at the cathode of cell B. How long did the current flow ? What mass of copper and zinc were deposited ? (At.wts.of Cu = 63.5, Zn = 65.3, Ag = 108)

184) Can absolute value of electrode potential of an electrode be measured ?

185) Can E^0_{cell} and $\Delta_r G^0$ for cell reaction ever be equal to zero ?

186) Aqueous copper sulphate solution and aqueous silver nitrate solution are electrolysed by 1 ampere current for 10 minutes in separate electrolytic cells. Will the mass of copper and silver deposited on the cathode be same or different ? Explain your answer.

187) Depict the galvanic cell in which the cell reaction is $Cu(s) + 2Ag^+(aq) \longrightarrow 2Ag(s) + Cu^{2+}(aq)$

188) Value of standard electrode potential for the oxidation of Cl^- ions is more positive than that of water, even then in the electrolysis of aqueous sodium chloride, why is Cl^- oxidised at anode instead of water ?

189) What is electrode potential ?

190) Why is alternating current used for measuring resistance of an electrolytic solution?

191) A galvanic cell has electrical potential of 1.1 V. If an opposing potential of 1.1 V is applied to this cell, what will happen to the cell reaction and current flowing through the cell?

192) Unlike dry cell, the mercury cell has a constant cell potential throughout its useful life. Why?

193) Solutions of two electrolytes 'A' and 'B' are diluted. The $\wedge_m$ of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer.

194) In an aqueous solution how does specific conductivity of electrolytes change with addition of water?

195) Which reference electrode is used to measure the electrode potential of other electrodes ?

196) Consider the cell :$Cu \mid Cu^{2+} \parallel Cl^- \mid Cl_2$, Pt
Write the reactions that occur at anode and cathode.

197) Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{cell} be affected when concentration of Zn^{2+} ions is increased ?

198) What advantage do the fuel cells have over primary and secondary batteries ?

199) Write the cell reaction of a lead storage battery when it is discharged. How does the density of the electrolyte change when the battery is discharged?

200) Why on dilution the $\wedge_m$ of CH_3COOH increases drastically, while that of CH_3COONa increases gradually?

201) What is meant by Faraday constant?

202) How many faradays of electric charge is required to liberate 5600 cm^3 of oxygen at STP ?

203) What is the effect of temperature on the electrical conduction of
(i) metallic conductor
(ii) electrolytic conductor?

204) How do metallic and ionic substances differ in conducting electricity ?

205) What are the units of molar conductivity?

206) What is the relationship between specific conductance and equivalent conductance ?

207) Express the relation among conductivity of the solution in the cell, the cell constant and resistance of solution in the cell.

208) Give the relationship between equivalent and molar conductance of a given solution?

209) How is cell constant calculated from conductance values ?

210) Which equation gives the relationship between equivalent or molar conductance and concentration of a strong electrolyte ?

211) What is the effect of decreasing concentration on the molar conductivity of a weak electrolyte ?

212) What is meant by limiting molar conductivity ?

213) Write an expression to relate molar conductivity of an electrolyte to its degree of dissociation.

214) What is the direction of flow of conventional current in a galvanic cell ?

215) What flows in the internal circuit of a galvanic cell ?

216) Why is it not possible to measure the single electrode potential ?

217) Given that the standard electrode potentials $\left(E^0\right)$ of metals are :
$K^+/K = -2.93V, Ag^+/Ag = 0.80V,\ \ Cu^{2+}/Cu = 0.34V, Mg^{2+}/Mg = -2.37V$
$Cr^{3+}/Cr = -0.74V, Fe^{2+}/Fe = -0.44V$
Arrange these metals in an increasing order of their reducing power.

218) Define electrochemical series . or two applications of electrochemical series.

219) Can we store copper sulphate in iron vessel ? Why ?

220) Why does zinc react with dilute sulphuric acid but copper does not?

221) Write Nernst equation for single electrode potential.

222) Write Nernst equation to calculate the cell potential of Mg(s) | Mg^{2+} (aq) || Ag^{+} (aq) | Ag

223) Write Nernst equation for the reaction
$(i) 2Cr(s) + 3Cd^{++}(aq) \longrightarrow 2Cr^{3+}(aq) + 3Cd(s)$
$(ii) 2Cr + 3Fe^{++} \longrightarrow 2Cr^{3+} + 3Fe$

224) Why a galvanic cell cell stops working after some time ?

225) How is free energy change of a cell reaction related to (i) its emf (ii) equilibrium constant of the cell reaction?

226) Is free energy change of a cell reaction an intensive property or extensive property?

227) Write the product obtained at anode on electrolysis of concentrated sulphuric acid using platinum electrodes

228) Name the electrolyte used in (i) dry cell (ii) mercury cell

229) What is a primary cell? Give an example.

230) Give an example of a secondary cell.

231) Write the name of a cell used in small watches.

232) Which cells were used in the Apollo space program ? What was the product used for ?

233) What is a fuel cell ?

234) How does H_2 - O_2 fuel cell operate ?

235) State two advantages of H_2 - O_2 fuel cell oevr ordinary cell.

236) Write the name of the electrolyte used in fuel cell.

237) What is the overall electrochemical reaction taking place in rusting?

238) Out of zinc and tin which one protects iron better even after cracks and why?

239) Define corrosion. What is the chemical formula of rust ?

240) Why is chromium used for coating iron?

241) What would happen if the protective tin coating over an iron bucket is broken in some places ?

242) Which type of metal can be used in cathodic protection of iron against rusting ?

243) Rusting of iron is quicker in saline water than in ordinary water. Give reason.

244) What is it not possible to measure the single electrode potential ?

245) On the basis of the standard electrode potential values stated for acid solution, predict whether Ti^{4+} species may be used to oxidize Fe^{II} to Fe^{III}

Reaction E/V

$Ti^{IV} + e^- \longrightarrow Ti^{3+}$: + 0.01

$Fe^{3+} + e^- \longrightarrow Fe^{2+}$: + 0.77

246) What is the free energy change for (a) galvanic cell (b) electrolytic cell?

