UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 4th Semester Examination, 2023

CC10-CHEMISTRY

PHYSICAL CHEMISTRY

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.

1. Answer any *five* questions from the following: 1×5 = 5

   (a) What will be the potential of standard hydrogen electrode at 323 K?

   (b) The resistance and specific resistance of an electrolyte in a conductivity cell are 100 ohms and 1000 ohms cm. Find its cell constant.

   (c) Molar conductance of $MgCl_2$ is 320 $ohm^{-1}cm^2mol^{-1}$. Find its equivalent conductance.

   (d) Write down the half cell reactions for Cl^-, AgCl/Ag(s) electrode.

   (e) What is liquid junction potential? How it could be eliminated?

   (f) Write down the validity of Debye-Hückel-Onsager theory.

   (g) Define polarizability.

   (h) Which of the following molecule would have zero dipole moment?

   (i) O-dichlorobenzene   (ii) m-dichlorobenzene

   (iii) p-dichlorobenzene   (iv) NH_3

   (v) CH_3Cl

2. Answer any *three* from the following: 5×3 = 15

   (a) (i) Arrange the alkali metal ions in order of their molar conductance in aqueous solution.   2

   (ii) Explain Wien effect and Debye-Falkenhagen effect.   3

   (b) (i) Explain why conductivities of H^+ and OH^- ions in aqueous medium are abnormally high.   3

   (ii) What is equivalence point in conductometric titration? How its differ from end point?   2

   (c) (i) Discuss the significance of Clausius-Mössötti equation.   3

   (ii) How do you determine the magnetic moments of paramagnetic substances?   2

   (d) (i) Define electrolytic cell and electrochemical cells with proper examples.   2

   (ii) Describe the construction, cell reaction and working principles of calomel electrode.   3

(e) (i) How can you obtained the unknown concentration of HCl in a mixture of HCl and CH_3COOH conductometrically? — 2

(ii) What is salt bridge? Why KCl or NH_4NO_3 is used for the preparation of salt bridge? — 3

3. Answer any *two* questions from the following: — $10 \times 2 = 20$

(a) (i) Define transport number. — 2

(ii) What do you mean by abnormal transport number? — 3

(iii) Write briefly about the transport numbers of the three alkali ions Li^+, Na^+ and K^+ ions in their chlorides. — 2

(iv) Ionic conductance of Na^+ is $60\,\Omega^{-1}cm^2$. Λ°_{NaCl} is $140\,\Omega^{-1}cm^2 equiv^{-1}$. Find the transport number of Cl^-. — 3

(b) (i) Derive Nernst equation for EMF. — 4

(ii) What is concentration cell? Describe with suitable examples. — 3

(iii) At 25°C and 1 atm for the cell Pt, H_2 (g) / HCl (0.1M) / AgCl-Ag the EMF = 0.35252 volt and $\dfrac{dE}{dT} = -1.8 \times 10^{-4}\,volt/°C$. Calculate ΔG, ΔH and ΔS for the cell reaction. — 3

(c) (i) What is the underlying principle of potentiometric titration? — 2

(ii) Discuss the potentiometric titration of HCl vs. NaOH. — 2

(iii) What are the advantages of conductometric and potentiometric titration over the volumetric titration? — 3

(iv) The Dipole moment of chlorobenzene is 1.69 D. Calculate the dipole moment of o, m and p-dichlorobenzene. — 3

(d) Write short notes on (any *four*): — $2\frac{1}{2} \times 4 = 10$

(i) Debye-Hückel theory

(ii) Walden's rule

(iii) Kohlrausch's law

(iv) Diamagnetism

(v) Ostwald's dilution law

(vi) Debye-Hückel limiting law.

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