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)

$\underline{\text{Full Marks} : 70}$
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)* H_2O and *(b)* CH_4.　　1+1=2

3. Define most probable velocity.

24J/**532**　　　　　　　　(Turn Over)

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=2

UNIT—III

7. Define the terms 'surface tension' and 'surface energy'.   1+1=2

8. What do you mean by cohesion and adhesion?   1+1=2

9. What will be the effect of addition of non-volatile solute on the surface tension of liquid?

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) $(2a, -3b, -3c)$.   1+1=2

12. What are extrinsic and intrinsic semi-conductors?   1+1=2

(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?

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 ;

    (ii) root mean square velocity.

    2+2=4

(Turn Over)

17. *(a)* Discuss the effect of temperature on the distribution of molecular velocities. 3

(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}. 3

(c) Explain the terms 'collision number' and 'collision frequency'. 2+2=4

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=4

(b) Draw and discuss the *P-V* isotherms of CO_2 molecule. 4

(c) Calculate the critical temperature of a van der Waals' gas for which P_C is 100 atm and *b* is $50 \text{ cm}^3 \text{ mol}^{-1}$. 2

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=4

(Continued)

(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

UNIT—IV

22. *(a)* Derive the Bragg's equation in X-ray crystallography.   3

(b) Write short notes on the following :   2½×2=5

      (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?   2

23. *(a)* What are edge and screw dislocations?   2+2=4

(b) Discuss the band theory of semiconductors and insulators.   3

(c) Describe the phase structures of smectic *A* and *C* phases of liquid crystals.   3

UNIT—V

24. *(a)* State the Nernst distribution law. How is the law derived from thermodynamic consideration?   1+3=4

(b) Define CST. Explain UCST, by taking a suitable example. What will be the effect of impurity on CST?   1+3+2=6

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. 4

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