This question paper contains 8 printed pages]

Your Roll No. .....

5760

B.Sc. (Hons.) Botany/Zoology/Microbiology/ Bio-chemistry/I Sem. B

Paper CHCT-301

Chemistry

(Admission of 2010 and onwards)

Time : 3 *Hours* *Maximum Marks* : 75

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

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

Section A

Attempt *Three* questions in all.

Q. No. **1** is compulsory.

1. Explain the following :

   (*a*) $MgSO_4 \cdot 7H_2O$ is soluble in water whereas $BaSO_4$ is insoluble. 2

(*b*) Lattice energy of alkali metal fluorides decreases from LiF to CsF. 2

(*c*) CO_3^{2-} is planar anion while SO_3^{2-} is not. 2

(*d*) Hybrid orbitals form stronger bonds. 2

(*e*) Not more than two electrons can be accommodated in an orbital. 1.5

(*f*) XeF_2 is a linear molecule. 2

(*g*) H_2SO_4 is a syrupy liquid. 2

2. (*a*) Write down the Born-Lande equation and define the terms in it. 3

(*b*) Explain the high melting point of diamond. 3

(*c*) What is the physical significance of ψ^2. 3

(*d*) What is Born-Haber cycle ? Discuss its usefulness in explaining the stability of solids. 3

3. (*a*) Dipole moment of NH_3 is greater than that of NF_3. Explain. 3

(*b*) What do you understand by the term polarising power and polarisability ? How do these influence the character of a compound ? 4

(*c*) Predict the shape of IF_2^- and NO_2^+ using valence bond theory. 3

(*d*) What is the value of *l* for a 4*d* orbital ? 2

4. (*a*) What are radial probability distribution curves ? Explain. 3

(*b*) $SnCl_2$ is solid while $SnCl_4$ is liquid at room temperature. Explain. 3

(*c*) Explain Heisenberg's uncertainty principle. 3

(*d*) Bond angle in PH_3 is less than that in PF_3. Explain. 3

Or

(*a*) What is the lowest shell which has an *f*-subshell ? 2

(*b*) Which of the following will exhibit greater polarising power and why Ca^{2+} or Cu^{2+} ? 4

(*c*) Write resonance structures for N_3^-. 3

(*d*) All P-Cl bonds in PCl_5 are not equivalent. Explain. 3

Section B

Attempt *All* questions.

Log tables to be provided.

1. Explain giving reasons (any *five*) of the following :

(*i*) Change in a state function will always be zero in a cyclic process.

(*ii*) Heat of neutralization of a strong acid and a weak base is not equal to –57.36 kJ mol^{-1} at 298 K and 1 atm pressure.

(*iii*) Distinguish between reversible and irreversible process.

(*iv*) Efficiency of Carnot engine can never be unity.

(*v*) Differentiate between integral heat of solution and differential heat of solution.

(*vi*) An aqueous solution of NaCl is neutral whereas that of NH_4Cl is acidic.

(*vii*) $MgSO_4$ gives a precipitate with NH_3 but not with NH_3 and NH_4Cl solution. 2½×5

2. (*a*) Distinguish by giving example between : 4

(*i*) Open and closed system

(*ii*) Intensive and extensive property.

(*b*) Show that for an ideal gas undergoing reversible adiabatic changes : 5

(*i*) $PV^{\gamma} = \text{constant}$

(*ii*) $TV^{\gamma - 1} = \text{constant}$.

(*c*) Calculate q, w, ΔG, ΔH for a reversible isothermal expansion of one mole of an ideal gas at 27°C from a volume of 10 dm^3 to a volume of 20 dm^3.

($R = 8.314\ J\ K^{-1}\ mol^{-1}$) 3½

P.T.O.

Or

(*a*) Define Hess Law of Constant Heat Summation.

Calculate ΔH for the reaction :

$$2C + 2H_2 \rightarrow C_2H_4$$

given the experimental results :

(*i*) $C + O_2 \rightarrow CO_2 \quad \Delta H_{25°C} = -94$ kcal

(*ii*) $H_2 + \frac{1}{2} O_2 \rightarrow H_2O \quad \Delta H_{25°C} = -68.3$ kcal

(*iii*) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O \quad \Delta H_{25°C} = +342$ kcal. 4½

(*b*) Derive the Maxwell's relation :

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

(*ii*) $(\partial V/\partial T)_P = -(\partial S/\partial P)_T$.

(*iii*) Show that for an adiabatic expansion of one mole of an ideal gas :

$$\Delta S \text{ system} = C_P \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{P_2}{P_1}\right). \quad 6$$

(*c*) State the third law of thermodynamics. 2

3. (*a*) What is meant by "Degree of Hydrolysis" and "Hydrolysis Constant" ? 2

(*b*) Derive the relationship between K_h and dissociation constant of base for the hydrolysis of a salt of strong acid and a weak base. 3

(*c*) Define "Solubility Product". The solubility product of $Al(OH)_3$ is $K_{sp} = 8.5 \times 10^{-32}$. Calculate the solubility of $Al(OH)_3$ in gram per litre.

(Al = 27, O = 16, H = 1). 4½

(*d*) Explain why in qualitative analysis group II cations are precipitated as sulphides in acidic medium whereas group IV cations are precipitated as sulphides in basic medium. 3

Or

(*a*) Define Buffer giving *one* example each of acidic buffer and basic buffer. 3

(*b*) A buffer solution contains 0.2 mol of NH_3 and 0.25 mol of NH_4Cl per litre. Calculate pH of the solution.

[Given : K_b of $NH_3 = 1.81 \times 10^{-5}$ at room temperature.] 3

(*c*) Define acid-base indicator. Give the criteria for selection of an acid-base indicator. 3.

(*d*) Explain why phenolphthalein is an ideal indicator for CH_3COOH *Vs.* NaOH titration whereas methyl orange is an ideal indicator for NH_3 *Vs.* HCl titration. 3½