

This question paper contains 8 printed pages]

Your Roll No.....

5703

B.Sc. (Hons.) PHYSICS/I Sem. B

Paper—CHCT-101 : 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

Answer any four questions.

1. (a) Calculate the lattice energy of NaCl crystal from the following data by the use of Born-Haber cycle : $3\frac{1}{2}$
- Sublimation energy of Na(S) = $108.7 \text{ kJ mol}^{-1}$
- Dissociation energy of $\text{Cl}_2(\text{g})$, $D = 225.9 \text{ kJ mol}^{-1}$
- Ionisation energy for Na(g), $(I) = 489.5 \text{ kJ mol}^{-1}$
- Electron affinity for Cl(g), $(E) = - 351.4 \text{ kJ mol}^{-1}$
- Heat of formation of NaCl(ΔH_f) = $- 414.2 \text{ kJ mol}^{-1}$.

P.T.O.

- (b) Which of the following complexes has higher value of Δ_0 and why ? 2×3
- (i) $[\text{V}(\text{H}_2\text{O})_6]^{2+}$ or $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
- (ii) $[\text{Rh}(\text{NH}_3)_6]^{3+}$ or $[\text{Ir}(\text{NH}_3)_6]^{3+}$
- (iii) $[\text{CoCl}_4]^{2-}$ Td or $[\text{Co}(\text{CN})_4]^{2-}$ planar.
2. (a) Sketch the crystal field splitting in a square planar complex. 4
- (b) Define John Teller theorem and give reasons why low spin octahedral Ni(II) complex will result into square planar complex. 5½
3. (a) For $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$, the mean pairing energy, P, is found to be $23,500 \text{ cm}^{-1}$. The magnitude of Δ_0 is $13,900 \text{ cm}^{-1}$. Calculate CFSE for the complex ion corresponding to high spin and low spin state. Which state is more stable ? 2+2+1
- (b) Draw the crystal field diagram of $[\text{Co}(\text{NH}_3)_6]^{3+}$ and predict its magnetic moment. 2½
- (c) How will you account for paramagnetic character of $[\text{CoF}_6]^{3-}$ on the basis of CFT. 2

4. (a) Sketch the MO diagram of NO and determine the bond order and predict the magnetic moment. $3+1\frac{1}{2}+1$
- (b) How will you use trans effect to synthesize cis and trans-[Pt(NH₃) NO₂.Cl₂][⊖] starting with [PtCl₄]²⁻. 4
5. (a) Explain the polarisation or π-bonding theory to account for trans effect in complex compounds. $3\frac{1}{2}$
- (b) Explain the ligand substitution reaction in octahedral complex by S_N² mechanism. 3
- (c) What are closed packed structures and sketch the unit cell in CsCl lattice ? 3
6. (a) Discuss the outer sphere mechanism for electron transfer reaction in complex compounds. 4
- (b) Give examples of complementary and non-complementary electron transfer reactions. $2\frac{1}{2}$
- (c) Discuss the factors affecting the rates of the direct electron transfer reactions. 3

(b) Convert the following Fischer formula to Sawhorse eclipsed and Sawhorse staggered forms. 4

(c) Write all possible Newman projection formulae for the various forms of *n*-butane and name them :

(i) Specify the dihedral angles

(ii) Specify the most stable and the least stable forms. 6½

2. (a) (i) Draw the enantiomers of tartaric acid 2, 3-dihydroxybutane—1, 4 dioic acid.

(ii) Assign R and S configurations to the chiral centres present in each case.

(Clearly write the steps used) 6+4

(b) Write the structures and names of optically active compounds with formula $C_3H_8O_2$. 2

3. (a) Accomplish the following transformations through a single step : 6

(i) phenol \rightarrow benzene

(ii) 1, 3-dinitrobenzene \rightarrow *m*-nitro aniline

(iii) aminobenzene \rightarrow phenyl isocyanide

(iv) benzoic acid \rightarrow benzyl alcohol.

- (b) What are A, B and D ? Write their structures and names : 4

(i) $C_7H_7NO \xrightarrow[\text{NaOH}]{\Delta} B + \text{gas with smell}$
Aromatic A.

(ii) $A \xrightarrow{\text{Br}_2 + \text{KOH}} D$ (soluble in aq. HCl).

- (c) Explain Saytzeff rule with suitable examples. 2

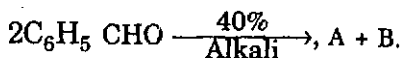
4. Explain why : 12

(a) 2, 4, 6-trinitrophenol is called picric acid ?

(b) Chlorine in vinyl chloride is less reactive than chlorine in allyl chloride ?

- (c) The chair conformation of cyclohexane is more stable than the boat conformation.
- (d) One of the following solvents is not suitable for determining the specific rotation of a chiral unknown sample. Explain which one and why :
water, methanol, 2-butanol.
5. (a) With reference to Baeyer's strain theory, calculate the angle strain in the following polygons : 6
- (i) Cyclopropane
 - (ii) Cyclopentane
 - (iii) Cyclohexane.
- (b) Define Hückel's rule and give *one* example each with explanation for : 6
- (i) Aromatic
 - (ii) Anti-aromatic
 - (iii) Alicyclic
 - (iv) Heterocyclic compound.

6. (a) Write the monomer units present in natural rubber and show their arrangement as cis or trans. 4
- (b) Write the components of Ziegler-Natta catalyst. 2
- (c) Mention 2 advantages of using Ziegler-Natta catalyst in polymerization. 3
- (d) What is diazonium chloride ? How is it prepared in the lab ? 3
7. (a) Write the products, name the reaction and outline the mechanism : 4



- (b) Nitration of toluene is much faster than nitration of nitrobenzene. Explain. 3
- (c) Specify the conditions under which different products are obtained in the halogenation of toluene (methyl benzene). Clearly write the products and name them. 5