

## coordination compounds-CBSE

2. Write the coordination isomer of  $[\text{Cu}(\text{NH}_3)_4][\text{PtCl}_4]$ .
3. Write the coordination number and oxidation state of platinum in the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]$ .
4. Write down the IUPAC name of the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ . What type of isomerism is shown by this complex.
5. What is the IUPAC name of the complex  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ ?
6. What type of isomerism is exhibited by the complex  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$ ?
7. What type of isomerism is exhibited by the following complex  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ ?
8. What type of isomerism is shown by the following complex  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ ?
9. What do you understand by denticity of a ligand?
10. Name the following coordination compound:  $\text{K}_3[\text{CrF}_6]$
11. Write the IUPAC name of  $[\text{PtCl}(\text{NH}_2\text{CH}_3)(\text{NH}_3)_2]\text{Cl}$
12. Write the IUPAC name of  $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$ .
13. Write the IUPAC name of  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$ .
14. Write the IUPAC name of  $[\text{Pt}(\text{NH}_3)_3(\text{NO})\text{Cl}_2]\text{Br}_2$ .
15. Write the IUPAC name of  $[\text{Co}(\text{CN})_2(\text{NH}_3)_4]\text{Cl}$
16. Write the IUPAC name of  $[\text{Cr}(\text{NH}_3)_5(\text{NCS})][\text{ZnCl}_4]$ .
17. Give an example of linkage isomerism.
18. Illustrate the following with an example: 'coordination isomerism'.
19. Give an example of coordination isomerism.

### 1 Mark Questions

1. What is the difference between a complex and a double salt?

30. Give an example of ionisation isomerism.
31. Write the IUPAC name of  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$  (Atomic no. of Co = 27).
32. What is ambidentate ligand? Give an example.

## 2 Marks Questions

33. Write IUPAC name of the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]$ . Draw structures of geometrical isomers for this complex.
34. Using IUPAC names write the formulae for the following
- Hexaamminecobalt(III) sulphate
  - Potassium trioxalatochromate(III)
35. Using IUPAC norms, write the formulae for the following :
- Potassium trioxalatoaluminate (III)
  - Dichlorido bis(ethane-1, 2-diamine) cobalt(III) ion
36. Using IUPAC norms write the formulae for the following :
- Sodium dicyanidoaurate (I).
  - Tetraamminechloridonitrito-N-platinum (IV) sulphate.
37. Write the IUPAC name of the complex  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$ . What type of isomerism does it exhibit?
38. (i) Write the IUPAC name of the following complex:  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$
- (ii) Write the formula for the following complex :  
Potassium tetrachloridonickelate (II)
39. (i) Write down the IUPAC name of the following complex :  
 $[\text{Cr}(\text{NH}_3)_2\text{Cl}_2(\text{en})]\text{Cl}$   
(where en = ethylene diamine)
- (ii) Write the formula for the following complex :  
Pentaamminenitrito-O-cobalt (III) ion

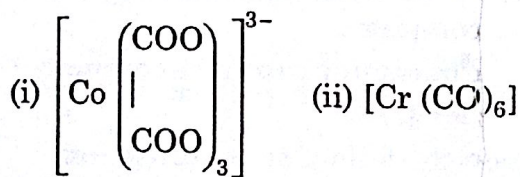
30. (i) Write down the IUPAC name of the following complex :  $[\text{Cr}(\text{en})_3]\text{Cl}_3$
- (ii) Write the formula for the following complex :  
Potassiumtrioxalato chromate (III)

31. Name the following coordination compounds and draw their structures.
- $[\text{CoCl}_2(\text{en})_2]\text{Cl}$
  - $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$   
(Atomic no. of Co = 27, Pt = 78)
32. Draw the structures of isomers, if any and write the names of the following complex.
- $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$
  - $[\text{Co}(\text{en})_3]^{3+}$   
(Atomic no. of Cr = 24, Co = 27)
33. Name the following coordination, compounds according to IUPAC system of nomenclature.
- $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$
  - $[\text{CrCl}_2(\text{en})_2]\text{Cl}$   
(where, en = ethane-1, 2-diamine)

