

Total No. of Printed Pages—7

1 SEM TDC CHMH (CBCS) C 2

2024

(November)

CHEMISTRY

(Core)

Paper : C-2

(Physical Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×3=3

(a) The temperature at which ethane molecule has the same root-mean square velocity of methane molecule at 27 °C is

(i) 292.5 °C

(ii) 289.5 °C

(iii) 280.0 °C

(iv) 294.0 °C

(2)

(b) Which of the following liquids will have highest boiling point?

(i) CH_3OH

(ii) CHCl_3

(iii) H_2O

(iv) CH_3COCH_3

(c) Potassium crystallizes in a b.c.c. lattice. The number of unit cells present in 2 mole of K metal is

(i) $2 \times 6.02 \times 10^{23}$

(ii) 6.02×10^{23}

(iii) $3 \times 6.02 \times 10^{23}$

(iv) None of the above

2. Answer any four questions from the following : $2 \times 4 = 8$

(a) Define van der Waals' constants a and b and give their significance.

(b) Explain why heat capacities of gases at constant pressure are more than at constant volume.

(c) Explain the structure of NaCl crystal from X-ray crystallography.

(3)

(d) Dissociation of ethanoic acid increases when concentration decreases. Explain why.

(e) What is the relation between solubility and solubility product of a A_xB_y type of electrolyte?

UNIT—I

3. Answer any two questions from the following : $7 \times 2 = 14$

(a) (i) Deduce the reduced equation of state from van der Waals' equation of states and define the law of corresponding states from it. $3+1=4$

(ii) Deduce Boyle's law from kinetic gas equation. What is Boyle's temperature? $2+1=3$

Or

Define viscosity of gases. Viscosity of gases increases as temperature is increased. Explain. 3

(b) (i) Describe critical phenomenon from Andrew's isotherm. 2

(ii) Define the critical constants P_c , T_c and V_c . 3

(4)

(iii) Show that

$$\frac{RT_c}{P_c V_c} = \frac{8}{3}$$

2

(c) (i) What are mean-free path, collision diameter and collision frequency of a gas molecule? Explain the effect of temperature on mean-free path.

$$1\frac{1}{2} + 1 = 2\frac{1}{2}$$

(ii) State and explain law of equipartition of energy taking a suitable example.

$$1 + 2\frac{1}{2} = 3\frac{1}{2}$$

(iii) What is compression factor z of gases?

1

UNIT—II

4. Answer any *one* question from the following : 5

(a) (i) What are the different kinds of intermolecular forces present in liquids? Discuss in detail. 3

(ii) Boiling point of CH_3OH is more than CH_3COCH_3 . Give reasons. 2

(b) (i) Name two factors on which viscosity of liquid depend. What is the SI unit of coefficient of viscosity? 1+1=2

(5)

(ii) Describe a method of determination of viscosity of a liquid at laboratory. 3

Or

The time of flow of H_2O is 59.2 seconds at 25°C and for a liquid is 46.2 seconds at the same temperature. If the densities of water and the liquid are 1.0 g cm^{-3} and 0.867 g cm^{-3} respectively, what is the viscosity of the liquid? (Given, $\eta_{\text{H}_2\text{O}} = 0.00895 \text{ poise}$)

UNIT—III

5. Answer any *two* questions from the following : $4\frac{1}{2} \times 2 = 9$

(a) (i) State the law of rational indices. What are Miller indices? If a crystal plane intersects the crystallographic axes in the ratio 1:-1:2, what is its Miller indices? $1 + 1 + \frac{1}{2} = 2\frac{1}{2}$

(ii) What do you understand by point group in crystal system? What is the total number of point groups present in crystal lattice? 1+1=2

- (b) What are nematic and smectic liquid crystals? Discuss their differences. Mention two applications of liquid crystals. $2+1\frac{1}{2}+1=4\frac{1}{2}$

- (c) (i) What are the various axes of symmetry and plane of symmetry present in simple cubic system? $1+1\frac{1}{2}=2\frac{1}{2}$

- (ii) Define *p*-type and *n*-type semi-conductors with suitable examples. 2

UNIT—IV

6. Answer any two questions from the following : $7 \times 2 = 14$

- (a) (i) Solubility product of $\text{Ag}_2\text{CrO}_4 = 1.3 \times 10^{-11} \text{ M}^3$. What is its solubility? 2

- (ii) In salt analysis in group II H_2S is passed in presence of HCl , while in group IV H_2S is passed in alkaline medium. Explain. 3

- (iii) What is common ion effect? Discuss with a suitable example. 2

- (b) (i) Equal volumes of 0.08 M CaCl_2 and $0.02 \text{ M Na}_2\text{SO}_4$ solutions are mixed at room temperature. Will there be precipitation of CaSO_4 ? $[K_{\text{sp}} \text{ CaSO}_4 = 2.4 \times 10^{-5} \text{ M}^2]$ 2

- (ii) What are acid base indicators? Name one indicator to be used in a titration of weak acid with a strong base. 2

- (iii) Derive an expression for degree of hydrolysis, hydrolysis constant and pH for an aqueous solution of a salt of weak acid and strong base. 3

- (c) (i) Calculate pH of an aqueous solution of $0.02 \text{ M CH}_3\text{COONa}$. [Given, $\text{p}K_a = 4.74$] 2

- (ii) pH of a 10^{-7} M HCl is less than 7. Give reasons. 2

- (iii) What are buffer solutions? Derive an expression for pH of an acidic buffer. $1+2=3$

Or

Discuss the mechanism of acidic buffer. What is buffer capacity?

 $2+1=3$
