63/1 (SEM–4) CHM HC 4106 (CC 10)

2022

CHEMISTRY

Paper : CC–10

(Physical Chemistry—IV)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×5=5

(a) Molten sodium chloride conducts electricity due to the presence of

(i) free electrons

(ii) free ions

(iii) free molecules

(iv) atoms of sodium and chlorine

(b) The main function of the salt bridge is

(i) to allow ions to go from one cell to another

(ii) to provide link between the half cells

(iii) to keep the e.m.f. of the cell positive

(iv) to maintain electric neutrality of the solution in the two half cells

(c) Molar conductance of a strong electrolyte

(i) decreases upon dilution

(ii) increases upon dilution

(iii) increases linearly upon dilution

(iv) does not change upon dilution

(d) Given,

(1) $Cu^{2+} + 2e \rightarrow Cu$, $E^\circ = 0{\cdot}337$ V

(2) $Cu^{2+} + e \rightarrow Cu^{+}$, $E^\circ = 0{\cdot}153$ V

Electrode potential, E° for the reaction

$$Cu^{+} + e \rightarrow Cu$$

will be

(i) 0·90 V

(ii) 0·30 V

(iii) 0·38 V

(iv) 0·52 V

(e) An element containing an odd number of electrons is

(i) paramagnetic

(ii) diamagnetic

(iii) ferromagnetic

(iv) antiferromagnetic

2. Answer the following questions : 2×5=10

(a) How many coulombs are required for reduction of 1 mole of Al^{3+} to Al?

(b) What is cell constant? How is it determined?

(c) What is a galvanic cell? Give the symbolic representation of the Daniell cell.

(d) Explain why hydrogen ion has exceptionally high ionic mobility.

(e) What do you understand by diamagnetism and paramagnetism?

3. Answer the following questions (any *five*) : 5×5=25

(a) Discuss qualitatively the Debye-Hückel-Onsager theory as applied to the variation of molar conductivity with dilution of a solution of a strong electrolyte. 5

(b) What is standard reduction potential of an electrode? Explain for the cell reaction

$$Fe^{2+}(a=1) + \frac{1}{2}I_2 \rightarrow Fe^{3+}(a=1) + I^{-}(a=1)$$

(i) Write down the cell.

(ii) Calculate its standard e.m.f.

(iii) Indicate whether the cell reaction as represented by the above equation is spontaneous or not.

Given,

$E^{\circ}_{Fe^{2+}|Fe^{3+}|Pt} = 0{\cdot}771$ V and

$E^{\circ}_{I^-|I_2|Pt} = 0{\cdot}535$ V

2+3

(c) Describe the construction and use of calomel electrode. Also write the electrode reaction and its Nernst equation. 2+1+1+1

(d) Write briefly about the following : 2½×2=5

(i) Metal-metal ion electrode

(ii) Potentiometric titrations

(e) Define specific and equivalent conductance. How are they interrelated? What is the effect of dilution on the specific and equivalent conductance of a solution? 2+1+2

(f) Explain the conductometric acid-base titration curves of—

(i) HCl vs. NaOH;

(ii) CH_3COOH vs. NaOH. 2½+2½

(g) (i) Write the expression for activity of KCl in terms of molality (m) and mean activity coefficient ($\gamma^{\pm}$). 1

(ii) What do you mean by ionic strength of a solution? Calculate the ionic strength of—

(1) 0·1 m KCl;

(2) 0·02 m $CaCl_2$ and 0·1 m KCl.

1+1+2

4. Answer the following questions (any *two*) : 10×2=20

(a) (i) How can you ascertain entropy of cell reaction from e.m.f. measurements? 3

(ii) Describe the use of quinhydrone electrode in pH determination of an unknown solution. 4

(iii) What is Nernst equation? Describe its utility. 1+2

(b) What is meant by transport number of an ion? Describe the moving boundary method to determine experimentally the transport number of an ion.

"Transport number of Cl^- ion in aqueous solution of HCl is 0·16 and it is 0·62 in aqueous solution of NaCl." Explain the difference. 2+6+2

(c) Write short notes on the following : 5×2=10

(i) Dipole moment and molecular structure

(ii) Magnetic susceptibility and its determination

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