247) Give reason :

(a) Why does an alkaline medium inhibit the rusting of iron.

(b) Why does a dry cell become dead after a long time even if it has not been used.

(c) Why is zinc better than tin in protecting iron from corrosion ?

(d) Value of standard electrode potential for the oxidation of Cl^- ions is more positive than that of water, even then in the electrolysis of aqueous sodium chloride, why is Cl^- oxidised at anode instead of water ?

(e) Why is alternating current used for measuring resistance of an electrolytic solution ?

248) The standard electrode potential of daniel is 1.1V. Calculate the standard Gibbs energy for the reaction:

$Zn\,(s) + Cu^{2+}\,(aq) \rightarrow Zn^{2+}\,(aq) + Cu\,(s)$

249) Define molar conductivity and give its SI units.

250) Define Kohlrausch law.

251) The e.m.f. of the cell:

$Zn|Zn^{2+}\,(1M)\,||H^+\,(1M)\,|H_2\,(1atm)$

Pt is 0.76V.What is the electrode potential of Zn^{2+}/Zn electrode?

252) How does concentration of sulphuric acid change in lead storage battery when current is drawn from it?

253) Write the relationship between

(i) standard free energy change and e.m.f. of a cell.

(ii) standard free energy change and equilibrium constant.

254) Give the units of specific conductance and molar conductance.

255) When the silver electrode having reduction potential 0.80V is attached to NHE, will it act as anode or cathode?

256) Give one example each of primary cell and secondary cell.

257) How are cell constant and specific conductance related to one another?

258) Write Nernst equation for the reaction:
$M^{n+}(aq) + ne^- \longrightarrow M(s)$

259) Why is the equilibrium constant K related to only E°_{cell} and not E_{cell}?

260) Can Fe^{3+} oxidise Br^- to Br_2 under standard conditions?
$E^\circ\left(Fe^{3+}|Fe^{2+}\right) = 0.771V$
$E^\circ\left(Br_2|Br^-\right) = 1.09V$

261) How does electrical resistivity of metallic conductors vary with temperature?

262) Express the relation between conductivity and molar conductivity of a solution.

263) Write two differences between primary cells and secondary cells

264) (a) Explain the following:
(i) CO_2 is always present in natural water. Explain its effect (increases, stops or no effects) on rusting of iron
(ii) Rusting of iron is quicker in saline water than in ordinary water. Explain.
(b) Discuss electrical protection for preventing rusting of iron pipes in underground water.

265) What are fuel cells? Discuss briefly hydrogen-oxygen fuel cell?

266) What is the corrosion? What are the factors which affect corrosion?

267) Define conductivity and give its units. Why is alternating current not used in place of direct current for measuring the electrolytic.

268) Give the main difference between an electrochemical cell and an electrolytic cell.

269) Write the various reaction taking place in nickel cadmium battery.

270) What is corrosion? How is cathode protection of iron different from galvanization?

271) Write the cell reaction which occur in lead storage battery:
(i) when the battery is in use and
(ii) When the battery is on charging

272) What is the sacrificial protection from rusting? Which metal is generally used for this purpose?

273) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:
$Ag^+(aq) + e^- \rightarrow Ag(s), E^0 = +0.80V;$
$H^+(aq) + e^- \rightarrow H_2(g), E^0 = +0.00V$
(a) On the basis of their standard reduction electrode potential (E^0) values, which reaction is feasible at the cathode and why?
(b) Define limiting molar conductivity. Why does conductivity of an electrolyte solution decrease with the decrease in concentration?

274) (a) Following reactions occur at cathode during the electrolysis of aqueous sodium chloride solution:
$Na^+(aq) + e^- \rightarrow Na(s), \quad E^0 = -2.71V$
$H^+(aq) + e^- \rightarrow H_2(g), \quad E^0 = 0.00V$
On the basis of their standard reduction electrode potential (E^0) values, which reaction is feasible at the cathode and why?
(b) Why does the cell potential of mercury cell remain constant throughout its life?

275) For 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?
(iv) Which cell does not have long life?

276) The molar conductivity at infinite dilution of $Al_2(SO_4)_3$ is 858 S cm^2 mol^{-1}. Calculate the molar ionic conductivity of Al^{3+} given that $\lambda^\circ\left(SO_4^{2-}\right) = 160$ S cm^2 mol^{-1}.

277) Define the following terms:
(a) Limiting molar conductivity (Λ_m°)
(b) Fuel cell

278) Define the following terms:
(i) Molar conductivity (Λ_m)
(ii) Secondary batteries.

279) State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?

280) (i) Following reactions occur at the cathode during the electrolysis of aqueous silver chloride solution:
$Ag^+(aq) + e^- \rightarrow Ag(s)$ E°=+0.80V
$H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)$ E°=0.00V
On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?
(ii) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

281) The standard electrode potential (E°)for Daniell cell is +1.1 V. Calculate the ΔG° for the reaction.
Zn(s)+Cu^{2+}(aq)$\rightarrow$$Zn^{2+}$(aq)+Cu(s);
(1 F = 96500 C mol^{-1})

282) 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 inverters?
(iv) Which cell does not have long life?

283) Calculate the time to deposit 1.27 g of copper at cathode when a current of 2 A was passed through the solution of $CuSO_4$.

284) (a) Calculate ΔG° for the reaction $Mg_{(s)}+Cu^{2+}\rightarrow Mg^{2+}_{(aq)}+Cu_{(s)}$
Given: E°_{cell} = +2.7V, 1F = 96500 C mol^{-1}
(b) Name the type of cell which was used in Apollo space programme for providing electrical power.

285) Define electrochemical cell. What happens if external potential applied becomes greater than E^0_{cell} of electrochemical cell?

286) Two half reactions of an electrochemical cell are given below:
$mnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l);$
E^0 = +1.51 V
$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$
E^0 = +1.51 V
Construct the redox equation from the standard potential of the cell and predict, if the reaction is reactant favoured or product favoured.

