

2008

**CHEMISTRY**

PAPER—CH - 1103

*Full Marks : 40*

*Time : 2 hours*

Answer **four** questions  
taking at least **two** from each Group

*The figures in the right-hand margin indicate marks*

*Candidates are required to give their answers in their  
own words as far as practicable*

*Illustrate the answers wherever necessary*

**GROUP—A**

1. (a) What do you mean by 'Trigger mechanism' ?

(b) Discuss Hill's equation.

(c) Write a note on 'N<sub>2</sub>-fixation'.

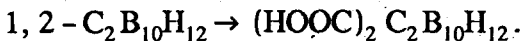
(d) What is "Hemosiderin".

2 + 3 + 3 + 2

(Turn Over)

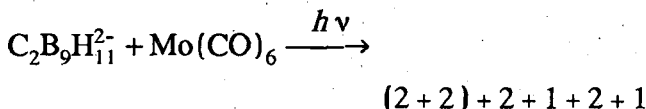
2. (a) How will you synthesize "ruthenates" ?
- (b) Write down the synthesis and structure of "Osminate" ?
- (c) What happen, when
- (i)  $\text{RuO}_4$  is treated with aq. HCl in presence of KCl.
- (ii)  $\text{OsF}_6$  is treated with CO in presence of  $\text{SbF}_5$ .
- (d) Write short note on  $\text{K}_2 [\text{Pt}(\text{CN})_4] \cdot 3\text{H}_2\text{O}$ .
- (e) How will you synthesize anh.  $\text{VOSO}_4$  ?
- (f) Write down the structure of  $\text{NbOCl}_3$ .  
 $1 + 2 + 3 + 2 + 1 + 1$
3. (a) Identify the core structure of the following species on the basis of Wade's rules :
- $\text{CB}_{10}\text{H}_{11}^-, (\eta^5 - \text{C}_5\text{H}_5) \text{Co}(\text{C}_2\text{B}_9\text{H}_{11})$ .
- (b) A borane molecule whose styx number is 4012, find out its formula and predict how many electron pair bonds are there.

(c) Carry out the following transformation :



(d) Justify that  $C_2B_9H_{11}^{2-}$  is more effective as a ligand than  $C_5H_5^-$ .

(e) Complete the following reaction :



4. (a) Derive the transformation matrix for rotation by an angle  $\phi$  about the  $y$ -axis of a point in  $xz$  plane.

(b) Chromium (II) fluoride and manganese (II) fluoride both have a central metal ion surrounded by six fluoride ligands. All the Mn-F bond distances are equivalent but all Cr-F bond distances are not equivalent. Provide an explanation.

(c) Discuss the role of the perfluoro chemicals (PFCs) as synthetic oxygen carriers.

- (d) What are the "Picket-fence" porphyrins and why they are used in model studies of oxygen binding to hemoglobin and myoglobin ?
- (e) What is Creutz Taube cation ?  $3 + 2 + 2 + 2 + 1$

## GROUP—B

5. (a) Prove that the vectors whose components are the characters of two different irreducible representations are orthogonal.
- (b) Considering P—O bond along  $z$ -axis, derive the matrix representation of vertical planes in  $\text{POCl}_3$  molecule.
- (c) Identify the point group for each of the following molecules :
- (i)  $\text{Be}(\text{CH}_3\text{COCHCOCH}_3)_2$  (ignore H atoms)
- (ii)  $\text{ClF}_2^+$
- (iii) Staggered  $\text{Cr}(\text{C}_6\text{H}_6)_2$
- (iv)  $\text{AsF}_4^-$ .

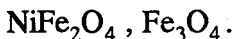
3 + 5 + 2

6. (a) Prove that if a  $C_4$  axis and one plane containing this axis exists then there must be a second plane which contain  $C_4$  axis and at an angle of  $45^\circ$  to the first one.

(b) Explain why the ligand field ( $d-d$ ) bands are shifted only slightly for  $[\text{CoX}(\text{NH}_3)_5]^{2+}$  ions ( $X^- = \text{F}^-, \text{Cl}^-, \text{Br}^-$  and  $\text{I}^-$ ), but charge-transfer bands are shifted greatly for the series?

(c) Prove that each element in a group has a unique inverse.

(d) Classify the following Oxides as normal or inverse spinel with explanation :



$$3 + 3 + 1 + 3$$

7. (a) Using "Great Orthogonality Theorem" prove that the sum of the squares of the characters in any irreducible representation equals to the order of the group.

(b) From the reaction of  $\text{NiBr}_2$  and  $\text{Ph}_2\text{EtP}$ , it is possible to isolate green crystals of  $[\text{Ni}(\text{Ph}_2\text{EtP})_2\text{Br}_2]$ , which have a magnetic moment of  $3.20$  B.M. and red crystals of  $[\text{Ni}(\text{Ph}_2\text{EtP})_2\text{Br}_2]$ , which have a magnetic moment of zero. When either of these is dissolved in dichloromethane at  $40^\circ\text{C}$ , the resulting solution has a magnetic moment of  $2.69$  B.M. Suggest structures for the green and red crystals and offer an explanation for the solution magnetic moment.

(c) The ligand to metal charge transfer bands increases in energy in the series :  $[\text{CoI}_4]^- < [\text{CoBr}_4]^- < [\text{CoCl}_4]^-$ . Explain.

(d) Explain why the electronic spectral bands due to  $d-d$  transitions in a transition metal complex are broad.  $3 + 3 + 2 + 2$

8. (a) Write notes on :

(i) Molybdenum blue

(ii) Ruthenium red.

(b) What are electron transport protein? Give examples.

(c) Discuss the origin of red colour of Rubredoxin.  $(3 \times 2) + 2 + 2$