TDC (CBCS) Odd Semester Exam., 2023

CHEMISTRY

(Honours)

(1st Semester)

Course No. : CHMHCC-102T

(States of Matter and Ionic Equilibrium)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer *ten* questions, taking any *two* from each Unit : 2×10=20

UNIT—I

1. Show that the mean-free-path of a gas at constant volume is directly proportional to temperature.

2. Calculate the various degrees of freedom for the following :
   (a) HCl
   (b) C_6H_6

3. Prove that the molecular velocity of any gas is proportional to the square root of absolute temperature.

UNIT—II

4. What are the causes of deviation of real gases from ideal behaviour?

5. What is Boyle temperature? State the law of corresponding states. 1+1=2

6. Draw isotherm of CO_2 at the following temperatures : ½×4=2
   (a) 13·1 °C
   (b) 21·5 °C
   (c) 31·1 °C
   (d) 35·5 °C

UNIT—III

7. What are cohesion and adhesion forces?

8. Explain the term 'cytostatic group'.

9. What is viscosity of liquid? How does viscosity vary with temperature?

UNIT—IV

10. Write the cell parameters for the most unsymmetrical unit cell.

11. Explain the term 'F-centre'.

12. What do you mean by the term 'plane of symmetry'?

UNIT—V

13. Define pH. Calculate the pH of 100 mL *M*/50 HCl solution. 1+1=2

14. Write the theory of acid-base indicators taking methyl orange as an example.

15. Give two applications of solubility product principle.

SECTION—B

Answer *five* questions, taking *one* from each Unit : 6×5=30

UNIT—I

16. *(a)* Deduce the kinetic gas equation. 3

    (b) Calculate the temperature at which the root-mean-square velocity, the average velocity and the most probable velocity of O_2 gas are all equal to 1500 m s^{-1}. 3

17. *(a)* Find out the number of molecules of an ideal gas per litre at *(i)* 300 K and 1 atm pressure and *(ii)* 400 K and 2 atm pressure. 2

(b) What is the effect of temperature and pressure on the coefficient of viscosity? 2

(c) Deduce an expression for mean-free-path relating to temperature. 2

UNIT—II

18. *(a)* Derive the van der Waals' equation for real gas. 3

(b) 1 mol of SO_2 gas occupies a volume of 350 mL at 27 °C and 50 atm pressure. Calculate the compressibility factor of the gas. Comment on the type of deviation shown by the gas from ideal behaviour. 2+1=3

19. *(a)* Show that for a van der Waals' gas, the Boyle temperature is $T_B = \frac{a}{R_b}$. 3

(b) Mention the difference between real gas and ideal gas. 1½

(c) Write the expression for reduced equation of state and explain the terms. 1½

UNIT—III

20. *(a)* Describe drop number method for the determination of surface tension of a liquid using stalagmometer. 4

(b) Explain the cleansing action of soaps and detergents. 2

21. *(a)* Write Poiseuille's equation. Use this equation to determine the relative viscosity of a liquid experimentally. Mention the name of the apparatus used for the purpose. 1+3+1=5

(b) Show that 1 Pa.s = 10 poise. 1

UNIT—IV

22. Derive Bragg's equation. How can this equation be used to determine the structure of NaCl? 4+2=6

23. Differentiate between Weiss and Miller indices. Calculate the Miller indices of crystal planes which cut through the crystal axis at—

(a) (2*a*, 3*b*, *c*);

(b) (6*a*, 3*b*, 3*c*);

(c) (2*a*, −3*b*, −3*c*). 3+3=6

UNIT—V

24. *(a)* Derive Henderson equation for basic buffer solution. What is buffer capacity? 3+1=4

(b) Draw acid-base titration curve for—

(i) NaOH—HCl

(ii) CH_3COOH—KOH 1×2=2

25. *(a)* Derive the expression for the hydrolysis constant, degree of hydrolysis and pH for hydrolysis of ammonium nitrate salt. 3

(b) Calculate the solubility of $BaSO_4$ at 298 K in *(i)* pure water and *(ii)* 0·05 *M* $BaCl_2$ solution. Given solubility product of $BaSO_4$ at 298 K is $1 \cdot 5 \times 10^{-9}$. 1+2=3

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