287) Calculate the emf for the given cell at 25°C.
Cr|Cr^{3+}(0.1M)||Fe^{2+}(0.01M)|Fe
[Given $E^0_{Fe^{2+}/Fe} = -0.74V$
$E^0_{Fe^{2+}/Fe} = -0.44V$]

288) Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (Λ_m) is 39.05 S cm^2 mol^{-1}
Given $\lambda^0(H^+) = 349.68 cm^2 mol^{-1}$ and $\lambda^0(CH_3COO^-) = 40.98 cm^2 mol^{-1}$

289) 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?

290) The conductivity of a 0.20 M solution of KCl at 298 K is 0.0248 Scm^{-1}. Calculate its molar conductivity.

291) Illustrate with the help of a diagram how the molar conductivities of
(i) a strong electrolyte and
(ii) a weak electrolyte vary with dilution of solutions. Give a reason for these variations.

292) Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.

293) (i) Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution.
$cu^{2+}(aq) + 2e^- \rightarrow Cu(s) E^0 = +0.34V$
$H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g), E^0 = 0.00V$
On the basis of their standard reduction electrode potential (E^O) values, which reaction is feasible at the cathode and why?
(ii) State Kohlrausch's law of independent migration of ions.Write its one application.

294) Set-up Nernst equation for the standard dry cell. Using this equation show that the voltage of a dry cell decreases with use.

295) Silver is uniformly electrodeposited on a metallic vessel of surface area of 900 cm^2 by passing a current of 0.5 A for 2 h. Calculate the thickness of silver deposited. Given, the density of silver is 10.5 g cm^{-3} and atomic mass of Ag = 108 amu.

296) The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.

297) Give an example of a fuel cell and write the cathode and anode reactions for it.

298) Which of the following has larger molar conductance:
a. 0.08 M soln. having conductivity equal to 2×10^{-2} $ohm^{-1}cm^{-1}$
b. 0.10 M soln. having resistivity equal to 5.8 ohm cm

299) Zn rod weighing 25 g was kept in 100 mL of 1M copper sulphate solution. After certain time interval, the molarity of Cu^{2+} was found to be 0.8 M. What is the molarity of SO_4^{2-} in the resulting solution and what should be the mass of Zn rod after cleaning and drying ?

300) Following reactions can occur at cathode during the electrolysis of aqueous silver nitrate solution using Pt electrodes:
$Ag^+(aq) + e^- \rightarrow Ag(s)$; $E^o = 0.80$ V
$H^+(aq) + e^- \rightarrow H2(g)$; $E^o = 0.00$ V
On the basis of their standard electrode potential values, which reaction is feasible at cathode and why?

301) Why alternating current is used for measuring resistance of an electrolytic solution?

302) How much charge is required for the reduction of 1mole of Cu^{2+} to Cu?

303) When acidulated water (dil. H_2SO_4) is electrolysed, will the pH of the solution be affected? Justify your answer.

304) What is the amount of charge required to carry out the conversion of 1 mole of Al^{3+}ions to Al according to the following reaction,
$Al^{3+} + 3e^-$ Al

305) How much charge is required for the reduction of 1 mole of Al^{3+} to Al?

306) How much charge is required for the following reduction of 1mole of MnO_4^- to Mn^{2+}?

307) Calculate the time required to deposit 1.27g of copper at cathode when a current of 2 A was passed through the solution of $CuSO_4$ (Molar mass of Cu = 63.5 g mol^{-1}, 1F = 96500 C mol^{-1})

308) Why does a dry cell become dead after a long time even if it has not been used?

309) Why does an alkaline medium inhibit the rusting of iron?

310) Why rusting of iron pipe can be prevented by joining it with a piece of magnesium?

311) Write the cell representation for the galvanic cell used for measuring standard electrode potential of iron having, E^o Fe^{2+}/ F_e = -0.44 V.

312) In a galvanic cell, what is the polarity of anode?

313) Write the Nernst equation to calculate the cell potential of Mg(s)I Mg2+(aq) II Ag^{+}I Ag.

314) When does an electrochemical cell behaves like an electrolytic cell?

315) List the factors on which molar conductivity of ionic solution depends.

316) List the factors on which conductivity of electrolyte depends.

317) The specific conductivity of a saturated solution of silver chloride is 2.30 x 10^{-6} S cm-1 at 25°C. Calculate the solubility of silver chloride at 25°C. Λ^{∞} for Ag^{+} and Cl^{-} ions are 61.9 and 76.3 S cm^2 mol^{-1}respectively.

318) From the values of a Faraday (96500 C) and Avogadro number (6.023 x 10^{23}), calculate the coulomb charge on an electron.

319) What features of a cell enables practical use of battery?

320) Mention the uses of mercury cell.

321) What is the advantage of nickel-cadmium cell over lead-storage battery?

322) List the advantages of using H_2 - O_2 fuel cell over ordinary cell.

323) Write the Nernst equation for single electrode potential.

324) What is the efficiency of a fuel cell? What is the use of a fuel cell?

325) Suggest a metal that can be used for cathodic protection of iron against rusting.

326) Write the relation between cell potential and equilibrium constant.

327) Why does a cell stops working after sometime?

328) Write the Nernst equation and emf of the following cell at 298 K. Fe (s) IFe^{2+}(0.001M) IIH^{+}(1M)IH2(g) (1 bar) I Pt

329) A solution of $MgSO_4$ is electrolysed for 20 min with a current of 1.5A. What mass of magnesium is deposited at the cathode?

330) Why it is not possible to measure the single electrode potential?

331) A current of 3.7A is passed for 6 h between nickel electrodes in 0.5 L of a 20 M solution of $Ni(NO_3)_2$ What will be the molarity of solution at the end of electrolysis?

332) Find the equilibrium constant for the reaction,
$Cu^{2+}+In^{2+} \rightleftharpoons Cu^{+} + In^{3+}$
Given that, $E_{cu^{2+}\,/\,Cu^{+}}$ =0.15 V,
$E^{o}In^{2+}/\ In^{+}$= - 0.4 V, $E^{o}_{In^{3+}/\ In^{+}}$ = 0.42 V

333) A lead-storage cell can act both as galvanic and electrolytic cells. Explain.

