

(Compulsory Question)

1. (a) What is excluded volume or co-volume ?
How is it related to the actual volume of the gas molecules ?
- (b) Is one degree Celsius rise in temperature equal to one degree Kelvin rise in temperature ? If not, which one is greater and why ?
- (c) What is Dunstan's rule ?
- (d) Explain cleansing action of soap to remove grease from the surface of a cloth.
- (e) Determine the interplanar spacing (d_{hkl}) between (221) planes for a cubic lattice having edge length 450 pm.
- (f) What is the significance of ' n ' in the Bragg's equation $2d \sin \Theta = n\lambda$.
- (g) Why the rate of a reaction becomes nearly double for every 10 degree Celsius rise in temperature ?
- (h) Explain, why reactions of higher molecularity are rare. $8 \times 2 = 16$

Section I

2. (a) At what temperature will the root mean square velocity of sulphur dioxide be same as that of methane at 27°C ? 3
- (b) Define mean free path. Explain the effect of pressure and temperature on mean free path. 3
- (c) Using van der Waal Equation, derive the expressions for critical constants of a gas. Give relationship among them. 8
- (d) Write expression for Maxwell distribution of molecular speed. What do different symbols signify ? 2
3. (a) Why do real gases fail to obey the ideal gas equation at high pressure and low temperature ? 2
- (b) Explain Andrew's isotherms for CO_2 gas at various temperatures and label them. 4
- (c) Define root mean square velocity and most probable velocity. Give mathematical formula for each. 2

- (d) Derive van der Waals equation of state for n moles of a gas. 8

Section II

4. (a) Explain the variation of surface tension with temperature. 3
- (b) What is Parachor ? What do we mean by Atomic and Structural Parachor ? 3
- (c) How will high a liquid rise in a capillary tube of 0.1 mm diameter if its density is 1.3 g/cm^3 and surface tension is 65 dynes/cm ? ($g = 980 \text{ cm/s}^2$). 4
- (d) Define the term 'coefficient of viscosity.' Describe the measurement of viscosity by 'Ostwald viscometer method'. 6
5. (a) Explain the drop number method and drop weight method for the measurement of surface tension of a given liquid. 8
- (b) The Parachors of ethane and propane are 110.5 and 150.8, respectively. What values of Parachor do you expect for hexane ? 2

- (c) Define the term fluidity. How is it related to coefficient of viscosity ? Give its units.

2

- (d) The times of flow for water and CCl_4 in an Ostwald's viscometer are 80 and 54.8 seconds. The density of water and CCl_4 are 0.998 and 1.542 g/cm^3 , respectively. What is the viscosity coefficient of CCl_4 if its value for water is 0.01002 poise ?

4

Section III

6. (a) What are Miller indices ? Draw (111) and (110) planes in a cubic crystal. 3

- (b) Explain the terms 'isomorphism' and 'polymorphism' with suitable examples.

4

- (c) Derive the mathematical formula for distance of separation between (hkl) planes.

6

- (d) Explain 'Frenkel defect' with example.

3

7. (a) Define the following terms : 6

- (i) Axis of symmetry
- (ii) Plane of symmetry
- (iii) Center of Inversion.

Show them diagrammatically for a cubic system.

(b) A face makes intercepts $3a$ and $2b$ on the X-axis and Z-axis, respectively and does not cut Y-axis at all. What are the Miller indices of the face ? 2

(c) Briefly describe the principle of Bragg's method used for X-ray diffraction by crystals. Explain the construction and working of Bragg's X-ray spectrometer. 8

Section IV

8. (a) What is a zero order reaction ? Derive expression for the rate constant and half-life period of a zero order reaction. Write units of rate constant for reaction of zero order. 6

- (b) Why some reactions do not take place at room temperature but take place at higher temperature ? 2
- (c) Briefly describe the 'Transition State Theory of reaction rates.' Give its advantages over 'Collision Theory of reaction rates'. 8
9. (a) Derive expression for rate constant and half life period of a second order reaction involving equal concentration of reactants. Write units of rate constant for the same. 6
- (b) Briefly describe 'half-life period method' and 'Ostwald isolation method' for determination of order of a reaction. 8
- (c) How is the rate constant of an ionic reaction related to the dielectric constant of the solvent ? 2