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1 SEM TDC CHMH (CBCS) C 2

2021

(Held in January/February, 2022)

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) At 27 °C, the kinetic energy of two moles of N_2 is

(i) 7482·6 J

(ii) 3741·3 J

(iii) 2494·2 J

(iv) 0

(b) With the increase in temperature, the viscosity of a gas

(i) increases

(ii) decreases

(iii) at first increases then decreases

(iv) remains same

(c) Out of the four liquids given below, the one having lowest vapour pressure at 25 °C is

(i) carbon tetrachloride

(ii) benzene

(iii) chloroform

(iv) water

2. Answer any *four* from the following questions : 2×4=8

(a) Explain why we have to define the heat capacity of gases under constant pressure and constant volume condition.

(b) Write the SI unit of van der Waals' constants *a* and *b*. Mention the physical significance of *a*.

(*Continued*)

(c) At what temperature the root mean square speed of nitrogen at 27 °C would be tripled?

(d) Show that in face-centered cubic lattice 74% space is occupied by lattice points.

(e) Explain why an aqueous solution of Na_2CO_3 is basic in nature.

UNIT—I

3. Answer any *two* from the following questions : 7×2=14

(a) (i) Write kinetic gas equation. From this equation, derive Boyle's law. 1+2=3

(ii) Derive the relation between mean free path and coefficient of viscosity of a gas. Explain the effect of temperature on the viscosity of a gas. 3+1=4

(b) (i) What is equipartition of energy? In the light of it, calculate the total energy in joules associated with one mole of the following molecules at 27 °C : 1+1½+1½=4

(1) O_2

(2) H_2O

(*Turn Over*)

(ii) Calculate the volume of 5 moles of methane at 50 atmospheric pressure and 0 °C. At this temperature and pressure, the value of Z is 0·75. 2

(iii) An ideal gas can never be liquefied. Justify. 1

(c) (i) What is critical phenomenon? Derive the expression for the critical constants of a gas using van der Waals' equation of state. 1+3=4

(ii) For one mole of a gas, express van der Waals' equation in the virial form. 3

UNIT—II

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

(a) Define the term 'surface tension'. What is its SI unit? Describe the laboratory method for determining the surface tension of a liquid. 1+1+3=5

(b) (i) The time of flow of water through Ostwald viscometer is 1·48 minutes. For the same volume of a liquid of density 0·792 g/ml, it is 2·42 minutes. Find the viscosity of

(*Continued*)

the liquid relative to that of water and also absolute viscosity at 20 °C. Density and viscosity of water at 20 °C are 0·995 g/ml and 10·02 millipoise respectively. 2+2=4

(ii) Define coefficient of viscosity of a liquid. 1

UNIT—III

5. Answer any *two* from the following questions : 4½×2=9

(a) (i) Derive an expression showing the relation between the spacings of the lattice planes and the wave-length of the X-rays used to study the crystal system. 3

(ii) Draw (110) plane in a cubic crystal. 1½

(b) (i) Discuss Schottky defects and Frenkel defects of crystal giving examples. 3

(ii) Calculate the number of atoms present in a face-centered cubic unit cell. 1½

(*Turn Over*)

(c) (i) What are liquid crystals? Write two important properties each of nematic and smectic liquid crystals. 1+1+1=3

(ii) The structure of CsCl is different from that of NaCl though both have the similar formula. Give reason. 1½

UNIT—IV

6. Answer any *two* from the following questions : 7×2=14

(a) (i) What is salt hydrolysis? Prove that the aqueous solution of a salt formed by a strong acid and a weak base is acidic in nature. 1+3=4

(ii) Write any one difference between solubility and solubility product of calcium phosphate. 1+2=3

(b) (i) Deduce Henderson equation for acidic buffer and basic buffer solution. 2+2=4

(ii) Determine the pH of a solution obtained by mixing equal volumes of 0·015 *N* NH_4OH and 0·15 *N* NH_4NO_3 solutions. (pK_b of NH_4OH is 4·74)

(Continued)

(c) (i) What are acid-base indicators? Describe Ostwald theory of indicators taking the example of phenolphthalein. 1+3=4

(ii) Explain why methyl orange indicator is not used as indicator in the titration between a strong acid with a strong base. 1½

(iii) Calculate the pH of *N*/50 HCl solution. 1½

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