



UNIVERSITY OF NORTH BENGAL

B.Sc. Honours Part-II Examination, 2021

CHEMISTRY

PAPER-V

PHYSICAL CHEMISTRY

Full Marks: 60

ASSIGNMENT

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

Answer any four questions from the following

15×4 = 60

1. (a) Derive the relationship between K_c , K_p and K_x for a general reaction. 4
- (b) What are the conditions for: $K_p = K_c = K_x$. 1
- (c) How are K_p and K_c related in the following case? 3
$$4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$$
- (d) Derive the relationships: 3+2
$$\frac{d \ln K_p}{dT} = \frac{\Delta H^\circ}{RT^2} \quad \text{and} \quad \frac{d \ln K_c}{dT} = \frac{\Delta U^\circ}{RT^2}$$
- (e) How will you increase the yield of ammonia in Haber's process? Discuss it with the help of Le Chatelier's principle. 2

2. (a) What do you mean by Surface tension of liquids? 2
- (b) Show that the Surface tension and Surface energy have the same dimension. 3
- (c) Define coefficient of viscosity of liquids. What is its unit? 2+1
- (d) How does coefficient of viscosity vary with temperature? 2
- (e) Describe the experimental method for the determination of surface tension of a liquid. 4
- (f) Why are liquid drops spherical? 1

3. (a) Define Osmotic Pressure. 2
- (b) Write down the differences between osmosis and diffusion. 2
- (c) How will you explain the value of osmotic pressure in three different aqueous solutions, if it contains 0.1 (M) NaCl, 0.1 (M) CH_3COOH and 0.1 (M) glucose? 2
- (d) What do you mean by Vant's Hoff factor? 2
- (e) Define molal depression constant. 2
- (f) Derive an expression relating the freezing point depression of a solution with mole fraction of the dissolved solute thermodynamically. 5

4. (a) What are azeotropes? 2
 (b) Is azeotrope a mixture or chemical compound? — Explain. 3
 (c) Discuss the conditions for ideal solution. 3
 (d) Show that in a Binary Ideal Solution if one constituent follow Raoult's Law then the other constituent will also follow Raoult's Law. 4
 (e) Explain why: Sodium chloride solution freezes at lower temperature than water but boils at higher temperature than water. 3
5. (a) Derive the Nernst Distribution law and write down the limitations. 4+2
 (b) What do you mean by Relative Lowering of vapour pressure? Explain why it should be considered as a Colligative property? 3+1
 (c) Define Dipole moment. 2
 (d) The molecular dipole moment of Chlorobenzene is 1.69 D. Calculate the dipole moments of *o*-, *m*-, *p*-dichlorobenzene. 3
6. (a) Write down a short note on Standard Hydrogen Electrode (SHE). 3
 (b) Write down the advantage of Saturated Calomel Electrode (SCE) over Standard Hydrogen Electrode. 2
 (c) Prove the relation $\Delta H = nF[T(\partial E/\partial T)_p - E]$ where the terms have their usual meaning. 3
 (d) What is liquid junction potential? 2
 (e) Derive Nernst Equation relating the EMF of a cell with the concentration of the reactants and products of the reaction. 3
 (f) Calculate the potential of the following cell at 298 K. 2
- $$\text{Zn} | \text{Zn}^{2+} (a = 0.01) || \text{Cu}^{2+} (a = 0.001) | \text{Cu}$$
- $$E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.762 \text{ V} \text{ and } E_{\text{Cu}^{2+}/\text{Cu}}^0 = +0.337 \text{ V}$$
7. (a) What is a buffer solution? What do you mean by the buffer capacity? Describe the mechanism of buffer solution. 2+2+2
 (b) Derive the Henderson's Equation. 3
 (c) Derive the pH expression of salt made from strong acid and weak base. 3
 (d) Calculate the pH of 10^{-8} M solution of HCl at 25° C. 3
8. (a) Explain the variation of specific conductance and equivalent conductance with dilution. 3
 (b) Define ionic mobility. Why do H⁺ ions have exceptionally high ionic mobility? 2+2
 (c) Discuss the principle underlying the conductometric titration between CH₃COOH vs NaOH. Draw the qualitative schematic titration curve. 3+2
 (d) What is Walden's Rule? 3

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