[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 8359 **C** **Roll No.....**

Unique Paper Code : 217586

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

Name of the Course : B.Sc. (Prog.) Physical Sciences, Part III (Concurrent Course)

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.

SECTION A (Inorganic Chemistry)

Attempt any **three** questions.
Question No. **1** is compulsory.

1. (a) Why dipole moment of NH_3 is greater than NF_3? (2)

(b) Write Schrödinger wave equation for single electron system. Define the various terms involved in the equation. (3)

(c) Give the values of quantum number (n, *l*, m and s) for an electron in 4f energy state. (2)

(d) Explain resonance in inorganic compounds.

OR

What is meant by normalization and orthogonality ? (2)

(e) Calculate the energy associated with the electron of a hydrogen atom in fourth orbit (n = 4). ($m = 9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C, $h = 6.625 \times 10^{-34}$ Js). (2)

P.T.O.

(f) Why ionic compounds have usually higher melting point while covalent compounds have low melting point ? (1.5)

2. (a) Discuss Born-Haber cycle for the determination of lattice energy with a suitable example. (4)

(b) Give reason : N_2 molecule is diamagnetic whereas O_2 molecule is paramagnetic. (4)

(c) What are the effects of the lone pair and electronegativity on the shapes of molecules ? (2.5)

(d) Explain why 2d and 3f orbitals are not possible ? (2)

3. (a) Write brief notes with examples on : (2×5)

(i) Hybridisation

(ii) Solvation energy and lattice energy

(iii) Heisenberg Uncertainty Principle

(iv) Orbit and Orbitals

(v) Aufbau's Principle

(b) Explain Radial Probability distribution curve. (2.5)

4. (a) Why σ bond is stronger than π bond ? (2)

(b) Explain why He_2 molecule does not exist ? (2)

(c) Using VSPER theory, predict the shapes of (i) BCl_3 (ii) SF_4 (iii) H_2O (iv) ClF_3. (4)

(d) Write Born Lande's equation and define the terms in it. (2.5)

(e) Explain why (2)

LiCl is insoluble in water but soluble in organic solvent

OR

XeF_2 is linear molecule but sp^3d hybridized.

SECTION B (Physical Chemistry)

Attempt any **three**.

1. (a) Derive the following relation for the salt formed from a weak acid and a strong base

$$pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log c \qquad (6)$$

(b) Calculate the enthalpy of formation of cane sugar ($C_{12}H_{22}O_{11}$) using the following data :

$C_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12CO_2(g) + 11H_2O(l)$ $\quad \Delta_r H = -5644$ kJ/mol

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\quad \Delta_r H = -286$ kJ/mol

Enthalpy of combustion of C(s) is –393 kJ/mol. (6.5)

2. (a) What do you understand by state function and path function ? Classify the following as state function and path function: work, heat, entropy, enthalpy. (4)

(b) Classify the following as strong and weak electrolyte: NaOH, NaCl, CH_3COOH, HCl, KNO_3. (2.5)

(c) Calculate the hydrolysis constant, degree of hydrolysis and pH of 10^{-2}mol dm^{-3} solution of NH_4Cl. Given K_b (NH_4OH) = 1.8×10^{-5}mol dm^{-3}. (6)

3. (a) Explain Hess's law of constant heat of summation with example. (5)

(b) Show that **(any 3)** (2.5×3)

(i) $C_p - C_v = nR$

(ii) $\left(\frac{\partial S}{\partial p}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_p$

P.T.O.

(iii) $P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$

(iv) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$

4. Write short notes on **(any five)** :

(i) Buffer solution

(ii) Law of conservation of energy

(iii) Bond Energy

(iv) Carnot cycle for Ideal gas

(v) Common Ion effect

(vi) Solubility Product (2.5×5)