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 : 2×2=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.

(Turn Over)

2. Answer any *one* from the following :   10

(a)   (i) Write the postulates of kinetic theory of gases and derived kinetic gas equation.   2+4=6

(ii) Calculate the vibrational degree of freedom of water and carbon dioxide molecule.   2+2=4

(b)   (i) Explain in detail, Maxwell's distribution of molecular velocities. What is the effect of temperature on this distribution?   4+2=6

(ii) Define coefficient of viscosity of gas. What will be the effect of temperature and pressure on the viscosity of gas?   2+2=4

UNIT—II

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

(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 $50 \, cm^3 \, mol^{-1}$.

4. 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 $P_c = 58 \cdot 0$ atm and $T_c = 289 \cdot 7$ 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 :   10

(a)   (i) Explain the method of determination of surface tension of liquid by drop number method.   5

    (ii) Explain different factors that affect the vapour pressure of a liquid.   3

    (iii) What are the basic properties of surface active agent?   2

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

                       2+4=6

    (ii) Explain why surface tension of a liquid decreases with increase in temperature.   2

    (iii) Explain with an example, how H-bonding affects the viscosity of a liquid.   2

UNIT—IV

7. Answer any *two* from the following :　　　2×2=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

(ii) Derive Bragg's law for crystal structure determination. 4

UNIT—V

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

(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 : 10

(a) (i) Describe the process of distillation and explain how aniline can be purified by steam distillation. 2+4=6

(ii) Explain why non-ideal solution does not follow Raoult's law. 2

(iii) Define LCST. Give one example. 2

(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

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