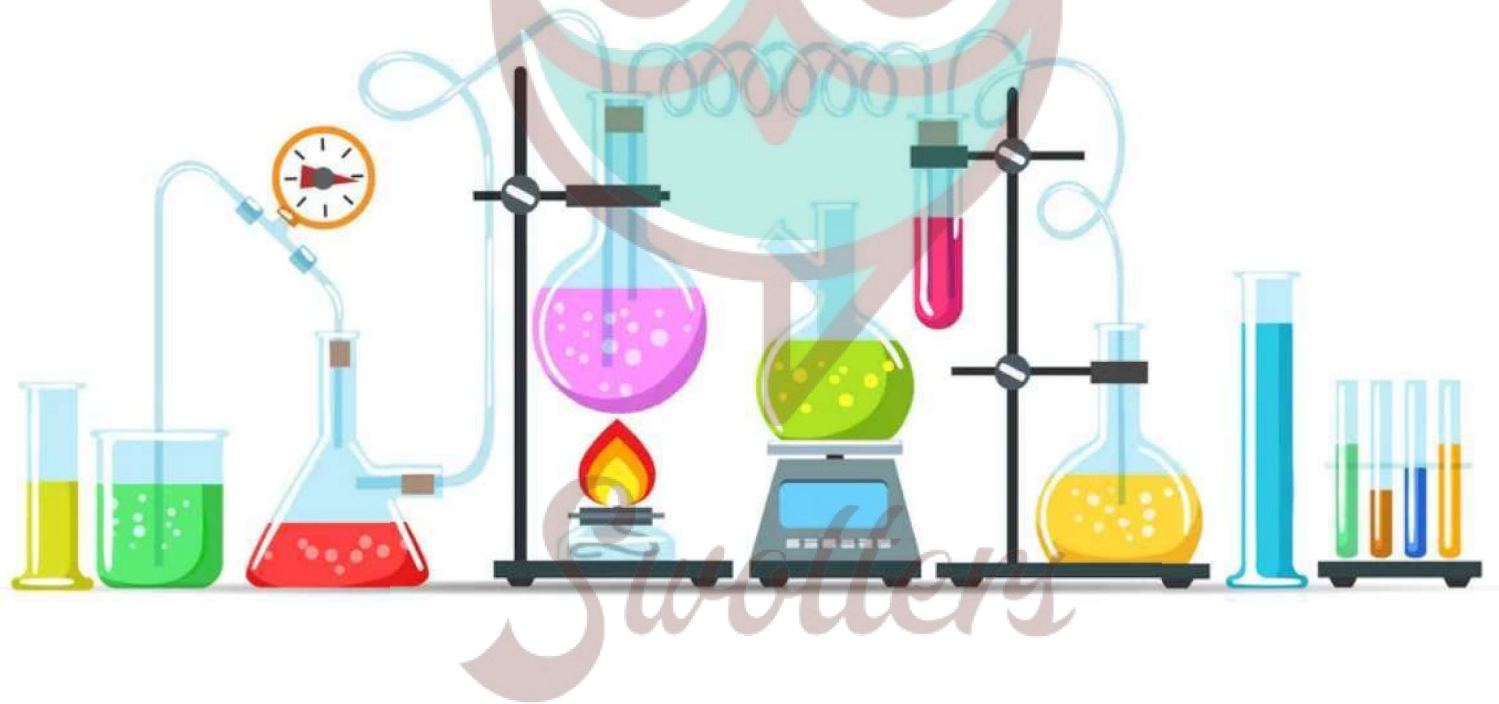


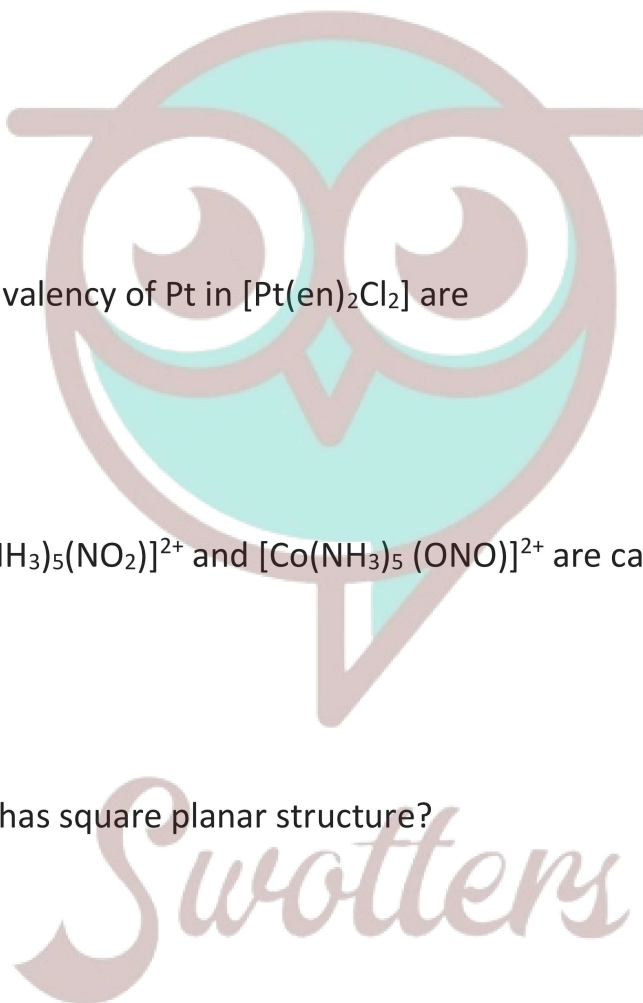
CHEMISTRY



Important Questions

Multiple Choice questions-

- IUPAC name of $[\text{Pt}(\text{NH}_3)_3 \text{Br} (\text{NO}_2) \text{Cl}] \text{Cl}$ is
(a) triamminechlorodibromidoplatinum (IV) chloride
(b) triamminechloridobromidonitrochloride- platinum (IV) chloride
(c) triamminebromidochloridonitroplatinum (IV) chloride
(d) triamminenitrochlorobromoplatinum (IV) chloride
- Turnbull's blue is
(a) Ferricyanide
(b) Ferrous ferricyanide
(c) Ferrous cyanide
(d) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_4$
- Primary and secondary valency of Pt in $[\text{Pt}(\text{en})_2\text{Cl}_2]$ are
(a) 4, 4
(b) 4, 6
(c) 6, 4
(d) 2, 6
- The complex ions $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ and $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$ are called
(a) Ionization isomers
(b) Linkage isomers
(c) Co-ordination isomers
(d) Geometrical isomers
- Which of the following has square planar structure?
(a) $[\text{NiCl}_4]^{2-}$
(b) $[\text{Ni}(\text{CO})_4]$
(c) $[\text{Ni}(\text{CN})_4]^{2-}$
(d) None of these
- Which of the following has magnesium?
(a) Chlorophyll
(b) Haemocyanin
(c) Carbonic anhydrate
(d) Vitamin B₁₂
- Mohr's salt is
