



Blue Print (As per PU Board)

Topic	1 mark questions	2 marks questions	3 marks questions	5 marks questions	Total Marks
Co-ordination Compounds	-	-	2	1	6

One mark questions

1. What is meant by a heteroleptic complex?

Answer: Complexes in which a metal is bound to more than one kind of donor groups (ligands) are known as heteroleptic complexes

2. Given an example of a hexadentate ligand?

Answer: $[EDTA]^{4-}$ or ethylenediamine tetra acetate ion.

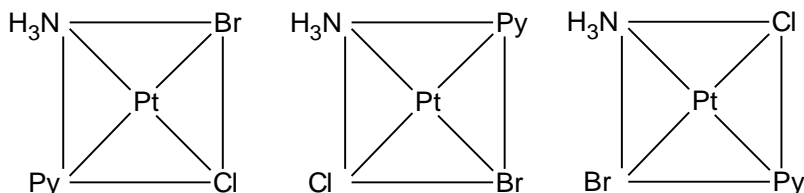
3. Write the IUPAC name of $[Co(NH_3)_6]Cl_3$

Answer: Hexaammine cobalt (III) chloride

Two marks questions

4. Write all the geometrical isomers of $[Pt(NH_3)(Br)(Cl)(Py)]$ and how many of these will exhibit optical isomers?

Answer:



(1 mark)

All will not show optical isomerism. Optical isomerism only rarely occurs in square planar or tetrahedral complexes and that too when they contain unsymmetrical chelating ligand. (1 mark)

5. Name two main factors that favours a metal ions forming complex.

Answer: (i) Smaller size of cation and higher charge

(1 mark)

(ii) Presence of vacant d-orbitals

(1 mark)

6. $CuSO_4 \cdot 5H_2O$ is blue in colour while $CuSO_4$ is colourless why?

Answer: In $CuSO_4 \cdot 5H_2O$, the H_2O molecules are present as ligands, therefore crystal field splitting occurs and hence $d-d$ transitions occurs which gives it blue colour. (1 mark)

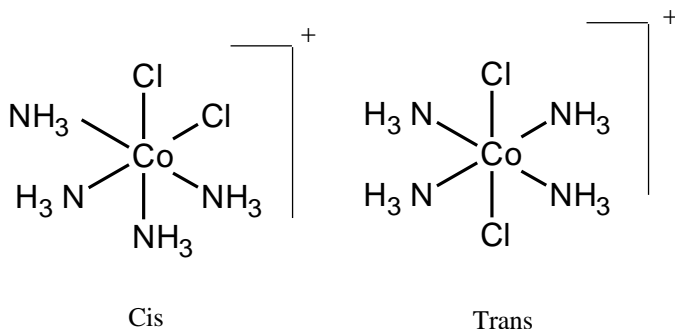
In $CuSO_4$, the absence of ligands makes it colourless. (1 mark)

Three marks questions

7. Give the IUPAC name of $[CoCl_2(NH_3)_4]Cl$. Draw cis and trans isomer of $[CoCl_2(NH_3)_4]$

Answer: Tetraammine dichlorido cobalt (III) chloride

(1 mark)



(2 marks)

8. (a) What is co-ordination isomerism? Give an example

(b) Write the IUPAC name of the complex: $[Ag(NH_3)_2][Ag(CN)_2]$ (2+1 marks)

Answer: (a) Co-ordination isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex. (2 marks)

Eg: $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are coordination isomers.

(b) Diammine silver (I) dicyanoargentate (I) (1 mark)

9. Give difference between $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ with respect to type of hybridisation, magnetic behaviour and geometry

Answer:

	Features	$[NiCl_4]^{2-}$	$[Ni(CN)_4]^{2-}$
(1)	Hybridisation	sp^3	dsp^2
(2)	Magnetic behaviour	Paramagnetic	Diamagnetic
(3)	Geometry	Tetrahedral	Square planar

(1 mark)

(1 mark)

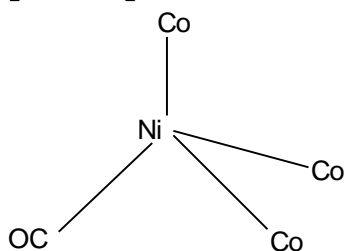
(1 mark)

Five marks questions

10. Explain bonding in metal carbonyls.

Answer: The homoleptic carbonyl compounds containing carbonyl ligands only are formed by most of the transition metals & have well defined structures.

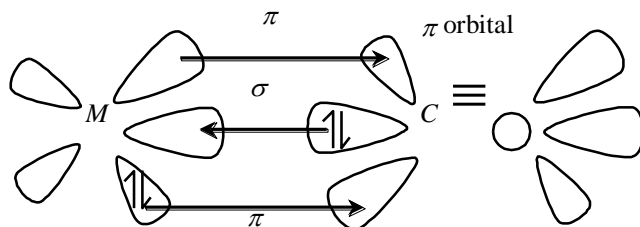
Eg: $[Ni(CO)_4]$ Tetra carbonyl nickel (0) is tetrahedral.



(1 mark)

The metal-carbon bond in metal carbonyls possess both σ & π character. The σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal.

The M - C π bond is formed by the donation of a pair of electrons from a filled d-orbital of metal into the vacant antibonding π^* orbital of carbon monoxide. The metal to ligand bonding creates a synergic effect which strengthens the bond (3 marks)



synergic bonding in M - CO

(1 mark)

11. (a) A complex of the type $[M(AA)_2X_2]^{n+}$ is known to be optically active. What does this indicate about the structure of the complex? Give one example of such complex. (2 marks)

Answer: An optically active complex of the type $[M(AA)_2X_2]^{n+}$ indicates *Cis*-Octahedral structure

(1 mark)

Eg: *Cis* $[Pt(en)_2Cl_2]^{2+}$ or *Cis* $[Cr(en)_2Cl_2]^+$

(1 mark)

- (b) Give the electronic configuration of the following complexes on the basis of crystal field splitting theory. $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$ and $[Cu(NH_3)_6]^{2+}$

Answer: $[CoF_6]^{3-}$, Co^{3+} has d^6 configuration with $t_{2g}^4 e_g^2$. (1 mark)

$[Fe(CN)_6]^{4-}$, Fe^{2+} has d^6 configuration with $t_{2g}^6 e_g^0$ (1 mark)

$[Cu(NH_3)_6]^{2+}$, Cu^{2+} has d^9 configuration with $t_{2g}^6 e_g^3$ (1 mark)

12. (a) What are the short comings of valence bond theory for bonding in complexes? (3 marks)

(b) Briefly describe crystal field theory. (2 marks)

Answer: (a) (i) The theory does not explain the colour and spectra of complexes. (1 mark)

(ii) It does not make exact predictions regarding tetrahedral and square planar structure of complexes.

(iii) It does not distinguish between weak and strong field ligands.

(b) Crystal Field Theory: CFT is an electrostatic model which considers the metal-ligand bond to be purely ionic & ligands are treated as point charges.

It is based on the effect of different crystal fields provided by different ligands on the degeneracy of d-orbital energies of the central metal atom/ion. This splitting of d-orbitals provides different electronic arrangements in strong and weak crystal fields. (1 mark)