[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 687 **G** **Your Roll No.....**

Unique Paper Code : 217151

Name of the Paper : Chemistry – I (CHCT-301)

Name of the Course : **B.Sc. (Hons.) Bio-Medical Science/Botany/Biochemistry/Microbiology/Zoology**

Semester : I

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

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

SECTION A

(Inorganic Chemistry)

Attempt any **three** *questions.*

1. Explain :

   (i) Rn,l and R^2n,1 cannot be related with the probability of electron density of an elecron. (3)

   (ii) I_3^- and XeF_2 molecules have linear geometry. (3)

   (iii) Cu^{2+} is more stable than Cu^+ in aqueous solution Explain. Is the same is true for Ag (Z=47) also ? (3)

   (iv) What do you understand by radial and angular wave functions ? How will you represents the complete wave function in terms of radial and angular wave function ? (3½)

2. (i) What is the concept of multiplicity rule ? How do you justify the Hund's rule of maximum multiplicity. (2½)

P.T.O.

(ii) Describe Fajans rules. How does it explain the relative covalent nature of the following pairs of compound ? (4)

(a) LiI and CsI

(b) KCl and AgCl

(iii) T shape of ClF_3, Explain. (3)

(iv) Why NF_3 is much weaker than NH_3 ? (2)

(v) Write the electronic configuration of Cu. (1)

3. (i) Write Born Lande expression. Explain various terms used in it. (2½)

(ii) Give the hybridisation in central atom of the following XeO_2F_2, SO_2, ClO_2. (3)

(iii) Calculate the lattice energy of NaCl from the following data by use of Born Haber Cycle

Sublimation Energy of Cl_2 = 108.7 KJ/mole

Dissociation energy of Cl_2 = 225.9 KJ/mole

Ionization energy for Na(g) = 489.5 KJ/mole

Electron affinity for Cl(g) = –351.4 KJ/mole

Heat of formation of NaCl = –414.2 KJ/mole (4)

(iv) Calculate the Madelung constant for two ions pair. (3)

4. (i) Sketch the radial probability distribution curve for 3s, 3p and 3d orbitals on the same set of axis. (3)

(ii) Why S-orbitals are spherically symmetrical ? (2½)

(iii) Calculate the kinetic energy of moving electron which has a wavelength of 4.8 pm (mass of electron = 9.11×10^{-31} kg h = 6.63×10^{-34} s). (2½)

(iv) Plot the radial wave function and radial distribution curve for (2)

(a) n = 2, l = 1

(b) n = 2, l = 0

(v) State giving a reason in each case, which cation will exert a greater polarizing power in the following cases

(a) Na^+ or Mg^{2+}

(b) Cu^{2+} or Ca^{2+} (2½)

SECTION – B

Scientific calculator is allowed.

Attempt **three** *questions in all. Question No.* **1** *is compulsory.*

$R = 8.314\ J\ K^{-1}\ mol^{-1}$.

1. Answer any **five** of the following : (5×2½)

(a) Define intensive and extensive properties? Which out the following are intensive properties :

Volume, molar entropy, viscosity, free energy, density, temperature.

(b) Differentiate between integral heat of solution and differential heat of solution.

(c) Efficiency of Carnot engine can never be unity. Explain.

(d) Show that the quantity q_{rev} is not a state function for an ideal gas, but q_{rev}/T is a state function.

(e) For an ideal gas C_p is always greater than C_v. Explain.

(f) What is meant by ionic product of water ? Explain its variation with temperature.

(g) $MgSO_4$ gives a precipitate with NH_3 but not with NH_3 and NH_4Cl solution.

2. (a) Show that the work done in isothermal reversible expansion is greater than that in irreversible expansion of an ideal gas. (2½)

(b) Derive any **two** of the following relations :

(i) $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

(ii) $\left(\frac{\partial T}{\partial P}\right)_S = -\left(\frac{\partial V}{\partial S}\right)_P$

(iii) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P = -\alpha V$ (2×3)

(c) One mole of an ideal gas expands isothermally and reversibly at 300 K from 2 dm^3 to 20 dm^3. Calculate q, ΔU, w and ΔH for the gas. (4)

3. (a) Derive the following expression

$$\left[\frac{\partial(\Delta G/T)}{\partial T}\right]_P = -\frac{\Delta H}{T^2}$$ (4)

(b) For an ideal gas $C_{p,m}$ = (5/2)R. Calculate the change in entropy suffered by 3 moles of the gas on being heated from 300 K to 600 K at (a) constant pressure, and (b) constant volume. (4)

(c) Derive integrated form of Kirchhoff 's equation assuming C_p to dependent on temperature. (4½)

4. (a) Define buffer and derive relation between pH and pK_b of a basic buffer. (4½)

(b) Derive relationship between hydrolysis constant K_h, and dissociation constant of base, K_b for the hydrolysis of a salt of strong acid and weak base. (4)

(c) Calculate the degree of hydrolysis of decimolar solution of ammonium acetate at 298 K. Dissociation constant of acetic acid and ammonium hydroxide are 1.75×10^{-5} and 1.81×10^{-5}, respectively at 298 K and K_w at 298 K is 1.008×10^{-14}. (4)