(a) $\text{Fe}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
(b) $\text{FeSO}_4 \cdot (\text{NH}_4)_2 \cdot \text{SO}_4 \cdot 6\text{H}_2\text{O}$



(c) $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

(d) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

8. Which of the following shall form an octahedral complex?

(a) d^4 (low spin)

(b) d^8 (high spin)

(c) d^6 (low spin)

(d) All of these

9. EDTA is used for the estimation of

(a) Na^+ and K^+ ions

(b) Cl^- and Br^- ions

(c) Cu^{2+} and Cs^+ ions

(d) Ca^{2+} and Mg^{2+} ions

10. The solution of the complex $[\text{Cu}(\text{NH}_3)_4] \text{SO}_4$ in water will

(a) give the tests of Cu^{2+} ion

(b) give the tests of NH_3

(c) give the tests of SO_4^{2-} ions

(d) not give the tests of any of the above

Very Short Questions-

1. What is the shape of $[\text{Fe}(\text{CO})_5]$?

2. What do you understand by stability of a complex and instability constant of coordination compounds?

3. How is EDTA used in estimation of hardness of water?

4. Explain the role of complexes in metallurgy with an example.

5. How is excess of copper and iron removed from body?

6. Define – isomerism.

7. Indicate the types of isomerisms shown by the complex $-\text{K}[\text{Fe}(\text{H}_2\text{O})_2(\text{en})_2\text{Cl}_2]$?

