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)* H_2O and *(b)* CH_4. 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=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 $R = 8{\cdot}314\ JK^{-1}\ mol^{-1}$, 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 cm^3 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

(Turn Over)

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 semi-conductors 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

(Continued)

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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