334) State and explain three methods of prevention of rusting of iron.

335) Conductivity of two electrolyte solutions A and B each having a concentration of 0.1 M are 8.5 x 10^{-2} Scm^{-1} and 4.1 x 10^{-4} S cm^{1} respectively. Which of the two offers less resistance to the flow of current?

336) Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode? Write overall reaction.
Given, $E^{o}_{Na^{+}/Na}$ = -2.71 V, $E^{o}_{H_2O}/H_2$ = - 0.83V,
$E^{o}_{Cl_2/Cl^{-}}$ = + 1.36V, $E^{o}_{H^{+}\ /H2/\ H2O}$ = +1.23V

337) Give an example of a primary cell?

338) Name the entity used to define the resistance offered by a substance of 1m length with area of cross section equal to $1m^2$.

339) Which cell is used in hearing aids?

340) Which of the following metal has higher reducing power?
$\mathrm{Hg}^{2+}/\mathrm{Hg}\left(E^{\circ}_{\mathrm{red}}=0.79\ \mathrm{V}\right)\ \mathrm{and}\ \mathrm{Mg}^{2+}/\mathrm{Mg}\left(E^{\circ}_{\mathrm{red}}=-2.37\ \mathrm{V}\right)$

341) Name an electrochemical process in which a metal is oxidised to metal oxide and forms a coating on the metal surface.

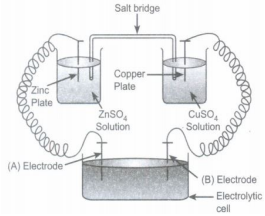
342) Give the unit of molar conductivity?

343) Which apparatus is used to connect two half-cells internally?

344) Which process is involved in coating an inferior metal with a superior metal by electrolysis?

345) Which cell (or battery) is used in automobiles and power inverters?

346) Consider the following diagram in which an electrochemical cell is coupled to an electrolytic cell. What will be the polarity of electrodes 'A' and 'B' in the electrolytic cell?



347) Write Nernst equation for the following chemical reaction:
$2Cr + 3Fe^{2+} \longrightarrow 2Cr^{3+} + 3Fe$

348) What is meant by cell constant? What is its use?

349) What do you mean by limiting molar conductivity?

350) How much charge in Faraday is required for the reduction of 1 mol of Ag^+ to Ag?

351) How much charge is required for the reduction of 1 mole of Zn^{2+} to Zn?

352) How much charge in Faraday is required for reduction of 1 mole of Al^{+3} +to Al?

353) How many Faradays are required to liberate 2 moles of hydrogen gas in electrolysis of acidified water?

354) What are the factors which depend on the products of electrolysis?

355) What are secondary cells?

356) Which electrolyte is used in fuel cell?

357) Why does alkaline medium inhibit rusting of iron?

358) Following reactions occur at cathode during electrolysis of aqueous sodium chloride solution:
$Na^+ + e^- \longrightarrow Na(s)$; $E^o = -2.71$ V
$H^+ + e^- \longrightarrow \frac{1}{2} H_2(g)$; $E^o = 0.00$ V
On the basis of their standard electrode potential (E^o) values, which reaction is feasible at the cathode and why?

359) Value of standard electrode potential for oxidation of Cl^- ions is more positive than water, even then in electrolysis of $NaCl^-$, why is Cl^- oxidised at anode instead of water?

360) In the electrolysis of aqueous sodium bromide, there are two possible anodic reactions:
$2H_2O(l) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$, $E^o = 1.23$V
$2Br^-(aq) \longrightarrow Br_2(g) + 2e^-$, EO = 1.08 V
Which reaction occurs at anode and why?

361) (a) Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution:
Cu2+(aq) + 2e- $\longrightarrow$ Cu(s); $E^o = +0.34$ V
H+ (aq) + e- $\longrightarrow \frac{1}{2} H_2(g)$; $E^o = 0.00$ V
On the basis of their standard reduction electrode potential (Eo) values, which reaction is feasible at the cathode and why?
(b) State Kohlrausch law of independent migration of ions. Write its one application.

362) Set up Nernst equation for the standard dry cell. Using this equation, show that the voltage of dry cell has to decrease with use.

363) Determine the values of equilibrium constant (K_c) and ΔG° for the following reaction:
$Ni(s) + 2Ag^+(aq) \longrightarrow Ni^{2+}(aq) + 2Ag(s)$,
$E^o = 1.05$ V (1 F =96500 C molt)

364) (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:
$Ag^+(aq) + e^- \longrightarrow Ag(s)$; $E^o = +0.80$ V
$H^+(aq) + e^- \longrightarrow \frac{1}{2} H_2(g)$; $E^o = 0.00$ V
On the basis of their standard reduction electrode potential (E^o) values, which reaction is feasible at the cathode and why?
(b) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

365) Calculate the time to deposit 1.27 g of copper at cathode when a current of 2 A was passed through the solution of $CuSO_4$. (Molar mass of Cu = 63.5 g mol^{-1}, 1 F = 96500 C mol^{-1})

366) What are the factors on which ionic conductance of the electrolytic solution depends?

367) The conductivity of 0.20 M KCI at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity.

368) The conductivity of 0.001 M acetic acid is 4 x 10^{-5} S cm^{-1}. Calculate the dissociation constant of an acid, if molar conductivity at infinite dilution for acetic acid is 390 S cm^2 mol^{-1}.

369) 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?

370) Write the overall reaction that occurs during use (discharging) of nickel-cadmium cell. Is it a primary or a secondary cell. Mention its one merit over the lead storage cell.

371) Give an example of a fuel cell and write the cathode and anode reactions for it.

372) It is not possible to measure the single electrode potential. Why?

373) Why is aluminium metal cannot be obtained by electrolysis of an aqueous solution of salt of aluminum?

374) What is the sign of ΔG , in electrolytic cell?