8. Give an example of coordination isomerism?

9. What are complex compounds?

10. Give some examples of coordination compounds.

Short Questions-

1. Explain the synergic bonding in metal carbonyls.

2. Give some examples showing importance of complexes in biological system?

3. Give examples of complexes in

a) Chemical analysis

b) Industries

4. Distinguish between homoleptic and heteroleptic ligands.

5. What are the different shapes or coordination polyhedral in the complexes?

6. What is the difference between a double salt and a complex? Explain with an example.

7. Predict the number of unpaired electrons in the square planar $[\text{Pt}(\text{CN})_4]^{2-}$ ion.

8. Write all the geometrical isomers of $[\text{Pt}(\text{NH}_3)(\text{Br})(\text{Cl})(\text{py})]$ and how many of these will exhibit optical isomers?

9. What is spectrochemical series? Explain the difference between a weak field ligand and a strong field ligand.

10. A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green but a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless. Explain.

Long Questions-

1. What are ligands? Explain different types of ligands.

2. Write the formulas for the following coordination compounds:

(i) Tetraammineaqua cobalt (III) chloride

(ii) Potassium tetracyanonickelate (II)

(iii) Tris(ethane-1,2-diamine) chromium (III) chloride

(iv) Amminebromidochloridonitrito-N-platinate (II)

(v) Dichloridobis(ethane-1,2-diamine)platinum(IV) nitrate

(vi) Iron (III) hexacyanoferrate (II)

3. Write the IUPAC names of the following coordination compounds:

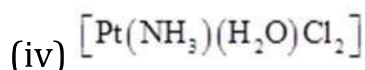
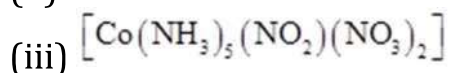
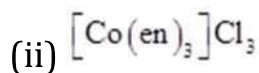
(i) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ (ii) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$

(iii) $\text{K}_3[\text{Fe}(\text{CN})_6]$ (iv) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$

(v) $\text{K}_2[\text{PdCl}_4]$ (vi) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NH}_2\text{CH}_3)]\text{Cl}$

4. Indicate the types of isomerism exhibited by the following complexes and draw the structures for these isomers:

(i) $\text{K}[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]$



5. Explain on the basis of valence bond theory that $[\text{Ni}(\text{CN})_4]^{2-}$ ion with square planar structure is diamagnetic and the $[\text{NiCl}_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.

6. $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why?

7. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is strongly paramagnetic whereas $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic. Explain.

8. Explain $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex.

Assertion and Reason Questions-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.
- Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- Assertion is correct statement but reason is wrong statement.
- Assertion is wrong statement but reason is correct statement.

Assertion: Zeise's salt is a $\pi\pi$ -bonded organometallic compound.

Reason: The oxidation number of platinum in Zeise's salt is +2.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.
- Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

Assertion: The second and third transition series elements have lesser tendency to form low spin complex as compared to the first transition series.

Reason: The CFSE (Δ_0) is more for 5d and 4d.

Case Study Questions-

1. Read the passage given below and answer the following questions:

Metal carbonyl is an example of coordination compounds in which carbon monoxide (CO) acts as ligand. These are also called homoleptic carbonyls. These compounds contain both σ and π character. Some carbonyls have metal-metal bonds. The reactivity of metal carbonyls is due to (i) the metal centre and (ii) the CO ligands. CO is capable of accepting an appreciable amount of electron density from the metal atom into their empty π^* or π^* -orbital. These types of ligands are called π -acceptor or π -acid ligands. These interactions increase the Δ_0 value.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) What is the oxidation state of metal in $[\text{Mn}_2(\text{CO})_{10}]$?

- a) +1
- b) -1
- c) +2
- d) 0

(ii) Among the following metal carbonyls, the C-O bond order is lowest in:

- a) $[\text{Mn}(\text{CO})_6]^+$
- b) $[\text{Fe}(\text{CO})_5]$
- c) $[\text{Cr}(\text{CO})_6]$
- d) $[\text{V}(\text{CO})_6]^-$

(iii) Which of the following can be reduced easily?

- a. $\text{V}(\text{CO})_6$
- b. $\text{Mo}(\text{CO})_6$
- c. $[\text{Co}(\text{CO})_4]^-$
- d. $\text{Fe}(\text{CO})_5$

(iv) The oxidation state of cobalt in $K[Co(CO)_4]$ is:

- a. +1
- b. +3
- c. -1
- d. 0

(v) Structure of decacarbonyl manganese is:

- a. Trigonal bipyramidal
- b. Octahedral
- c. Tetrahedral
- d. Square pyramidal

2. Read the passage given below and answer the following questions:

Coordination compounds are formulated and named according to the IUPAC system.

