[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 6869 **D** **Your Roll No.....**

Unique Paper Code : 217586

Name of the Course : **B.Sc. (Prog.) Physcial Sciences**

Name of the Paper : CHCT–501 : Chemistry – I

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Both Section – A and Section – B are compulsory.
4. Attempt **three** questions from Section – A and **three** questions from Section – B.

1. Attempt **any five** parts from the following :

   (a) Write down the Schrodinger wave equation of Hydrogen atom. Describe the various terms involved. (3)

   (b) What do you understand by Heisenberg's Uncertainty principle ? (3)

   (c) Explain why CuCl is insoluble but NaCl is soluble in water. (3)

   (d) Explain the first law of thermodynamics giving its mathematical formulation. (3)

   (e) Explain why C_p is always greater than C_v. (3)

   (f) Derive an expression for the hydrolysis constant for a salt of weak acid and strong base. (3)

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SECTION – A

Attempt **any three** *questions.*

2. (a) Show the Born-Haber Cycle for the formulation of ionic NaCl. Give the meaning of each and every term used in the Cycle. (5)

   (b) Calculate the heat of formation of ionic KF crystal from the following data by the use of Born-Haber Cycle. Sublimation energy of potassium = 87.8 KJ/mol, Dissociation Energy for F_2 = 158.9 KJ/mol, Ionization Energy for K(g) = 414.2 KJ/mol, Electron affinity for F(g) = –334.7 KJ/mol, Lattice energy of KF = –807.5 KJ/mol. (3)

   (c) What is the physical significance of the Madelung's constant in the Born-Lande equation ? (2)

3. Give reasons for **any four** of the following : (2.5×4)

   (a) Melting point of BaO is very high.

   (b) KCl_2 is not formed.

   (c) NaCl has higher melting point than $AlCl_3$.

   (d) Bond angle of H_2O is greater than H_2S.

   (e) Highly charged ions are rare.

4. (a) Give the quantum mechanical expression and the physical significance of orthogonality principle. (3)

   (b) Explain the importance of the radial probability distribution curves and plot the same for 2s, 3s and 3p orbitals of H atom. (5)

   (c) Calculate the energy associated with the electron of a hydrogen atom in the fourth orbit (n=4). ($m=9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C, $h = 6.626 \times 10^{-34}$ Js) (2)

5. (a) Predict the shape and the type of hybridization in each of the following molecules : BCl_3, NH_3, SF_4, PCl_5, XeF_2 (5)

(b) Draw the MO diagram for NO molecule and calculate its bond order. (3)

(c) State the limitations of the VSEPR theory. (2)

SECTION – B

Attempt **any three** *questions*

6. (a) Calculate q, w, ΔU and ΔH for an adiabatic reversible and adiabatic irreversible expansion of an ideal gas. (6)

(b) The enthalpy of combustion of ethyl alcohol (C_2H_5OH) is 1380.7 KJ/mol. If the enthalpies of formation of CO_2 and H_2O are 394.5 and 286.6 KJ/mol respectively, calculate the enthalpy of formation of ethyl alcohol. (4)

7. (a) Derive the following relation for a salt of weak acid and strong base :

$pH = \frac{1}{2} [pKw + pKa + \log c]$ (6)

(b) What is the solubility of $Ag_2(CrO_4)$ in water if the value of the solubility product is $K_{sp} = 1.3 \times 10^{-11}\ M^3$? (4)

8. (a) Derive the following Thermodynamic expression :

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

Give the name of this equation. (5)

(b) Calculate the increase in entropy in the evaporation of one mole of water at 373K. Latent heat of vaporization of water is 2.26 KJ/g. (2)

(c) Show that : $\left(\frac{\partial T}{\partial p}\right)_S = \left(\frac{\partial V}{\partial S}\right)_p$. (3)

9. Write short notes on **any four** :

(i) Buffer Action of Basic Buffer (qualitative explanation)

(ii) Henderson-Hasselbalch equation for Acidic Buffer

(iii) Carnot Cycle for an ideal gas

(iv) Salt hydrolysis

(v) Intensive and extensive thermodynamic properties (2.5×4)