

**2025/FYUG/ODD/SEM/
CHMDSC-102T/455**

FYUG Odd Semester Exam., 2025

CHEMISTRY

(1st Semester)

Course No. : CHMDSC-102T

(Physical Chemistry—I)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

UNIT—I

1. Answer any two from the following : $2 \times 2 = 4$

- (a) What is the difference between collision number and collision frequency?
- (b) Explain the effects of temperature and pressure on the mean-free-path of a gas molecule.
- (c) Calculate the r.m.s. velocity of nitrogen at 27°C and 70 cm pressure.

(2)

the following :

2. Answer any one from the following :
(a) Write the postulates of kinetic theory of gases and derived kinetic gas equation. 2+

(ii) Calculate the vibrational degree of freedom of water and carbon dioxide molecule. 2+

(b) (i) Explain in detail, Maxwell's distribution of molecular velocities. What is the effect of temperature on this distribution? 4+

(ii) Define coefficient of viscosity of gas. What will be the effect of temperature and pressure on the viscosity of gas? 2+

UNIT—II

3. Answer any two from the following : 2+

(a) Explain why real gas does not follow ideal gas equation, $PV = nRT$.

(b) Prove that excluded volume of molecules in a real gas is four times the actual volume of molecule.

(c) Calculate the critical temperature of a van der Waals' gas for which P_c is 100 atm and b is $50 \text{ cm}^3 \text{ mol}^{-1}$.

(3)

Answer any one from the following : 10

(a) (i) Explain the critical phenomenon on the basis of isotherm of CO_2 gas and show that $P_c V_c = 3/8 RT_c$. 4+2=6

(ii) Define critical and reduced temperature and state the law of corresponding state. 1+1+2=4

(b) (i) Define compressibility factor (z) and explain its variation with pressure for H_2 , CH_4 and NH_3 gas at constant temperature. 2+3=5

(ii) Explain why van der Waals' gas obeys ideal gas equation at high temperature and low pressure. 3

(iii) Xe has $P_c = 58.0 \text{ atm}$ and $T_c = 289.7 \text{ K}$. Determine its van der Waals' constants a and b . 2

UNIT—III

5. Answer any two from the following : 2×2=4

(a) Define surface tension and surface energy of a liquid.

(b) Explain why viscosity of liquid and gas varies differently with rise in temperature.

(c) What will be the effect of addition of solute on the surface tension?

6. Answer any one from the following :

(a) (i) Explain the method of determination of surface tension of liquid by drop number method.

(ii) Explain different factors that affect the vapour pressure of a liquid.

(iii) What are the basic properties of surface active agent?

(b) (i) Define the term 'relative viscosity' and explain a method of determination of viscosity of liquid.

(ii) Explain why surface tension of a liquid decreases with increase in temperature.

(iii) Explain with an example, how H-bonding affects the viscosity of a liquid.

UNIT—IV

7. Answer any two from the following : $2 \times 2 = 4$

(a) Explain the basic difference between crystalline and amorphous solid.

(b) Calculate the Miller indices of crystal planes which cut through the crystal axes at $(2a, -3b, -3c)$.

(c) Although both graphite and diamond are covalent solid, why graphite conducts electricity while diamond cannot?

8. Answer any one from the following : 10

(a) (i) Define unit cell and describe the characteristics of seven crystal systems. $1+5=6$

(ii) What will be the effects of Schottky and Frenkel defects on crystal lattice? $2+2=4$

(b) (i) Explain with the help of suitable diagram, the structural difference among nematic (N), smectic A, smectic C and phase of a liquid crystalline compound. $2+2+2=6$

(vi) Derive Bragg's law for crystal structure determination.

UNIT—V

2×2

9. Answer any two from the following :

- (a) What are the characteristics of ideal solution?
- (b) Define azotropic mixture. Give one example.
- (c) What will be the effect of impurities on the CST of a liquid mixture?

10. Answer any one from the following :

- (a) (i) Describe the process of distillation and explain how aniline can be purified by steam distillation. 2+4=
- (ii) Explain why non-ideal solution does not follow Raoult's law.
- (iii) Define LCST. Give one example.

(b) (i) State under what condition the distribution law is valid. Explain how this law is used to determine the concentration of solute which undergoes association and dissociation in the solvent. 2+4=6

(ii) Explain UCST with the example of phenol-water system. 4