Few rules for naming coordination compounds are:

- I. In ionic complex, the cation is named first and then the anion.
- II. In the coordination entity, the ligands are named first and then the central metal ion.
- III. When more than one type of ligands are present, they are named in alphabetical order of preference without any consideration of charge.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) The IUPAC name of the complex $[Pt(NH_3)_3Br(NO_2)Cl]Cl$ is:

- a) Triamminechlorobromonitroplatinum (IV) chloride.
- b) Triamminebromonitrochloroplatinum (IV) chloride.
- c) Triamminebromidochloridonitroplatinum (IV) chloride.
- d) Triamminenitrochlorobromoplatinum (IV) chloride.

(ii) The IUPAC name of $[Ni(CO)_4]$ is:

- a) Tetracarbonylnickel (II).
- b) Tetracarbonylnickel (0).
- c) Tetracarbonylnickelate (II).
- d) Tetracarbonylnickelate (0).

(iii) As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is:

- a) Tetraaquadiamminecobalt (II) chloride.

- b) Tetraaquadiammincobalt (III) chloride.
- c) Diamminetetraaquacobalt (II) chloride.
- d) Diamminetetraaquacobalt (III) chloride.

(iv) Which of the following represents correct formula of dichloridobis(ethane -1, 2-diamine)cobalt (III) ion?

- a) $[\text{CoCl}_2(\text{en})]^{2+}$
- b) $[\text{CoCl}_2(\text{en})_2]^{2+}$
- c) $[\text{CoCl}_2(\text{en})]^+$
- d) $[\text{CoCl}_2(\text{en})_2]^+$

(v) Correct formula of pentaamminenitro-O-cobalt (III) sulphate is:

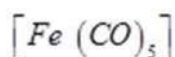
- a) $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]\text{SO}_4$
- b) $[\text{Co}(\text{ONO})(\text{NH}_3)_5]\text{SO}_4$
- c) $[\text{Co}(\text{NO}_2)(\text{NH}_3)_4](\text{SO}_4)_2$
- d) $[\text{Co}(\text{ONO})(\text{NH}_3)_4](\text{SO}_4)_2$

MCQ Answers-

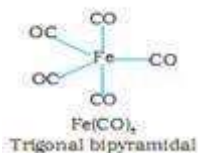
1. Answer: c
2. Answer: b
3. Answer: d
4. Answer: b
5. Answer: c
6. Answer: a
7. Answer: b
8. Answer: b
9. Answer: d
10. Answer: c

Very Short Answers-

Ans 1.



Geometry = Trigonal bipyramidal/span>



Ans 2. The stability of a complex in solution is the degree of association between the two species involved in the state of equilibrium. The instability constant is reciprocal of the formation constant. It is also called dissociation constant.

Ans 3. Hard water is titrated with $\text{Na}_2\text{-EDTA}$ complex for estimation of its hardness. During the process, the Ca^{2+} and Mg^{2+} ions form complex with EDTA replacing Na^+ . The method is based on the difference in the stability constant of calcium and magnesium complexes.

Ans 4. Some extraction processes make use of complex formation e.g. during metallurgy of Gold, it combines with cyanide in the presence of oxygen and water to form the complex $[\text{Au}(\text{CN})_2]^-$ in aqueous solution by addition of zinc.

Ans 5. Excess of copper and iron are removed by chelating Ligands D - penicillamine and deferoxamine B through the formation of coordination compounds.

Ans 6. Isomerism is the phenomenon of existence of two or more compounds with same chemical formula but a different arrangement of atoms.

Ans 7. Both geometrical and optical isomerisms will be present.

Ans 8. Example of coordination isomerism is

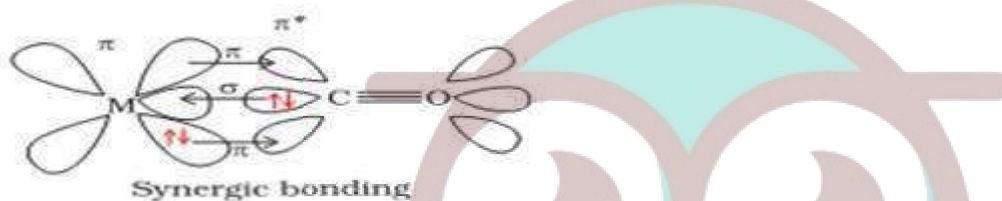


Ans 9. Complex compounds or coordination compounds are those compounds in which the metal atoms are bound to a number of anions or neutral molecules.

