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4 SEM TDC CHMH (CBCS) C 10

2023

(May/June)

CHEMISTRY

(Core)

Paper : C–10

(Physical Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option (any *five*) : 1×5=5

(a) The value of conductivity depends on

(i) number of ions

(ii) number of molecules of the electrolyte

(iii) mobility of the ions

(iv) Both *(i)* and *(iii)*

(b) The equation $\lambda_c = \lambda_0 - (A + B\lambda_0)\sqrt{c}$ is applicable to

(i) CH_3COOH

(ii) HCN

(iii) NH_4OH

(iv) KNO_3

(c) The potential of standard hydrogen electrode is

(i) 0 V

(ii) +1 V

(iii) –1 V

(iv) –0·184 V

(d) If copper rod is dipped into a ferrous sulphate solution, then

(i) copper will precipitate out

(ii) iron will precipitate out

(iii) both Cu and Fe will precipitate out

(iv) no reaction takes place

(e) The values of magnetic moment for the complexes $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ are, respectively

(i) 5·91 BM and 5·91 BM

(ii) 1·73 BM and 1·73 BM

(iii) 5·91 BM and 1·73 BM

(iv) 1·73 BM and 5·91 BM

(f) In the Gouy's balance experiment, when a paramagnetic substance is suspended in a magnetic field, then

(i) weight of the substance will decrease and the sample cylinder will go up

(ii) weight of the substance will increase and the sample cylinder will go down

(iii) weight of the substance remains same

(iv) weight of the substance may increase or decrease depending on the strength of magnetic field

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

(a) Define ionic mobility and potential gradient.

(b) Why do lithium ions move slower than potassium ions in water?

(c) Write the advantages and disadvantages of standard hydrogen electrode (SHE).

(d) What is meant by reference electrode? Give examples.

(e) The dipole moment of chlorobenzene is 1·55 D. The bond distance of Cl—C_6H_5 is 2·8 Å. Calculate the percentage ionic character of the bond.

3. Answer the following question {either *(a)* or *(b)*} :

(a) Define transport number of an ion. State the Hittorf's rule. On the basis of this rule, how is the transport number of an ion related to the fall of concentrations? 1+1+1=3

Or

(b) What are molar conductance and specific conductance? Write the relationship between specific conductance and molar conductance. 2+1=3

4. Answer the following questions (any *three*) : 4×3=12

(a) What do you mean by abnormal transport number of an ion? Explain under what condition an aqueous solution of CdI_2 shows the negative transport number of Cd^{2+} ion. 2+2=4

(b) Explain clearly what are meant by asymmetric and electrophoretic effect. 2+2=4

(c) The equivalent conductance at infinite dilution of NH_4Cl is 150 $Scm^2g.eq^{-1}$. The ionic conductances at infinite dilution of OH^- and Cl^- are 198 and 76 $Scm^2g.eq^{-1}$, respectively. Calculate the Λ^{∞}_{eq} for NH_4OH. If the equivalent conductances of a 0.01 *N* solution of NH_4OH be 9.6 $Scm^2g.eq^{-1}$, what will be its degree of dissociation? 2+2=4

(d) Explain the difference in the nature of the conductometric titration curves when *(i)* NH_4OH is titrated with HCl taken in the burette and *(ii)* HCl is titrated with NH_4OH taken in the burette. 2+2=4

(e) Derive the relation between ionic conductance with ionic mobility. 4

5. Answer the following question {either *(a)* or *(b)*} :

(a) How can you detect whether a given cell is reversible or not? 3

Or

(b) Discuss with diagram the variation of the e.m.f. during the potentiometric titration of a strong acid with a strong base. How can the exact equivalence point in a potentiometric titration be detected? 2+1=3

6. Answer the following questions (any *three*) : 4×3=12

(a) Describe how the pH of a solution can be determined by using a hydrogen electrode.

(b) What is liquid junction potential? How can it be eliminated?

(c) Derive an equation showing the dependence of e.m.f. of a cell on the concentration of the electrolyte.

(d) Calculate the electrode (reduction) potentials of the following single electrodes at 30°C :

(i) Sn/Sn^{2+} (0.01 *M*) Given,

$E^{\circ}_{Sn^{2+}/Sn} = -0.14$ V and $[Sn^{2+}] = 0.01\ M$

(ii) $Ag/AgI(s), I^{-}(0.0001\ M)$ Given,

$E^{\circ}_{AgI/I^{-}} = -0.15$ V and $[I^{-}] = 0.0001\ M$

(e) Write the cell reactions of the following cells :

(i) $Zn(s) | Zn^{2+}(aq) | | I^{-}(aq), CuI | Cu(s)$

(ii) $Al(s) | Al^{3+}(aq) | | Ag^{+}(aq) | Ag(s)$

7. Answer the following questions (any *two*) : 4×2=8

(a) What are magnetic permeability and magnetic susceptibility? Deduce the relationship between them. 2+2=4

(b) Explain the Gouy method for the determination of magnetic susceptibility. 4

(c) Define polarizability of a molecule. Explain different types of polarizations that may take place when a molecule is placed in an electric field. 1+3=4

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