Odd Semester, 2020

(Held in March, 2021)

CHEMISTRY

(Honours)

(Chem–H–502)

(Part A : Physical)

Marks : 37

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Using Maxwell's distribution law of molecular velocities, show that the most probable velocity of a molecule is $\sqrt{\dfrac{2RT}{M}}$, where the terms have their usual meanings. 4

   (b) Explain the following terms : 1½×2=3

   (i) Continuity of state

   (ii) Collision diameter

   (c) Calculate the root-mean-square velocity of oxygen molecule at 27 °C.
   (Given : $R = 8.314$ JK^{-1} mol^{-1}) 2

OR

2. *(a)* Draw P-V isotherm of carbon dioxide and mention the salient features of the isotherm. 3

   (b) State the law of corresponding states and derive the reduced equation of state. 3

   (c) The van der Waals' constants of a gas are $a = 0.751$ dm^6 atm mol^{-2} and $b = 0.0226$ dm^3 mol^{-1}. Calculate its critical volume and critical pressure. 1½+1½=3

3. *(a)* Define viscosity of a liquid. Describe the method of determination of viscosity by Ostwald's viscometer. 1+3=4

   (b) The parachors of ethane and propane are 110·5 and 150·8 respectively. What parachor value is expected for hexane? 2

OR

4. *(a)* Explain the following : 1½+1½=3

   (i) Orientation polarization

   (ii) Dipole-induced dipole interaction

(b) Calculate the molar refraction of methyl acetate (CH_3COOCH_3) at a temperature at which its density is 0.928 g cm^{-3}. The refractive index at this temperature is 1.3594. 3

5. *(a)* Derive the Bragg's equation for X-ray diffraction of a crystal. 3

(b) Explain Schottky defect and Frenkel defect. $1½+1½=3$

OR

6. *(a)* Describe the Laue method for the determination of crystal structure. 3

(b) Tabulate the seven crystal systems along with their Bravais lattices. 3

7. *(a)* Define chemical potential. Derive the variation of chemical potential with temperature and pressure. $1+3=4$

(b) Derive the following Maxwell's relations : $1½+1½=3$

(i) $\left(\dfrac{\partial V}{\partial T}\right)_P = -\left(\dfrac{\partial S}{\partial P}\right)_T$

(ii) $\left(\dfrac{\partial P}{\partial T}\right)_V = \left(\dfrac{\partial S}{\partial V}\right)_T$

(Turn Over)

OR

8. *(a)* Explain Nernst heat theorem. How does it lead to the enunciation of the third law of thermodynamics? $2+2=4$

(b) What do you understand by partial molar quantities? Why is volume a partial molar quantity but not temperature and pressure? $1+2=3$

9. *(a)* Discuss the Lindemann theory of unimolecular reactions. 5

(b) Write notes on the following : $2×2=4$

(i) Chain reaction

(ii) Acid-base catalysis

OR

10. *(a)* Write a note on consecutive reactions and obtain the rate expression for such reactions. 5

(b) Derive Michaelis-Menten equation for an enzyme-catalyzed reaction. 4

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