Ans 10. Examples of coordination compounds are chlorophyll, haemoglobin, and vitamin B_{12}

Short Answers-

Ans 1. The metal – carbon bond in metal carbonyls has both s & P- character. The M – C σ bond is formed by donation of lone pair of electrons of carbonyl carbon into a vacant orbital of metal. The M – C π bond is formed by the donation of a pair of electrons from a filled d- orbital of metal to the vacant π^* orbital of carbon monoxide. The metal to ligand bonding creates a synergic effect that strengthens the bond.



Ans 2. Examples of complexes in biological system-

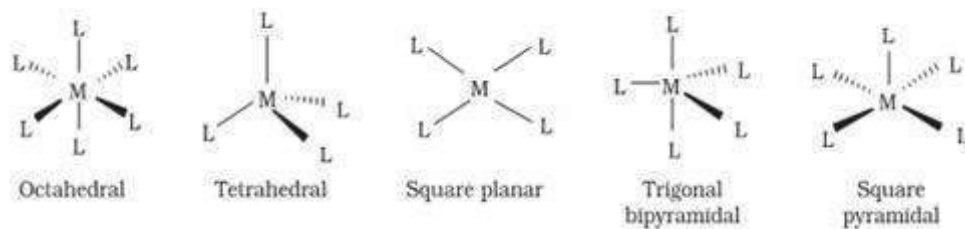
1. Chlorophyll is a complex of Mg.
2. Haemoglobin is a complex of iron.
3. Cyanocobalamin, Vit B_{12} , is a complex of cobalt.

Ans 3. (a) Chemical analysis – Qualitative and Quantitative analysis methods involve use of Ligands like EDTA, DMG etc.

(b) Industries - Hydrogenation of alkenes is done by using a sodium complex called Wilkinson catalyst. In black and white photography, silver complexes are used.

Ans 4. Homoleptic complexes are those in which only one type of ligand or donor group is present e.g. $[Pt(NH_3)_6]^{2+}$ has only NH_3 as ligand. Whereas heteroleptic complexes are those in which different types of ligands are present eg. $[Pt(NH_3)_4Cl_2]^+$ has two type of ligands- NH_3 and Cl^- .

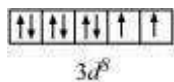
Ans 5. The various coordination polyhedra are –



Ans 6. Double salts dissociate completely into simple ions when dissolved in water e.g., Mohr salt, $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ will dissolve in water and give ferrous, ammonium and sulphate ions. On the other hand, the complex ions do not completely dissociate into all constituent ions e.g. $K_4[Fe(CN)_6]$ will dissociate to give potassium ions and $[Fe(CN)_6]^{4-}$ ions only.

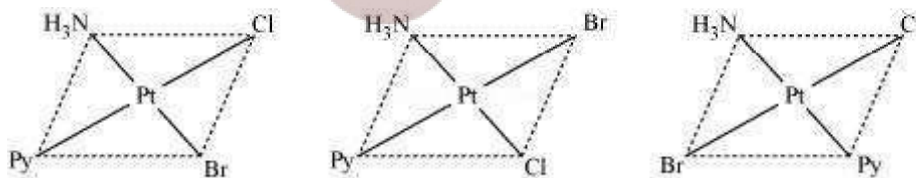
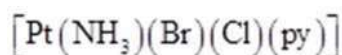
Ans 7. $[Pt(CN)_4]^{2-}$

In this complex, Pt is in the +2 state. It forms a square planar structure. This means that it undergoes dsp^2 hybridization. Now, the electronic configuration of Pd(+2) is $5d^8$.



CN^- being a strong field ligand causes the pairing of unpaired electrons. Hence, there are no unpaired electrons in $[Pt(CN)_4]^{2-}$.

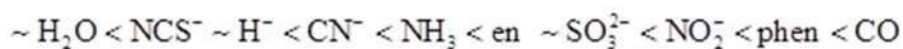
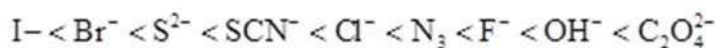
Ans 8.



From the above isomers, none will exhibit optical isomers. Tetrahedral complexes rarely show optical isomerization. They do so only in the presence of unsymmetrical chelating agents.

