This question paper contains 4+2 printed pages]

Your Roll No..... .....

903

B.Sc.(Hons.)/I **C**

CHEMISTRY- -Paper III

(Physical Chemistry---I)

Time : 3 *Hours* *Maximum Marks* : 38

(Write your Roll No on the top immediately on receipt of this question paper.)

Attempt *six* questions in all, selecting at least *two* questions from each section. Question No. 1 is compulsory. Use of scientific calculator is allowed.

($R = 8.314\ JK^{-1}\ mol^{-1}$, $N = 6.023 \times 10^{23}\ mol^{-1}$

$k = 1.38 \times 10^{-23}\ JK^{-1}$).

1. Explain briefly giving reasons (any *four*) : 2×4=8

   (*a*) Viscosity of glycerol is much more than that of an ether.

P.T.O.

(*b*) It is not possible to liquefy an ideal gas.

(*c*) The enthalpy of neutralization of a strong acid with a strong base is always a constant.

(*d*) Entropy of the universe always increases.

(*e*) The barometric equation is not strictly obeyed.

(*f*) Work can be completely converted to heat but heat cannot be completely converted into work.

Section A

2. (*a*) Write the definition of the mean free path.

(*b*) Calculate the mean free path of oxygen at 25°C and a pressure of 10^{-3} mm of Hg. The collision diameter is 3.61×10^{-8} cm.

(*c*) At Boyle's temperature a real gas behaves as if it is an ideal gas. Why ? 1,3,2

3. (*a*) State the law of equipartition of energy.

(*b*) Write the equation for the energy of rotation whenever :

(*i*) Molecule is linear

(*ii*) Molecule is non-linear.

(*c*) Calculate the root mean square, average and the most probable speeds for oxygen molecule at 25°C. 2,2,2

4. (*a*) Write van der Waals' equation in the virial form and evaluate the second virial coefficient.

(*b*) Show that the height at which atmospheric pressure is reduced to one half of its value, is given by the expression :

$$x = 0.6909\ RT/Mg.$$

(*c*) State the law of corresponding states. 3,2,1

5. (*a*) What is surface tension ? What is its importance in daily life ?

(*b*) Discuss the structure of liquid as obtained from the study of radial distribution function.

(*c*) How the viscosity of a highly viscous liquid like oil can be determined experimentally ? 2,2,2

Section B

6. Explain the following (any *three*) 2×3=6

(*i*) Integral heat of solution

(*ii*) Joule-Thomson's coefficient

(*iii*) Maximum flame temperature

(*iv*) Intensive properties.

7. (*a*) Show that :

$$dS_{system} + dS_{surrounding} = 0$$

for an infintesimal reversible process.

(*b*) Calculate the entropy change involved in the isothermal expansion of 5 moles of an ideal gas from a volume of 10 liters to 100 liters at 300 K.

(c) Why in adiabatic expansion of an ideal gas, cooling is produced ? 2,3,1

8. (*a*) Give the following standard enthalpies of formation in kJ mol^{-1} (at 298 K and 1 atm pressure) :

$I_2(g)$ - 7.9, $C_2H_6(g)$ = - 84.7, $C_2H_5I(l)$ = - 31.0, $HI(g)$ = + 25.9.

Calculate the enthalpy change for the reaction :

$I_2(g) + C_2H_6(g) \Rightarrow C_2H_5I(l) + HI(g)$.

(*b*) Given the following average bond energies in kJ mol^{-1} :

C-H 412 ; I-I 11; C-I 238; H-I 299.

Calculate the enthalpy change for the same reaction in part (*a*) of this question.

(*c*) What is the difference between Bond energy and Bond dissociation energy ? 2,3,1

P.T.O.

9. (*a*) Define $C_{p.m}$ and $C_{v.m}$ and then derive the relation between them for n moles of an ideal gas.

(*b*) For van der Waals' gas derive the expressions for work done, heat, internal energy change and enthalpy change for isothermal expansion. 3,3