

- (c) Explain the concept of surface-active agents and describe the cleansing action of detergents with a suitable example. (4)
7. (a) Describe Bragg's law and discuss its importance. (3)
- (b) Deduce the expression for $[H^+]$ ion concentration for the salt of a weak acid-strong base with a suitable example. (7)
- (c) What is the effect of dilution and addition of strong acids/bases on buffer systems? Explain with two suitable examples. (5)

Roll No.

Total Pages : 4

323204

May 2026

B.S.C. (MATHS/MATHS & COMP.) II SEMESTER

Physical Chemistry-I (CHU-103-V)

Time : 3 Hours]

[Maximum Marks : 75

Instructions :

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.
2. Answer any **four** questions from Part-B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.

PART-A

1. (a) Calculate the collision frequency of O_2 molecules at $0^\circ C$ and 1 atm pressure, given that the molecular diameter of O_2 is 2×10^{-8} cm. (1.5)
- (b) Define mean-free path. What are the factors affecting it for a gaseous molecule? (1.5)
- (c) Describe the relation of temperature to the coefficient of viscosity for gases. (1.5)
- (d) Calculate the volume occupied by 1 mole of a slightly imperfect gas at 4.75 atm and $17^\circ C$. The second virial coefficient of the gas is 0.028 L mol^{-1} . (1.5)

- (e) Use the Maxwell-Boltzmann distribution of speed to estimate the fraction of N_2 molecules at 400 K that have speeds in the range of 200 to 210 $m\ s^{-1}$. (1.5)
- (f) At what pressure does the mean free path of argon at 20°C become comparable to the diameter of a 100 cm^3 vessel that contains it? (given $\sigma = 0.36\ nm^2$). (1.5)
- (g) Define Parachor for a liquid. (1.5)
- (h) The van der Waals constant b for CO_2 is $4.28 \times 10^{-2}\ dm^3\ mol^{-1}$. Assuming CO_2 molecule to be spherical, calculate its molecular diameter. (1.5)
- (i) Why does the temperature of the liquid not rise at the boiling point, although it is heated? (1.5)
- (j) What are the units of reduced volume? Why is the air less dense at a hill station compared to sea level? (1.5)

PART-B

2. (a) Define Miller indices. Describe the method for determining Miller indices of crystal planes with suitable examples. Discuss their importance in crystallography. (6)
- (b) Explain the equipartition of energy principle and its limitations. (4)
- (c) Calculate the boiling point of benzene at 76 mm, given that the normal boiling point of benzene is 353 K. (5)

3. (a) Show the calculation of the root mean square velocity of Cl_2 molecules at 17°C and 800 mm pressure. (5)
- (b) Describe the seven crystal systems and fourteen Bravais lattices. Discuss how lattice parameters and symmetry distinguish different systems. (7)
- (c) Describe the Maxwell distribution of molecular speeds. What is its significance in understanding gas behavior? (3)
4. (a) Define buffer solutions. Derive the Henderson-Hasselbalch equation and discuss its limitations and practical applications. (7)
- (b) What are the main features of NaCl structure and how is it different from CsCl structure? (5)
- (c) State the law of corresponding states. (3)
5. (a) Discuss the relationship between symmetry, lattice type, and diffraction behaviour. (3)
- (b) What kind of intermolecular forces exist in the liquid state? State the equation for the mathematical treatment of intermolecular forces. (5)
- (c) Discuss the behaviour of real gases. Define the compressibility factor (Z) and explain its variation with pressure and temperature for different gases. (7)
6. (a) Explain the criteria for the selection of indicators in titrations. (5)
- (b) Derive the relationships between critical constants and van der Waals constants (a, b). (6)