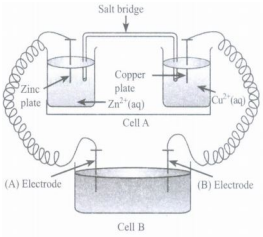
375) What are the products obtained at cathode and anode when molten $PbBr_2$ is electrolysed?

376) Which electrolyte is used for electroplating of silver?

377) What is the value of potential of SHE?

378) State Faraday's second law of electrolysis.

379) Consider the Figure and answer the following questions.



(i) Cell' A' has E_{Cell} = 2V and Cell 'B' has E_{Cell} = 1.1 V. Which of the two cells 'A' or 'B' will act as an electrolytic cell? Which electrode reactions will occur in this cell?
(ii) If cell 'A' has E_{Cell} = 0.5 V and Cell 'B' has E_{Cell} = 1.1 V then what wi II be the reactions at anode and cathode?

380) Express the relation among cell constant, resistance of the solution in the cell and conductivity ofthe solution. How is molar conductivity of solution related to its conductivity.

381) The conductivity of 0.40 M solution of KCI at 258 K is 4.96 x 10^{-2} S cm^{-1}. Calculate its molar conductivity.

382) Calculate the volume of oxygen liberated at anode at STP in the electrolysis of $CuSO_4$ solution when 1-ampere current is passed for 16 minutes.
$2H2O \longrightarrow 4H^+ + O2 + 4e^-$ (IF = 96500 C).

383) State
(a) Kohlrausch law of independent migration of ions.
(b) Faraday's first law of electrolysis.

384) Resistance of a conductivity cell filled with 0.2 mol L^{-1} KCl solution is 200 Ω. If the resistance of the same cell when filled with 0.05 mol L^{-1} KCl solution is 620 Ω, calculate the conductivity and molar conductivity of 0.05 mol L^{-1} KCl solution. The conductivity of 0.2 mol L^{-1} KCl solution is 0.0248 S cm^{-1}.

385) Define the following terms.
(a) Faraday's second law of electrolysis
(b) Corrosion

386) Using E° values of X and Y given below, predict which is better for coating the surface of iron to prevent corrosion and why?
Given: $E^{\circ}_{X^{2+}/X} = -2.36\ \text{V}$
$E^{\circ}_{Y^{2+}/Y} = -0.14\ \text{V}$
$E^{\circ}_{\text{Fe}^{2+}/\text{Fe}} = -0.44\ \text{V}$

387) X and Y are two electrolytes. On dilution, molar conductivity of 'X' increases 2.5 times, while that of Y increases 25 times. Which of the two is a weak electrolyte and why?

Case Study Questions 14 x 4 = 56

388) **Read the passage given below and answer the following questions:**
Molar conductivity of ions are given as product of charge on ions to their ionic mobilities and Faraday's constant.
$\lambda_{A^{n+}} = n\mu_{A^{n+}}F$ (here μ is the ionic mobility of A^{n+}).
For electrolytes say A_XB_y, molar conductivity is given by
$\lambda_{m(A_xB_y)} = x_n\mu_{A^{n+}}F + y_m\lambda_{A^m-F}$

Ions	Ionic mobility
K^+	7.616 x 10^{-4}
Ca^{2+}	12.33 x 10^{-4}
Br^-	8.09 x 10^{-4}
SO_4^{2-}	16.58 x 10^{-4}

The following questions are multiple choice questions. Choose the most appropriate answer
(i) At infinite dilution, the equivalent conductance of $CaSO_4$ is
(a) 256 x 10^{-4} **(b) 279** **(c) 23.7** **(d) 2.0 x 10^{8}**
(ii) If the degree of dissociation of $CaSO_4$ solution is 10% then equivalent conductance of $CaSO_4$ is
(a) 3.59 (b) 36.9 (c) 27.9 (d) 30.6
(iii) What is the unit of equivalent conductivity?
(a) ohm^{-1} cm^2 eq^{-1} (b) ohm cm^{2}eq^{-1}
(c) ohm^{-1} cm eq^{-1} (d) ohm cm^2 eq^{-1}
(iv) If the molar conductance value of Ca^{2+} and Cl^- at infinite dilution are 118.88 x 10^{-4} m^2 mho mol^{-1} and 77.33 x 10^{-4} m^2 mho mol^{-1} respectively then the molar conductance of $CaCl_2$ (in m^2 mho mol^{-1}) will be
(a) 120.18 x 10^{-4} **(b) 135 x 10^{-4}** **(c) 273.54 x 10^{-4}** **(d) 192.1 x 10^{-4}**

389) **Read the passage given below and answer the following questions:**

Standard electrode potentials are used for various processes:

(i) It is used to measure relative strengths of various oxidants and reductants.

(ii) It is used to calculate standard cell potential.

(iii) It is used to predict possible reactions.

A set of half-reactions (in acidic medium) along with their standard reduction potential, E^o (in volt) values are given below

$I_2 + 2e^- \rightarrow 2I^-; \quad E^\circ = 0.54\ V$

$Cl_2 + 2e^- \rightarrow 2Cl^-; \quad E^\circ = 1.36\ V$

$Mn^{3+} + e^- \rightarrow Mn^{2+}; \quad E^\circ = 1.50\ V$

$Fe^{3+} + e^- \longrightarrow Fe^{2+}; \quad E^\circ = 0.77\ V$

$O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O; E^\circ = 1.23\ V$

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) Which of the following statements is correct?