Ans 9. A spectrochemical series is the arrangement of common ligands in the increasing order of their crystal-field splitting energy (CFSE) values. The ligands present on the R.H.S

of the series are strong field ligands while that on the L.H.S are weak field ligands. Also, strong field ligands cause higher splitting in the d orbitals than weak field ligands.



Ans 10. In $[Ni(H_2O)_6]^{2+}$, $H_2\ddot{O}$ is a weak field ligand. Therefore, there are unpaired electrons in Ni^{2+} . In this complex, the d electrons from the lower energy level can be excited to the higher energy level i.e., the possibility of $d-d$ transition is present. Hence, $[Ni(H_2O)_6]^{2+}$ is coloured.

In $[Ni(CN)_4]^{2-}$, the electrons are all paired as CN^- is a strong field ligand. Therefore, $d-d$ transition is not possible in $[Ni(CN)_4]^{2-}$. Hence, it is colourless.

Long Answers-

Ans 1. The ions or molecules bound to central atom or ion in the coordination entity are ligands e.g. $[Fe(CN)_6]^{4-}$ has six CN^- ligands.

Types: -

(1) On the basis of charges on them ligands can be negative, positive (e.g. H_3O^+ , NH_4^+ etc.) or neutral (e.g. CO , NH_3 , H_2O).

(2) On the basis of their donor atoms ligands can be monodentate or unidentate (one donor atom) e.g. H_2O , NH_3 , Cl^- etc, or didentate ligands (two donor atoms) $H_2NCH_2CH_2NH_2$ or $C_2O_4^{2-}$ etc. or polydentate (several donor atoms) e.g. $[EDTA]^{4-}$ is a hexadentate ligand.

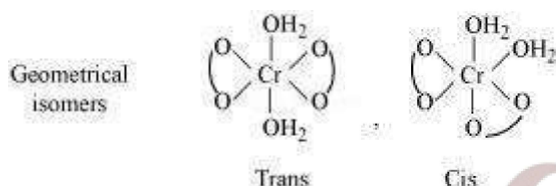
(3) Ligands which can ligate through two different atoms are called ambidentate ligands eg. NO_2^- and SCN^- ions. Whereas when a di- or polydentate ligand uses its two or more donor atoms to bind a single metal ion, it is called chelate ligand.

Ans 2.

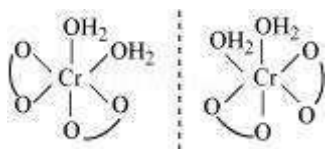
- (i) $[\text{Co}(\text{H}_2\text{O})_2(\text{NH}_3)_4]\text{Cl}_3$
 (ii) $\text{K}_2[\text{Ni}(\text{CN})_4]$
 (iii) $[\text{Cr}(\text{en})_3]\text{Cl}_3$
 (vi) $[\text{Pt}(\text{NH}_3)_3\text{BrCl}(\text{NO}_2)]^-$
 (v) $[\text{PtCl}_2(\text{en})_2](\text{NO}_3)_2$
 (vi) $\text{Fe}_4[\text{Fe}(\text{CN})_5]_3$

- Ans 3. (i)** Hexaamminecobalt(III) chloride
(ii) Pentaamminechloridocobalt(III) chloride
(iii) Potassium hexacyanoferrate(III)
(iv) Potassium trioxalatoferrate(III)
(v) Potassium tetrachloridopalladate(II)
(vi) Diamminechlorido(methylamine)platinum(II) chloride

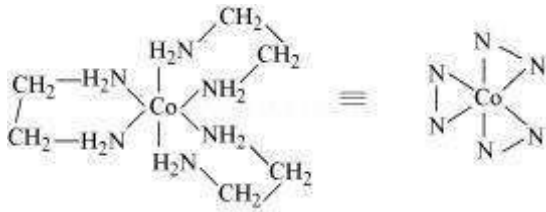
Ans 4. Both geometrical (*cis-*, *trans-*) isomers for $\text{K}[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]$ can exist. Also, optical isomers for *cis* isomer exist.



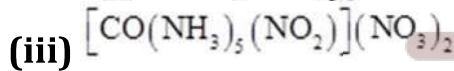
Trans-isomer is optically inactive. On the other hand, *cis* isomer is optically active.



