

Total number of printed pages-7

3 (Sem-5) CHM M 4

2021

(Held in 2022)

CHEMISTRY

(Major)

Paper : 5:4

(Inorganic Chemistry)

Full Marks : 60

Time : Three hours

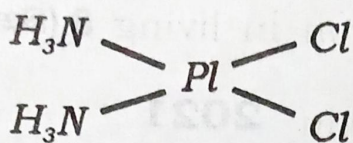
The figures in the margin indicate full marks for the questions.

Objective-type questions : (Choose the correct answers) $1 \times 7 = 7$

1. Three-fold axes of symmetry are present in
- (a) octahedron
 - (b) tetrahedron
 - (c) trigonal bipyramid
 - (d) All of the above

Contd.

2. The point group symmetry of the complex



is

(a) T_d

(b) D_{4h}

(c) C_{2v}

(d) D_{2h}

3. TEL is an/a

(a) ionic organometallic compound

(b) sigma-bonded organometallic compound

(c) electron-deficient organometallic compound

4. Vitamin B12 contains

(a) Zn

(b) Fe

(c) Co

(d) Mo

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

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

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

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

7. Each of the following contains a six-membered ring. Which molecule will have a six-fold (C_6) principal notation axis ?

- (a) Borazine
- (b) Pyridine
- (c) Benzene
- (d) S_6 -molecule

Very short answer-type questions : $2 \times 4 = 8$

8. Draw the structure of $Fe_2(CO)_9$, and verify the EAN rule for this complex.
9. Show all the symmetry elements present and assign the point-group symmetry of boric acid, $B(OH)_3$.
10. What is the $Cr-Cr$ bond order in the compound $Cr_2(N-O_2)(CH_3)_4(H_2O)_2$?
11. Predict the magnetic properties of the species $[COF_6]^{-3}$ and $[CO(NH_3)_6]^{+3}$.

Short answer-type questions : **(any three)**

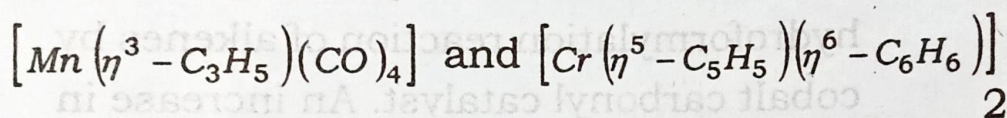
$5 \times 3 = 15$

12. (a) Explain why CO is a strong field ligand while I^- is a weak field ligand.
- (b) Write a short note on dioxygen toxicity.
- (c) Discuss the applications of organometallic compounds of zinc.

(d) Discuss the Dewar-Chatt-Duncanson theory of bonding in metal olefin complexes.

(e) (i) Explain the basis of 18-electron rule for octahedral organic complexes. 3

(ii) Verify the EAN rule for the organometallic compounds



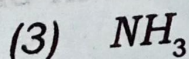
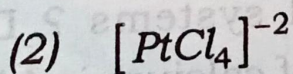
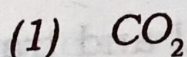
13. Answer the following essay-type questions :

(any three)

10×3=30

(a) (i) Discuss the conditions under which a group of symmetry elements forms a group.

(ii) Find the symmetry elements and respective point groups for the following molecules :



(b) (i) Discuss the functions of haemoglobin and myoglobin. Explain the terms 'cooperative effect' and 'Bohr effect'. 6

(ii) Give an account of toxicity arising from dioxygen in the living system. 4

(c) Discuss the catalytic cycle of hydroformylation reaction of alkenes by cobalt carbonyl catalyst. An increase in carbon monoxide (CO) partial pressure decreases the rate of cobalt catalyzed hydroformylation of 1-pentene suggest an interpretation of this observation.

6+4=10

(d) 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

(e) What are essential and trace elements in biological systems? Discuss the importance of calcium in biology.

5+5=10

- (f) 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=10
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