(a) Cl^- is oxidised by O_2 **(b) Fe^{2+} is oxidised by iodine**

(c) I^- is oxidised by chlorine. **(d) Mn^{2+} is oxidised by chlorine**

(ii) Mn^{3+} is not stable in acidic medium, while $Fe^{3+}$is stable because

(a) O_2 oxidises Mn^{2+} to Mn^{3+}

(b) O_2 oxidises both Mn^{2+} to Mn^{3+} and Fe^{2+} to Fe^{3+}

(c) Fe^{3-}oxidises H_2O to O_2

(d) Mn^{3+} oxidises H_2O to O_2

(iii) The strongest reducing agent in the aqueous solution is

(a) I^- (b) Cl^- (c) $Mn2^+$ (d) Fe^{2+}

(iv) The emf for the following reaction is

$I_2 + KCl \rightleftharpoons 2KI + Cl_2$

(a) -0.82 V (b) +0.82 V (c) -0.73 V (d) +0.73 V

390) **Read the passage given below and answer the following questions :**

All chemical reactions involve interaction of atoms and molecules. A large number of atoms/molecules are present in a few gram of any chemical compound varying with their atomic/molecular masses. To handle such large number conveniently, the mole concept was introduced. All electrochemical cell reactions are also based on mole concept. For example, a 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrode. The amount of products formed can be calculated by using mole concept.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) The total number of moles of chlorine gas evolved is

(a) 0.5 (b) 1.0 (c) 1.5 (d) 1.9

(ii) If cathode is a Hg electrode, then the maximum weight of amalgam formed from this solution is

(a) 300 g (b) 446 g (c) 396 g (d) 296 g

(iii) In the electrolysis, the number of moles of electrons involved are

(a) 2 (b) 1 (c) 3 (d) 4

(iv) In electrolysis of aqueous NaCl solution when Pt electrode is taken, then which gas is liberated at cathode?

(a) H_2 gas (b) C_2 gas (c) O_2 gas (d) None of these

391) **Read the passage given below and answer the following questions:**

The concentration of potassium ions inside a biological cell is at least twenty times higher than the outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simple model for such a concentration cell involving a metal M is $M_{(s)}$ | M^+(aq.; 0.05 molar) || M^+(aq; 1 molar) |$M_{(s)}$.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) For the above cell,

(a) $E_{\text{cell}} < 0; \Delta G > 0$ **(b)** $E_{\text{cell}} > 0; \Delta G < 0$ **(c)** $E_{\text{cell}} < 0; \Delta G^\circ > 0$ **(d)** $E_{\text{cell}} > 0; \Delta G^\circ < 0$

(ii) The value of equilibrium constant for a feasible cell reaction is

(a) < 1 (b) = 1 (c) > 1 (d) zero

(iii) What is the emf ofthe cell when the cell reaction attains equilibrium?

(a) 1 (b) 0 (c) > 1 (d) < 1

(iv) The potential of an electrode change with change in

(a) concentration of ions in solution **(b) position of electrodes**

(c) voltage of the cell **(d) all of these**

392) **Read the passage given below and answer the following questions:**

The electrochemical cell shown below is concentration cell. M|M^{2+} (saturated solution of a sparingly soluble salt, MX_2) || M^{2+} (0.001 mol dm^{-3}) | M The emf of the cell depends on the difference in concentrations of M^{2+} ions at the two electrodes. The emf of the cell at 298 K is 0.059 V.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) The solubility product (K_{sp}, mol^3 dm^{-9}) of MX_2 at 298 K based on the information available for the given concentration cell is (take 2.303 x R x 298/P = 0.059)

(a) 2 x 10^{-15} (b) 4 x 10^{-15} (c) 3 x 10^{-12} (d) 1 x 10^{12}

(ii) The value of ΔG (in kJ mol^{-1}) for the given cell is (take 1F = 96500 C mol^{-1})

(a) 3.7 (b) -3.7 (c) 10.5 (d) -11.4

(iii) The equilibrium constant for the following reaction is

$\mathrm{Fe}^{2+} + \mathrm{Ce}^{4+} \rightleftharpoons \mathrm{Ce}^{3+} + \mathrm{Fe}^{3+}$

(Given, $E^0\mathrm{Ce}^{4+}/\mathrm{Ce}^{3+} = 1.44$ and E° $E_{\mathrm{Fe}^{3+}/\mathrm{Fe}^{2+}} = 0.68\ \mathrm{V}$)

(a) 7.6 x 10^{12} (b) 6.5 x 10^{10} (c) 5.2 x 10^{9} (d) 3.4 x 10^{12}

(iv) To calculate the emf of the cell, which of the following options is correct?

(a) emf = $E_{cathode}$ - E_{anode} (b) emf = E_{anode} - $E_{cathode}$

(c) emf = E_{anode} + $E_{cathode}$ (d) None of these

393) **Read the passage given below and answer the following questions :**

The potential of each electrode is known as electrode potential. Standard electrode potential is the potential when concentration of each species taking part in electrode reaction is unity and the reaction is taking place at 298 K. By convention, the standard ectrode potential of hydrogen (SHE) is 0.0 V. The electrode potential value for eacfı electrode process is a measure of relative tendency of the active species in the process to remain in the oxidisedlreduced form. The negative electrode potential means that the redox couple is stronger reducing agent than H^+/H_2 couple. A positive electrode potential means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. Metals which have higher positive value of standard reduction potential form the oxides of greater thermal stability.

In these questions (i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(i) **Assertion :** An electrochemical cell can be set-up only if the redox reaction is spontaneous.

Reason : A reaction is spontaneous if the free energy change is negative.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(ii) **Assertion :** The standard electrode potential of hydrogen is 0.0 V.

Reason : It is by convention.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(iii) Assertion : The negative value of standard reduction potential means that reduction takes place on this electrode with reference to hydrogen electrode.

Reason : The standard electrode potential of a half cell has a fixed value.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(iv) **Assertion :** The absolute value of electrode potential cannot be determined experimentally.

Reason : The electrode potential values are generally determined with respect to SHE.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

394) **Read the passage given below and answer the following questions:**

Two types of conductors are generally used, metallic and electrolytic. Free electrons are the current carrier in metallic and in electrolytic conductors, free ions. Specific conductance or conductivity of an electrolytic solution is given by

$\kappa = C \times \frac{l}{A}$

where, C = l/R and l/A = G* (cell constant)

Molar conductance (Λ_m) and equivalent conductance (Λ_e) of an electrolyte solution are calculated as

$\Lambda_m = \frac{\kappa \times 1000}{M}$ or $\Lambda_e = \frac{\kappa \times 1000}{N}$

where, M = molarity of solution and Nis normality of solution. Molar conductance of strong electrolyte depends on the concentration.

