[This question paper contains 4 printed pages.]

**Sr. No. of Question Paper : 8443** **C** **Roll No.....**

Unique Paper Code : 217151

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

Name of the Course : B.Sc. (H) Microbiology/Botany/Zoology/Bio-chemistry/ Bio-Medical

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.
2. Use separate answer-sheets for Section A and Section B.

## SECTION – A

Attempt **Three** questions in all.
Q. No. **1** is compulsory.

1. Answer the following briefly

   (a) Explain why orbitals like 1p, 2d and 3s are not permissible. (2)

   (b) What is the total Number of orbitals in 5g and 6h. (2)

   (c) What is the relation between polar co-ordinates and Cartesian co-ordinates ? (2)

   (d) On what factors the radial part of a wave function $R_{(r)}$ depends. What is the nodal point ? (2)

   (e) Highly charged ions are rare. Why ? (2)

   (f) Which is more covalent LiCl or KCl. (2)

   (g) The bond angle in $CH_4$ is 109° while in $NH_3$ is 107°. Why ? (1½)

2. (a) What is the significance of $\psi$ and $\psi^2$. (4)

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(b) What do you mean by dipole moment ? Calculate the ionic character of HF if its dipole moment is 1.92 D and bond distance 1.2 A°. (4)

(c) What is resonance ? Write the resonating structure for CO, $NH_3$ and $N_2O$. (4)

3. (a) Define with example Hunds rule of maximum spin multiplicity. Account for the ± ½ value assigned to spin quantum number. (4)

(b) Taking the example of $MgCl_2$ explain Born-Haber cycle. What is its significance ? (4)

(c) Born-Lande equation comprises of two energy terms, one term is attractive in nature and the other repulsive in nature. What are these terms ? Find lattice energy for NaCl crystal from the following data

$A = 1.75$, $r_o = 2.8$ A, $n = 9$, $N = 6.02 \times 10^{23}$, $e = 4.8 \times 10^{-10}$ esu. (4)

4. (a) What is hybridization ? Predict the shape of following molecules on the basis of hybridization

(i) $SnCl_2$ (ii) $SF_4$ (iii) $XeF_2$ (4)

(b) Draw radial probability distribution curve for :

(a) $n = 4$, $l = 0$ and (b) $n = 3$, $l = 2$ (2)

(c) What are conditions that $\psi$ must obey as a wave function. (2)

(d) $ZnCl_2$ is soluble in organic solvents but $MgCl_2$ is insoluble. Why ? (2)

(e) The dipole moment of $NH_3$ is more than $NF_3$. Why ? (2)

## SECTION B

Scientific calculator is allowed.
Attempt **three** Questions in all.
**Question No. 1** is compulsory.

1. Explain (Answer any **five**) : (2½×5)

(a) What are extensive properties ? State which of the following properties are extensive :

Density, volume, heat capacity and temperature.

(b) Why is the value of $C_p$ always greater than $C_v$. ? How are they related ?

(c) What is buffer solution .Give one example each of acidic buffer and basic buffer ?

(d) Explain Degree of hydrolysis and hydrolytic constant. Give the mathematical expression which relates them.

(e) Why phenolphthalein is suitable indicator for titration of strong acid against strong base ?

(f) Explain Hess's law of constant heat summation and its importance in thermochemistry.

2. (a) Show that pH of solution of a salt of weak acid and strong base is given by

$$pH = \tfrac{1}{2} (pk_w + pk_a + \log_{10}C) \qquad (3\tfrac{1}{2})$$

(b) Derive Henderson equation for pH of a basic buffer buffer solution. (3)

(c) Define solubility and solubility product of sparingly soluble salt ($AX_2$ type). If 20 $cm^3$ each of 0.01M $AgNO_3$ and 0.0004 M NaCl are mixed, will precipitation of AgCl occur ? Given ($K_{sp}(AgCl) = 1.7 \times 10^{-10}$). (3,3)

3. (a) Derive (any **three**) :

(i) $(\partial V/\partial S)_T = (\partial T/\partial P)_v$

(ii) $(\partial T/\partial P)_S = -(\partial V/\partial S)_P$

(iii) $H = G - T(\partial G/\partial T)_P$

(iv) $TV^{\gamma-1}$ = constant

All the symbols have their usual meanings. (2×3)

(b) Distinguish between bond enthalpy and bond dissociation enthalpy.

Calculate $\Delta H_{N-H}$ bond using the following data :

$\Delta H°_f(NH_3) = -46$ KJmol$^{-1}$

$\Delta H°_{diss.}$ $H_2(g) = 436$ KJmol$^{-1}$

$\Delta H°_{diss.}$ $N_2(g) = 941.3$ KJmol$^{-1}$ (4½)

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(c) Derive the expression of work done during reversible adiabatic expansion for one mole of ideal gas. (2)

4. (a) Write short note :– (any **three**) (3×3)

(i) Common-ion effect.

(ii) Kirchhoff's law

(iii) Efficiency of Carnot engine

(iv) Second law of thermodynamics

(v) Ionic product of water.

(b) Four moles of an ideal gas are compressed isothermally at 300K from $2.02 \times 10^5$ $Nm^{-2}$ to $4.04 \times 10^5$ $Nm^{-2}$ pressure. Calculate the free energy change for the process involved. (3½)