CHEMISTRY (043)

TOPIC: ELECTROCHEMISTRY

CLASS: XIIA

2 MARKS

1. Determine the values of equilibrium constant (K_c) and ΔG° for the following reaction :
   $Ni(s) + 2Ag^+ (aq) \rightarrow Ni^{2+} (aq) + 2Ag(s)$,
   $E^\circ = 1.05$ V, ($1F = 96500$ C mol^{-1})
2. 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
3. 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.
4. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?
5. Calculate the time to deposit 1.27 g of copper at cathode when a current of 2A was passed through the solution of $CuSO_4$.
   (Molar mass of Cu = 63.5 g mol^{-1},1 F = 96500 C mol^{-1})

3 MARKS

6. a. Calculate the degree of dissociation (a) of acetic acid if its molar conductivity (Λ_m) is 39.05 S cm^2 mol^{-1}. Given: $\lambda^\circ(H^+) = 349.6$ S cm^2 mol^{-1} and $\lambda^\circ(CH3COO^-) = 40.9$ S cm^2 mol^{-1}
7. b. 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.
8. Chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.
9. A copper-silver cell is set up. The copper ion concentration in it is 0.10 M. The concentration of silver ion is not known. The cell potential is measured 0,422 V. Determine the concentration of silver ion in the cell.
   Given: $E^\circ_{Ag^+}/Ag = +0.80$ V, $E^\circ_{Cu^{2+}}/Cu = +0.34$ V.
10. 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

5 MARKS

11. The cell in which the following reaction Occurs:
    $2Fe^{3+} (aq) + 2I^- (aq) \rightarrow 2Fe^{2+} (aq) + I_2 (s)$ has $E^0_{cell} = 0.236$V at 298K. Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.
    (Antilog of $6.5 = 3.162 \times 10^6$; of $8.0 = 10 \times 10^8$; of $8.5 = 3.162 \times 10^8$)
12. (i) Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes.
    [Given: Molar mass of Ag = 108 g mol^{-1} 1F = 96,500 C mol^{-1})
    (ii) Define fuel cell.
    (iii) Why electrochemical cells stop working after some time? The reduction potential of an electrode depends upon the concentration of solution with which it is in contact

CASE STUDY

13. **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 each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidized reduced 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.

(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:** 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.

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

Reason: It is by convention.

(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.

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

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

v. **Assertion:** Am for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason: For weak electrolytes degree of dissociation increases with dilution of solution.

The charge required for the reduction of 1 mol of MnO_2^- to MnO_2 is

(a) 1 F

(b) 3 F

(c) 5 F

(d) 6 F

If limiting molar conductivity of Ca^{2+} and Cl^- are 119.0 and 76.3 S cm^2 mol^{-1}, then the value of limiting molar conductivity of CaCl2 will be

(a) 195.3 S cm^2 mol^{-1}

(b) 271.6 S cm^2 mol^{-1}

(c) 43.3 S cm^2 mol^{-1}

(d) 314.3 S cm^2 mol^{-1}.

$NH_4NC>3$ is used in salt bridge because

(a) it forms a jelly like material with agar-agar.

(b) it is a weak electrolyte.

(c) it is a good conductor of electricity.

(d) the transport number of NH_4^+ and NO_3^- ions are almost equal.

The standard emf of a galvanic cell involving cell reaction with n = 2 is formed to be 0.295 V at 25° C. The equilibrium constant of the reaction would be

(a) 1.0×10^{10}

(b) 2.0×10^{11}

(c) 4.0×10^{12}

(d) 1.0×10^{2}

[Given F = 96500 (mol^{-1}); R = 8.314 JK^{-1} mol^{-1}

If $E°_{Fe^{2+}/Fe}$ = -0.441 V and $E°_{Fe^{2+}/Fe^{2+}}$ = 0.771 V, the standard EMF of the reaction,

$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$ will be

(a) 1.212 V

(b) 0.111 V

(C) 0.330 V

(d) 1.653 V