

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.

I. Explain the following:

- (a)  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  is soluble in water whereas  $\text{BaSO}_4$  is insoluble.

2

P.T.O.

- (b) Lattice energy of alkali metal fluorides decreases from LiF to CsF. 2
- (c)  $\text{CO}_3^{2-}$  is planar anion while  $\text{SO}_3^{2-}$  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)  $\text{XeF}_2$  is a linear molecule. 2
- (g)  $\text{H}_2\text{SO}_4$  is a syrupy liquid. 2
2. (a) Write down the Born-Landé equation and define the terms in it. 3
- (b) Explain the high melting point of diamond. 3
- (c) What is the physical significance of  $\psi^2$ . 3
- (d) What is Born-Haber cycle ? Discuss its usefulness in explaining the stability of solids. 3

3. (a) Dipole moment of  $\text{NH}_3$  is greater than that of  $\text{NF}_3$ .  
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  $\text{IF}_2^-$  and  $\text{NO}_2^+$  using valence bond theory. 3
- (d) What is the value of  $l$  for a  $4d$  orbital? 2
4. (a) What are radial probability distribution curves?  
Explain. 3
- (b)  $\text{SnCl}_2$  is solid while  $\text{SnCl}_4$  is liquid at room temperature.  
Explain. 3
- (c) Explain Heisenberg's uncertainty principle. 3
- (d) Bond angle in  $\text{PH}_3$  is less than that in  $\text{PF}_3$ . 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  $\text{Ca}^{2+}$  or  $\text{Cu}^{2+}$  ? 4
- (c) Write resonance structures for  $\text{N}_3^-$ . 3
- (d) All P-Cl bonds in  $\text{PCl}_5$  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  $-57.36 \text{ kJ mol}^{-1}$  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  $\text{NH}_4\text{Cl}$  is acidic.
- (vii)  $\text{MgSO}_4$  gives a precipitate with  $\text{NH}_3$  but not with  $\text{NH}_3$  and  $\text{NH}_4\text{Cl}$  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)  $TV^{\gamma-1} = \text{constant}$ .

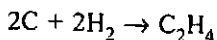
(c) Calculate  $q$ ,  $w$ ,  $\Delta G$ ,  $\Delta H$  for a reversible isothermal expansion of one mole of an ideal gas at  $27^\circ\text{C}$  from a volume of  $10 \text{ dm}^3$  to a volume of  $20 \text{ dm}^3$ .

( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ) 3½

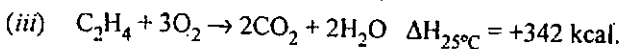
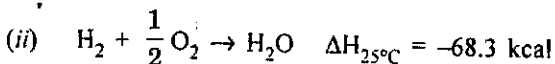
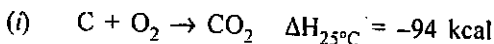
P.T.O.

Or

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

Calculate  $\Delta H$  for the reaction :

given the experimental results :



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  $\text{Al}(\text{OH})_3$  is  $K_{sp} = 8.5 \times 10^{-32}$ . Calculate the solubility of  $\text{Al}(\text{OH})_3$  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  $\text{NH}_3$  and 0.25 mol of  $\text{NH}_4\text{Cl}$  per litre. Calculate pH of the solution.

[Given :  $K_b$  of  $\text{NH}_3 = 1.81 \times 10^{-5}$  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  $\text{CH}_3\text{COOH}$  Vs.  $\text{NaOH}$  titration whereas methyl orange is an ideal indicator for  $\text{NH}_3$  Vs.  $\text{HCl}$  titration.  $3\frac{1}{2}$