$\Lambda_m = \Lambda_m^0 - b\sqrt{C}$

Λ_m° = molar conductance at infinite dilution, b = constant, C = conc of solution

In these questions (i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(i) **Assertion :** The molar conductivity of strong electrolyte decreases with increase in concentration.

Reason : At high concentration, migration of ions is slow

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement

(d) Assertion is wrong statement but reason is correct statement.

(ii) **Assertion :** Equivalent conductance of all electrolytes increases with increasing concentration.

Reason : More number of ions are available per gram equivalent at higher concentration.

(**a) Assertion and reason both are correct statements and reason is correct explanation for assertion**

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement

(d) Assertion is wrong statement but reason is correct statement.

(iii) **Assertion :** Specific conductance decreases with dilution whereas equivalent conductance increases.

Reason : On dilution, number of ions per milli litre decreases but total number of ions increases considerably

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement

(d) Assertion is wrong statement but reason is correct statement.

(iv) **Assertion :** The ratio of specific conductivity to the observed conductance does not depend upon the concentration of the solution taken in the conductivity cell.

Reason : Specific conductivity decreases with dilution whereas observed conductance increases with dilution.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement

(d) Assertion is wrong statement but reason is correct statement.

395) **Read the passage given below and answer the following questions:**

Electrical work done in unit time is equal to electrical potential multiplied by total charge passed. In order to obtain maximum work from a cell, the charge has to be passed reversibly. The reversible work done by a cell is equal to decrease in its Gibb's energy. Hence, Gibb's energy of reaction is given by

$\Delta G = -nFE_{\text{cell}}$

Hence, E is the emf of the cell and nF is the amount of energy.

In these questions (i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices

(i) **Assertion :** $\Delta G^{\circ} = -nFE^{\circ}$

Reason : E^{o} should be positive for a spontaneous reaction

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(ii) **Assertion :** An electrochemical cell can be set up only if the redox reaction is spontaneous.

Reason : A reaction is spontaneous if free energy change is negative.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(iii) **Assertion :** Current stops flowing when $E_{cell} = 0$.

Reason : Equilibrium of the cell reaction is attained.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(iv) **Assertion:** E_{cell} should have a positive value for the cell to function.

Reason : $E_{cell} = E_{cathode} - E_{anode}$

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

396) **Read the passage given below and answer the following questions:**

Nernst equation relates the reduction potential of an electrochemical reaction to the standard potential and activities of the chemical species undergoing oxidation and reduction. Let us consider the reaction,

$M^{n+}_{(aq)} \longrightarrow nM_{(s)}$

For this reaction, the electrode potential measured with respect to standard hydrogen electrode can be given as

$E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{RT}{nF}\ln\frac{[M]}{[M^{n+}]}$

In these questions (i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

(c) Assertion is correct statement but reason is wrong statement

(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** For concentration cell, $\underset{C_1}{Zn_{(s)}}\left|Zn^{2+}{}_{(aq)}\right\|\underset{C_2}{Zn^{2+}{}_{(aq)}}\left|Zn\right.$

For spontaneous cell reaction, $C_1 < C_2$.

Reason : For concentration cell $E_{\text{cell}} = \frac{RT}{nF}\log\frac{C_2}{C_1}$

For spontaneous reaction, $E_{\text{cell}} = +\text{ve} \Rightarrow C_2 > C_1$

(ii) **Assertion :** For the cell reaction, $Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ voltmeter gives zero reading at equilibrium.

Reason : At the equilibrium, there is no change in concentration of Cu^{2+} and Zn^{2+} ions.

(iii) **Assertion :** The Nernst equation gives the concentration dependence of emf of the cell.

Reason : In a cell, current flows from cathode to anode

(iv) **Assertion :** Increase in the concentration of copper half cell in a cell, increases the emf of the cell

Reason : $E_{\text{cell}} = E^{\circ}_{\text{cell}} + \frac{0.059}{2}\log\frac{[Cu^{2+}]}{[Zn^{2+}]}$

397) Metallic conductance involves movement of electrons where as electrolytic conductance involves movement of ions. Specific conductance increases with increase in concentration where as A_m (molar conductivity) decreases with increase in concentration. Electrochemical cell converts chemical energy of redox reaction into electricity. Mercury cell, Dry cells are primary cells where as Ni-Cd cell, lead storage battery are secondary cells. Electroehemical series is arrangement of elements in increasing order of their reduction potential. Electrolytic cell converts electrical energy into chemical energy which is used in electrolysis. Amount of products formed are decided with the help of Faraday's laws of Electrolysis. Kohlrausch law helps to determine limiting molar conductivity of weak electrolyte, their degree of ionisation (α) and their dissociation constants. Corrosion is electrochemical phenomenon. Metal undergoing corrosion acts as anode, loses electrons to form ions which combine with substances present in atmosphere to form surface compounds. More reactive metals are coated over less reactive metals to prevent corrosions. H_2 -O_2 fuel cell was used in apollo space programme.

(a) Out of 0.5 M, 0.01 M, 0.1 M and 1.0 M which solution of KCl will have highest value of specific conductance? Why?

(b) Write the product of electrolysis of aq. NaCl on cathode. Why?

(c) When does electrochemical cell behaves like electrolytic cell?

(d) For an electrochemical cell Mg(s) + $2Ag^+$(aq) $\rightarrow$ 2Ag(s) + Mg^{2+}. Give the cell representation and write Nernst equation.

(e) Which will have higher conductance, silver wire at 30° or at 60°C?

(f) Calculate maximum work obtained from the cell Ni(s) + $2Ag^+$(aq) $\rightarrow$ Ni^{2+}(aq) + 2Ag(s) E^o_{cell} = 1.05V.

(g) Which cell is used in hearing aids and watches?

398) Electrochemistry plays a very important part in our daily life. Primary cells like dry cell is used in torches, wall clock, mercury cell is used in hearing aids, watches. Secondary cells Ni-Cd cell is used in cordless phones, lithium battery is used in mobiles, lead storage battery is used in vehicle and inverter. Fuel cells like H_2 -O_2 cell was used in apollo space programme. A 38% solution of sulphuric and is used in lead storage battery. Its density is 1.30 g mL^{-1}. The battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.14 g mL^{-1} (20% solution by mass) (Molar mass of H_2SO_4 is 98 g mol^{-1}).

