'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 4th Semester Examination, 2022

CC10-CHEMISTRY

PHYSICAL CHEMISTRY

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
All symbols are of usual significance.

Answer any *four* questions

1. (a) Define 'Standard electrode potential' and 'Standard emf of a cell'. 3+4+3

   (b) The redox reaction between Fe^{2+} and MnO_4^- in presence of 1M H_2SO_4 is —

   $$5Fe^{2+}(aq.) + MnO_4^-(aq.) + 8H^+(aq.)$$
   $$\rightleftharpoons 5Fe^{3+}(aq.) + Mn^{2+}(aq.) + 4H_2O$$

   Write down the electrochemical cell for this reaction to take place. Calculate the equilibrium constant for this reaction.

   Given $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.77$ V and

   $E^\circ_{MnO_4^-/Mn^{2+}} = 1.51$ V at 25°C

   (c) Write down the construction and functions of a salt bridge.

2. (a) How do you calculate standard free energy change and equilibrium constant of a given reaction from emf measurement? 4+3+3

   (b) Explain ionic product of water. Calculate pH of 10^{-8} M HCl (aq.) solution.

   (c) In a strong acid-base titration, conductance falls rapidly while in precipitation titration conductance decreases slowly, why?

3. (a) Define equivalent conductance and molar conductance. Derive relation between them. What are their S.I. units? 4+1+3+2

   (b) The ion conductance of Li^+ ion is less than that of K^+ ion. — Explain.

   (c) Describe moving boundary method for determination of transport numbers.

   (d) Explain how does a reference electrode provide in measuring the potential of electrochemical processes?

4. (a) The specific conductance of a saturated solution of AgCl is 1.56×10^{-6} ohm^{-1} cm^{-1}. The mobilities of Cl^- and Ag^+ ions are 5.6×10^{-4} cm/sec and 6.8×10^{-4} cm/sec. Calculate the solubility product of AgCl. 4+3+3

(b) State and explain the Kohlrausch's law of independent migration of ions with suitable examples.

(c) Describe the general possible rate determining steps in an electrolytic chemical reaction.

5. (a) Differentiate between paramagnetism and diamagnetism. 2+3+3+2

(b) What is magnetic susceptibility? Give its significance.

(c) What is Clausius-Mossotti equation? Give its significance.

(d) What do you mean by dipolemoment and polarizability?

6. (a) Molar polarization value of O_2 and CH_4 are independent of temperature while that of HCl and CH_3Cl decreases with increase in temperature in their gaseous phase. — Explain. 4+3+3

(b) Three different dichlorobenzene have dipole moments—

(i) 1.48 D, (ii) 0.0 D and (iii) 2.25 D.

Identify the isomers with explanation.

(c) Explain the order of polarizability and dipole moments of the following compounds in their gaseous phases: HCl, HBr, HI.

7. Write short note (any ***four***) on the following: $2\frac{1}{2}\times4 = 10$

(a) Glass electrode

(b) Transport number

(c) Concentration cells

(d) Conductometric titration

(e) Electrochemical cell

(f) Debye-Huckel theory.

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