

2014

CHEMISTRY

(Major)

Paper : 5.4

(Inorganic Chemistry)

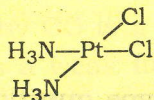
Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Objective-type questions (choose the correct answers) : 1×5=5

- Three-fold axes of symmetry are present in
 - octahedron
 - tetrahedron
 - trigonal bipyramid
 - All of the above
- The point group symmetry of the following complex



is

- T_d
- D_{4h}
- C_{2v}
- D_{2h}

3. The crystal field stabilization energy for a d^4 -ion in a weak octahedral field is

- (a) $0.4 \Delta_o$
- (b) $0.6 \Delta_o$
- (c) $0.8 \Delta_o$
- (d) $1.2 \Delta_o$

4. The catalytically important metal in Ziegler-Natta polymerization is

- (a) Rh
- (b) Al
- (c) Ti
- (d) Pd

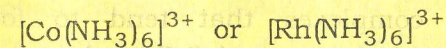
5. The metalloprotein which is involved in the storage of iron in living systems is

- (a) ferredoxin
- (b) haemoglobin
- (c) myoglobin
- (d) ferritin

Very short answer-type questions : 2×5=10

6. Why do five coordinate complexes commonly have a structure that is intermediate between trigonal bipyramidal and square pyramidal geometries?

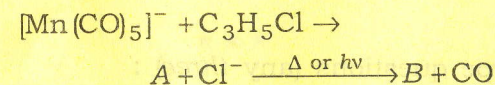
7. Which of the following complexes has a larger crystal field splitting parameter?



8. What is the M—M bond in the following compounds?

- (a) $\text{Mn}_2(\text{CO})_{10}$
- (b) $\text{K}_2\text{Re}_2\text{Cl}_8$

9. Identify A and B in the following reaction :



10. What is oxyhaemoglobin? What is the oxidation state of iron in this metalloprotein?

Short answer-type questions (any three) : 5×3=15

11. (a) Explain why CO is a strong field ligand while I^- is a weak field ligand.

(b) Write what are normal and inverse spinels giving examples. With the help of CFSE calculation, find out which type of spinel Mn_3O_4 is.

(4)

- (c) What is the basis of the 18-electron rule? What kind of ligands form complexes that tend to follow the 18-electron rule? Why does not $V(CO)_6$ follow this rule, while $Co(CO)_4$ dimerize to obey the rule?
- (d) Discuss the applications of organo-metallic compounds of zinc.
- (e) Write a short note on dioxygen toxicity.

Essay-type questions (any three) : $10 \times 3 = 30$

12. (a) What are symmetry elements and symmetry operations? Illustrate all possible symmetry elements of an octahedral complex (ML_6) with the help of a diagram. 10
- (b) Compare and contrast homogeneous and heterogeneous catalysis. Discuss the role of transition metal complexes as homogeneous catalysts for hydrogenation of alkenes by taking suitable examples. 3+7
- (c) What are essential and trace elements in biological systems? Discuss the importance of calcium in biology. 5+5

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(5)

- (d) Draw the catalytic cycle of the hydroformylation of alkenes in presence of cobalt carbonyl catalyst and discuss the reactions involved in various steps. 10
- (e) Give a brief description of molecular orbital theory as applied to coordination compounds. Construct a molecular orbital energy-level diagram for an octahedral complex involving metal-ligand σ -bonds only. 10

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3 (Sem-5) CHM M 4