2023
B.A./B.Sc.
First Semester
CORE – 2
CHEMISTRY
Course Code: CHC 1.21
(Physical Chemistry - I)

Total Mark: 70 *Pass Mark: 28*
Time: 3 hours

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

UNIT–I

1. (a) Write notes on the following: 3×2=6
   (i) Most probable velocity (ii) Average velocity
   (b) What is mean free path? Explain the effect of temperature and pressure on mean free path. 4
   (c) What do you understand by degrees of freedom of gaseous molecule? Explain. 4

2. (a) What do you meant by heat capacity of gases? Explain. 4
   (b) Calculate the average velocity of oxygen molecule at 20°C. 3
   (c) Derive an expression for the collision frequency with respect to gases. 4
   (d) Discuss the distribution of molecular speeds as a function of temperature. 3

UNIT–II

3. (a) Define the following: 1×3=3
   (i) Critical temperature (ii) Critical volume
   (iii) Critical pressure
   (b) The van der Waal constant for HCl are $a = 0.367\ Nm^4\ mol^{-2}$ and $b = 0.0408 \times 10^{-3}\ m^3\ mol^{-1}$. Calculate the critical constant of the gas. 3
   (c) Explain the deviation of real gases from ideal behaviour with respect to temperature and pressure. 3

(d) Describe how van der Waal corrected the ideal gas equation for real gases. 5

4. (a) Explain the effects of addition of solutes on surface tension and viscosity. 4
   (b) Define viscosity of a liquid. Discuss the determination of viscosity of a liquid by Ostwald viscometer method. 5
   (c) Establish the relationship between van der Waal equation and critical constant. 5

UNIT–III

5. (a) What is crystallography? Name the fundamental laws of crystallography. 3
   (b) What are glasses? Explain one method of manufacturing ordinary glasses. 1+3=4
   (c) Discuss the determination of crystal structure by powder method. 5
   (d) Give the difference between liquid crystal and liquids. 2

6. (a) Calculate the Miller indices of crystal plane for the following: 4
      (i) (2a, 3b, c)
      (ii) (6a, 3b, 3c)
   (b) What is meant by elements of symmetry of a crystal? Discuss the various elements of symmetry in a cubic crystal. 5
   (c) At room temperature, sodium crystallizes in a body centred cubic cell with $a = 4.24$ Å. Calculate the theoretical density of sodium. (molecular mass of sodium = 23g mol^{-1}). 3
   (d) State the law of rational indices. 2

UNIT–IV

7. (a) Write a note on ionic product of water. 3
   (b) Calculate the hydrogen ion concentration in moles per litre of a solution whose pH is 5.4. 3
   (c) What are protic acids? Explain the dissociation constant (exact treatment) of monoprotic acids. 1+3=4
   (d) What do you know by salts of weak acid and strong bases? Give the expression of hydrolysis constant for such salts. 4

8. (a) What are common ion effect? Give the application of common ion effects. 1+3=4

(b) Calculate the degree of hydrolysis of 0.1 M solution of sodium acetate at 25°C. (Given: Ka = 1.75×10^{-5} and Kw= 1.008×10^{-14}). 3

(c) Determine the hydrolysis constant for the salts of strong acids and weak bases. Also, give the relation between K_h, K_b and Kw for salts of strong acid and weak bases. 2+3=5

(d) Explain in short, the effects of temperature on pH of a solution. 2

UNIT–V

9. (a) Briefly explain acid-base titration taking example. 3

(b) Discuss the action of indicators in acid-base titration and give their limitations. 4

(c) Derive the expression of Henderson-Hasselbalch equation for buffer solution. 4

(d) A buffer solution contains 0.20 mole of NH_4OH and 0.25 mole of NH_4Cl per litre. Calculate the pH of the solution. Dissociation constant of NH_4OH at room temperature is 1.81×10^{-5}. 3

10. (a) What is buffer action? Explain the buffer action of an acidic buffer. 1+3=4

(b) Explain the Quinonoid theory of acid-base indicators. 4

(c) Discuss the acid-base titration curves for weak acid and strong bases. 4

(d) Write a short note on solubility product. 2