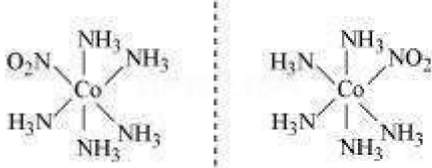
- (ii)** Two optical isomers for $[\text{Co}(\text{en})_3]\text{Cl}_3$ exist.



Two optical isomers are possible for this structure.



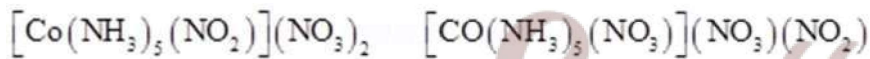
A pair of optical isomers:



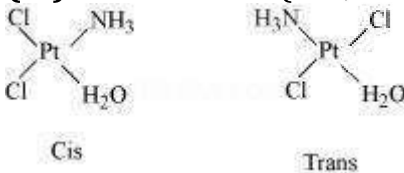
It can also show linkage isomerism.



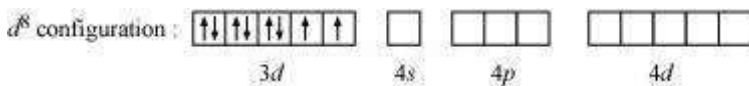
It can also show ionization isomerism.



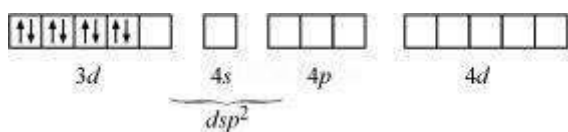
(iv) Geometrical (*cis*-, *trans*-) isomers of $[\text{Pt}(\text{NH}_3)(\text{H}_2\text{O})\text{Cl}_2]$ can exist.



Ans 5. Ni is in the +2-oxidation state i.e., in d^8 configuration.

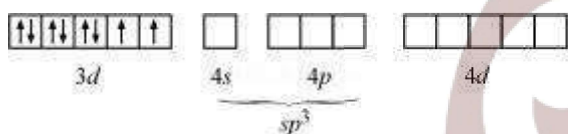


There are 4 CN^- ions. Thus, it can either have a tetrahedral geometry or square planar geometry. Since CN^- ion is a strong field ligand, it causes the pairing of unpaired $3d$ electrons.



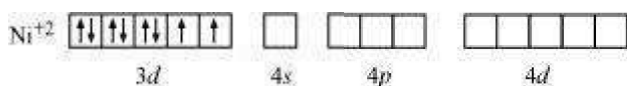
It now undergoes dsp^2 hybridization. Since all electrons are paired, it is diamagnetic.

In case of $[\text{NiCl}_4]^{2-}$, CN^- ion is a weak field ligand. Therefore, it does not lead to the pairing of unpaired $3d$ electrons. Therefore, it undergoes sp^3 hybridization.

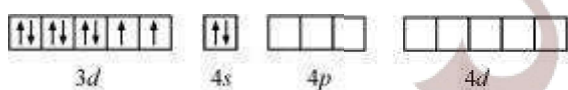


Since there are 2 unpaired electrons in this case, it is paramagnetic in nature.

Ans 6. Though both $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$ are tetrahedral, their magnetic characters are different. This is due to a difference in the nature of ligands. CN^- is a weak field ligand and it does not cause the pairing of unpaired $3d$ electrons. Hence, $[\text{NiCl}_4]^{2-}$ is paramagnetic.



In $\text{Ni}(\text{CO})_4$, Ni is in the zero-oxidation state i.e., it has a configuration of $3d^8 4s^2$.



But CO is a strong field ligand. Therefore, it causes the pairing of unpaired $3d$ electrons. Also, it causes the $4s$ electrons to shift to the $3d$ orbital, thereby giving rise to sp^3 hybridization. Since no unpaired electrons are present in this case, $[\text{Ni}(\text{CO})_4]$ is diamagnetic.

Ans 7. In both $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{3-}$, Fe exists in the +3-oxidation state i.e., in d^5 configuration.



Since CN^- is a strong field ligand, it causes the pairing of unpaired electrons. Therefore, there is only one unpaired electron left in the d -orbital.



Therefore,

$$\mu = \sqrt{n(n+2)}$$

$$= \sqrt{1(1+2)}$$

$$= \sqrt{3}$$

$$= 1.732 \text{ BM}$$

On the other hand, H_2O is a weak field ligand. Therefore, it cannot cause the pairing of electrons. This means that the number of unpaired electrons is 5.