(a) Write the chemical reaction taking place at anode when lead storage battery is in use.

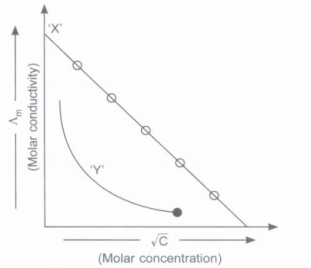
(b) How much electricity in Faraday is required to carry out the reduction of one mole of PbO_2 ?

(c) What is molarity of sulphuric acid before discharge?

(d) What is mass of sulphuric acid in solution after discharge?

(e) Write the products of electrolysis when dilute sulphuric acid is electrolysed using platinum electrodes.

399) Observe the graph shown in figure between Am (molar conductivity) Vs $\sqrt{C}$ (Molar concentration) and answer the questions based on graph.



(a) The curve 'V' is for KCl or CH_3COOH?

(b) What is intercept on Λ_m axis for 'X' equal to?

(c) Give mathematical equation representing straight line.

(d) What is slope equal to?

(e) What happens to molar conductivity on dilution in case of weak electrolyte and why?

400) Observe the following table in which conductivity and molar conductivity of NaCl at 298 K at different concentration for different electrolytes is given. Answer the questions based in the table that follows:

Conductivities and molar conductivities of NaCl at 298 K at different concentrations.

S. No	Conc. (M)	K_m S cm^{-1}	$\Lambda_m Scm^2\ mol^{-1}$
1	0.001	1.237 x 10^{-4}	123.7 S cm^2 mol^{-1}
2	0.010	11.85 x 10^{-4}	118.5 S cm^2 mol^{-1}
3	0.020	23.15 x 10^{-4}	115.8 S cm^2 mol^{-1}
4	0.050	55.53 x 10^{-4}	111.1 S cm^2 mol^{-1}
5	0.100	106.74 x 10^{-4}	106.7 S cm^2 mol^{-1}

Λ_m^o
NaCl 126.4 S cm^2 mol^{-1}
HCl 426.1 S cm^2 mol^{-1}
CH_3COONa 91 S cm^2 mol^{-1}
NH_4Cl 129.8 S cm^2 $mo1^{-1}$

(a) What happens to conductivity on dilution and why?

(b) Why is Λ_m^o (limiting molar conductivity) for HCl more than NaCl?

(c) Calculate degree of dissociation (α) of NaCl of 0.001 M concentration using the table.

(d) Calculate Λ_m^o of CH_3COOH using the table.

(e) Calculate Ka of 0.01 M CH_3COOH solution if Λ_m^o for CH_3COOH is 390.07S cm^2 mol^{-1}, Λ_m = 39.07S cm^{-1}.

401) Rahul set-up an experiment to find resistance of aqueous KCl solution for different concentrations at 298 K using a conductivity cell connected to a Wheatstone bridge. He fed the Wheatstone bridge with a.c. power in the audio frequency range 550 to 5000 cycles per second.
Once the resistance was calculated from null point he also calculated the conductivity and molar conductivity ∧m and recorded his readings in tabular form.

S.No.	Conc. (M)	κS cm^{-1}	Λ_mScm^{2}mol^{-1}
1.	1.00	111.3×10^{-3}	111.3
2.	0.10	12.9×10^{-3}	129.0
3.	0.01	141×10^{-3}	141.0

Answer the following questions:
(i) Why does conductivity decrease with dilution?
(ii) If of KCl is 150.0 Scm² mol^{-1}. Calculate the degree of dissociation of 0.01 M KCL.
(iii) If Rahul had used HCl instead of KCl, then would you expect the values to be more or less than those per KCl for a given concentration. Justify.
Or
Amit, a classmate of Rahul repeated the same experiment with CH_3COOH solution instead of KCl solution.
Give one point that would be similar and one that would be different in his observations as compared to Rahul.

5 Marks 11 x 5 = 55

402) Explain how rusting of iron is envisaged as setting up of an electrochemical cell.

403) Predict the products of electrolysis in each of the following:
(i) An aqueous solution of $AgNO_3$ with silver electrodes.
(ii) An aqueous solution of $AgNO_3$ with platinum electrodes.
(iii) A dilute solution of H_2SO_4 with platinum electrodes.
(iv) An aqueous solution of $CuCl_2$ with platinum electrodes.

404) Calculate the standard cell potentials of galvanic cell in which the following reactions take place:
(i) $2Cr(s) + 3Cd^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cd(s)$
(ii) $Fe^{2+}(aq) + Ag^{+}(aq) \rightarrow Fe^{3+}(aq) + Ag(s)$
Calculate the $\triangle_r G^o$ and equilibrium constant for the reactions.

405) How much electricity in terms of Faraday is required to produce
(i) 20.0 g of Ca from molten $CaCl_2$?
(ii) 50.0 g of Al from molten Al_2O_3?

406) Three electrolytic cells A, B, C containing solutions of $ZnSO_4$, $AgNO_3$, and $CuSO_4$, respectively are connected in series. A steady current of 1.5 amperes was passed through them until 1.45 g of silver deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited?

407) Using the standard electrode potentials, predict if the reaction between the following is feasible:
(i) Fe^{3+}(aq) and I^-(aq)
(ii) Ag^+(aq) and Cu(s)
(iii) Fe^{3+}(aq) and Br^-(aq)
(iv) Ag(s) and Fe^{3+}(aq)
(v) Br_2(aq) and Fe^{2+}(aq)

408) Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging.

409) Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

410) The conductivity of sodium chloride at 298 K has been determined at different concentrations and the results are given below.

Concentration/M	0.001	0.010	0.020	0.050	0.100
10^{-2} x κ / Sm^{-1}	1.237	11.85	23.15	55.53	106.74