2022

B.A./B.Sc.

Fourth Semester

CORE – 10

CHEMISTRY

Course Code: CHC 4.31

(Physical Chemistry – IV)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Define the terms equivalent and molar conductance. 3
   (b) State Kohlrausch's law. The molar conductance of sodium acetate, HCl and NaCl at infinite dilution are 91.0×10^{-4}, 426.16×10^{-4} and 126.45×10^{-4} Sm^2mol^{-1} respectively at 25°C. Calculate the molar conductance at infinite dilution for acetic acid. 1+4=5
   (c) Discuss in detail the Debye-Hückel theory of strong electrolytes. 6

2. (a) Define transport number. Calculate the transport number of Li^+ and Br^- ions when a current flows through an infinitely dilute aqueous solution of LiBr at 25°C, given the ionic mobilities of Li^+ and Br^- ions at infinite dilution are 4.01×10^{-8} and 8.09×10^{-8} $m^2V^{-1}S^{-1}$ respectively. 1+2=3
   (b) Explain the Ostwald's law. Write its uses and limitation. 5
   (c) How will you determine transport number by moving boundary method? 6

UNIT–II

3. (a) Derive the expression for Nernst equation in terms of effect of electrolyte concentration on electrode potential. 4

(b) Calculate the equilibrium constant of cell reaction

$2Ag^{+} + Zn \longleftrightarrow 2Ag + Zn^{2+}$ occurring in the zinc-silver cell at 25°C when $[Zn^{2+}] = 0.01M$ and $[Ag^{+}] = 10M$. The EMF of the cell is found to be 1.62 volts. 4

(c) Explain the following terms with relevant examples: 2×3=6

(i) Reversible cells

(ii) Irreversible cells

(iii) Reference cell

4. (a) State the two Faradays law of electrolysis. Suggest the application of these laws. 4

(b) Differentiate the terms electrolytic and Galvanic cells with suitable examples. 4

(c) Write short notes on the following: 2×3=6

(i) Half-cell potential

(ii) Reduction potential

(iii) EMF

UNIT–III

5. (a) Give the postulates of quantum mechanics. 4

(b) Write the derivation of radial part of Schrodinger equation. 5

(c) Give the properties of wave functions. What is an orthogonal wave function? 3

(d) What are operators? Explain. 2

6. (a) Discuss the probability distribution function quantum mechanically. 6

(b) Derive an expression for free particle using Schrodinger equation. 3

(c) Explain the average and most probable distances of the electron from the nucleus. 4

(d) What is meant by quantization of energy? 1

UNIT–IV

7. (a) Mention and explain all types of molecular spectra state and express Born-Oppenheimer approximation. 3+2=5

(b) Give a vibrational–rotational energy level of a diatomic molecule taking it as a simple harmonic oscillator. 5

(c) Define Raman spectra. Write a short note on the three lines in Raman spectra. 4

8. (a) Show how to determine the bond length of a linear triatomic molecule using rotational spectra. 6

(b) Give the experimental set up of Raman spectroscopy and state the rules of mutual exclusion. 4+1=5

(c) With the help of a diagram explain absorption and emission spectroscopy. 3

UNIT–V

9. (a) Explain polarization of a molecule in a magnetic field. 4

(b) Derive the expression for Clausius-Mossotti equation. 5

(c) Molar polarization of diethyl ether on dissolving in it cyclohexane at 20°C was found to be 58.50 cm^3mol^{-1}. The molar refraction was found to be 22.40 cm^3mol^{-1}. Applying 5% correction to molar refractivity (Rm), calculate the dipole moment of diethyl ether. 5

10. (a) Describe the temperature method for measurement of dipole moment of a molecule. 5

(b) Discuss the important application of dipole moment in chemistry. 5

(c) How will you obtain Debye equation using induced polarization and orientation polarizability. 4

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