Therefore,

$$\mu = \sqrt{n(n+2)}$$

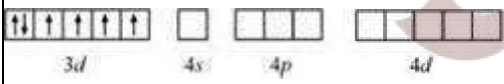
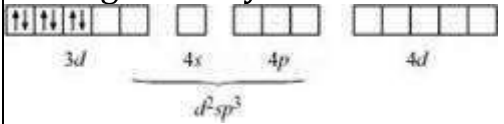
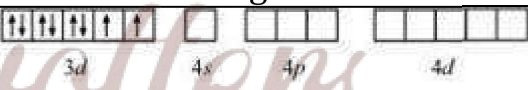
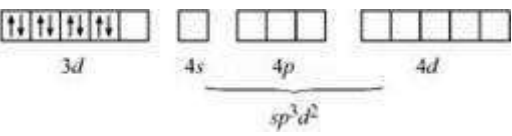
$$= \sqrt{5(5+2)}$$

$$= \sqrt{35}$$

$$= 6 \text{ BM}$$

Thus, it is evident that $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is strongly paramagnetic, while $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic.

Ans 8.

$[\text{Co}(\text{NH}_3)_6]^{3+}$	$[\text{Ni}(\text{NH}_3)_6]^{2+}$
Oxidation state of cobalt = +3	Oxidation state of Ni = +2
Electronic configuration of cobalt = d^6	Electronic configuration of nickel = d^8
 <p>NH_3 being a strong field ligand causes the pairing. Therefore, Cobalt can undergo d^2sp^3 hybridization.</p>  <p>Hence, it is an inner orbital complex.</p>	 <p>If NH_3 causes the pairing, then only one $3d$ orbital is empty. Thus, it cannot undergo d^2sp^3 hybridization. Therefore, it undergoes sp^3d^2 hybridization.</p>  <p>Hence, it forms an outer orbital complex.</p>

Assertion and Reason Answers-

1. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation:

In these complexes, the metal and ligand form a bond that involves the π -electrons of the ligand and so it is a π -bonded organometallic compound.

2. (d) Assertion is wrong statement but reason is correct statement.

Explanation:

4d and 5d elements have greater tendency to form low spin complex (allows better pairing of electrons) in comparison to 3d because the difference in energy of t_{2g} and e_g (CFSE, Δ_0) increases in 4d and 5d.

Case Study Answers-

1. Answer :

(i) (d) 0

Explanation:

Oxidation state of Mn in $[\text{Mn}_2(\text{CO})_{10}]$ is zero.

(ii) (d) $[\text{V}(\text{CO})_6]^-$

Explanation:

In $[\text{V}(\text{CO})_6]^-$, the anionic carbonyl complex can delocalise more electron density to antibonding π -orbital ($d\pi-p\pi$ back bonding) of CO and thus lowers the bond order.

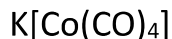
(iii) (a) $\text{V}(\text{CO})_6$

Explanation:

$\text{V}(\text{CO})_6$ can be easily reduced to $[\text{V}(\text{CO})_6]^-$. $\text{V}(\text{CO})_6$ has a total of 17 bonding electrons, hence it is very reactive and unstable. $[\text{V}(\text{CO})_6]^-$ on the other hand has complete set of 18 bonding electrons as an electron is added into the bonding orbital when $\text{V}(\text{CO})_6$ gets reduced to $[\text{V}(\text{CO})_6]^-$. All others have 18 bonding electrons.

(iv) (c) -1

Explanation:



$$+1 + (x) + 4(0) = 0 \text{ or } x = -1$$

(v) (d) Square pyramidal.

Explanation:

$Mn_2(CO)_{10}$ is made up of two square pyramidal $Mn(CO)_5$ units joined by Mn-Mn bond.

2. Answer :

(i) (c) Triamminebromidochloridonitroplatinum (IV) chloride.

Explanation:

Ligands are named in alphabetical order irrespective of their charge.

(ii) (b) Tetracarbonylnickel (0).

(iii) (d) Diamminetetraaquacobalt (III) chloride.

(iv) (d) $[CoCl_2(en)_2]^+$

(v) (b) $[Co(ONO)(NH_3)_5]SO_4$

Explanation:

Ligand NO_2^- is ambidentate ligand as it can donate electrons through either nitrogen (NO_2) or oxygen (ONO).