

**2023/FYUG/ODD/SEM/
CHMDSC-102T/093**

**FYUG Odd Semester Exam., 2023
(Held in 2024)**

**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*

SECTION—A

Answer ten questions, selecting two from each

Unit :

2×10=20

UNIT—I

1. Show that the mean free path of a gas molecule increases by decrease in pressure.

2. Determine the possible number of vibrational mode of (a) H₂O and (b) CH₄.

1+1=2

3. Define most probable velocity.

UNIT—II

4. Discuss the effect of temperature on the deviation of real gas from ideal gas behaviour.
5. What is Joule-Thomson effect?
6. What are critical pressure and critical temperature?

1+1=

UNIT—III

7. Define the terms 'surface tension' and 'surface energy'.
8. What do you mean by cohesion and adhesion?
9. What will be the effect of addition of non-volatile solute on the surface tension of liquid?

1+1=

UNIT—IV

10. What are liquid crystals?
11. Calculate the Miller indices of crystal planes which cut through the crystal axes at—
(a) (2a, 3b, c);
(b) (2a, -3b, -3c).
12. What are extrinsic and intrinsic semiconductors?

1+1=

24J/532

Continued

UNIT—V

13. State and explain the Raoult's law for vapour pressure of binary solutions of volatile liquids.
14. What do you mean by azeotropic mixture?

1+1=

15. One mole of component A and two moles of component B are mixed at 27 °C to form an ideal binary mixture. Assuming $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$, calculate ΔG_{mix} and ΔS_{mix} .

1+1=2

SECTION—B

Answer five questions, selecting one from each Unit : 10×5=50

UNIT—I

16. (a) Write down the basic postulates of the kinetic theory of gases. Derive the kinetic gas equation. 3+3=6
(b) Derive mathematical expression for—
(i) average velocity; 2+2=4
(ii) root mean square velocity.

24J/532

(Turn Over)

17. (a) Discuss the effect of temperature on the distribution of molecular velocities.

(b) Calculate the temperature at which the root mean square velocity, the average velocity and the most probable velocity of oxygen gas are all equal to 1500 ms^{-1} .

(c) Explain the terms 'collision number' and 'collision frequency'. 2+2

UNIT—II

18. (a) Define excluded volume. Show that excluded volume designated as b in van der Waals' gas equation is four times of the actual volume of the gas molecules. 1+3

(b) Draw and discuss the P - V isotherms of CO_2 molecule.

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

19. (a) State the principle of corresponding states. Derive the relations between critical constants (T_c , P_c , V_c) with van der Waals' constant (a and b). 1+3

24J/532

- (b) Define Boyle temperature. Derive an expression for the Boyle temperature of a van der Waals' gas. 1+3=4

(c) What is compressibility factor? Explain. 2

UNIT—III

20. (a) Derive the expression for the determination of surface tension by the drop number method. 3

(b) Explain the mechanism of cleansing action of detergent. 4

(c) How does intermolecular force affect vapour pressure and surface tension? 3

21. (a) What is viscosity of a liquid? Describe the process of determination of viscosity of liquid by Ostwald's viscometer. 1+3=4

(b) What are newtonian and non-newtonian liquids? Discuss the effect of temperature on the viscosity of a liquid. 2+1=3

(c) What is surfactant? What are the different types of surfactant? Give examples. 1+2=3

(Continued 24J/532

(Turn Over)

UNIT—IV

22. (a) Derive the Bragg's equation in X-ray crystallography.

(b) Write short notes on the following :

2½x2

(i) Schottky defect

(ii) Frenkel defect

(c) NaCl has f.c.c. structure. How many Na⁺ and Cl⁻ ions are present in the unit cell?

23. (a) What are edge and screw dislocations?

2+2=

(b) Discuss the band theory of semiconductors and insulators.

(c) Describe the phase structures of smectic A and C phases of liquid crystals.

UNIT—V

24. (a) State the Nernst distribution law. How is the law derived from thermodynamic consideration?

1+3=

(b) Define CST. Explain UCST, by taking a suitable example. What will be the effect of impurity on CST?

1+3+2=

25. (a)

Discuss the three types of derivation shown by non-ideal solutions from the ideal behaviour in their vapour pressure with a suitable example.

6

(b) Discuss the variation of vapour pressure of completely miscible liquid pairs with composition.

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