## 3 Marks Questions

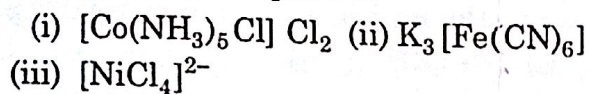
34. Write IUPAC name for each of the following complexes :
- $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$
  - $\text{K}_3[\text{Fe}(\text{CN})_6]$
  - $[\text{Co}(\text{en})_3]^{3+}$
35. Write the IUPAC name of the following:
- $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
  - $[\text{NiCl}_4]^{2-}$
  - $\text{K}_3[\text{Fe}(\text{CN})_6]$
36. Indicate the types of isomerism exhibited by the following complexes.
- $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$
  - $[\text{Co}(\text{en})_3]\text{Cl}_3$  [where en = ethylene diamine]
  - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

37. Write the IUPAC name and draw the structure of each of the following complex entities:

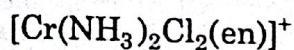
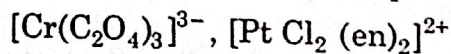


(iii)  $[\text{PtCl}_3(\text{C}_2\text{H}_4)]$   
(Atomic no. of Cr = 25, Co = 27, Pt = 78)

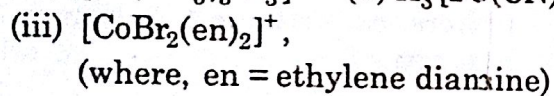
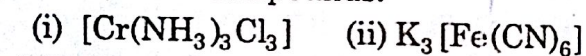
38. Write down the IUPAC name for each of the following complexes:



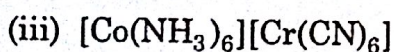
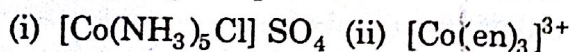
39. Draw the structures of optical isomers of each of the following complex ions.



40. Write the IUPAC name of the following coordination compounds:

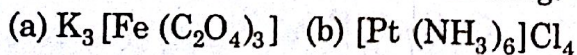


41. Write the types of isomerism exhibited by the following complexes:



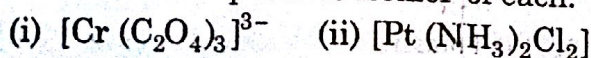
42. (i) How is double salt different from a complex?

(ii) Write IUPAC name of the following:



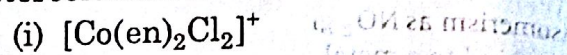
(iii) Draw the structure of *cis*-isomer of  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ .

43. Name the following complexes and draw the structure of one possible isomer of each:



(iii)  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$   
(where en = ethane-1,2-diamine or ethylene diamine)

44. Name the following coordination entities and draw the structures of their stereoisomers.



(where, en = ethane-1,2-diamine)



(Atomic no. of Cr = 24, Co = 27)

45. Write the structures and names of all the stereoisomers of the following compounds:



### ☑ 1 Mark Questions

1. When a coordination compound  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  is mixed with  $\text{AgNO}_3$ , 2 moles of  $\text{AgCl}$  are precipitated per mole of the compound write structural formula of the complex.
2. When a coordination compound  $\text{CoCl}_3 \cdot 6\text{NH}_3$  is mixed with  $\text{AgNO}_3$ , 3 moles of  $\text{AgCl}$  are precipitated per mole of the compound. Write structural formula of the complex.
3. What is meant by chelate effect?
4. Which of the following is more stable complex and why?  
 $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Co}(\text{en})_3]^{3+}$

5. Explain the following.  
 $[\text{Fe}(\text{CN})_6]^{4-}$  and  $[\text{Fe}(\text{H}_2\text{O})]^{2+}$  are of different colours in dilute solutions.
6. Why is CO a stronger ligand than  $\text{Cl}^-$ ?

## 2 Marks Questions

7. When a coordination compound  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  is mixed with  $\text{AgNO}_3$ , 2 moles of  $\text{AgCl}$  are precipitated per mole of the compound. Write  
 (i) structural formula of the complex.  
 (ii) IUPAC name of the complex.
8. When a coordination compound  $\text{CoCl}_3 \cdot 6\text{NH}_3$  is mixed with  $\text{AgNO}_3$ , 3 moles of  $\text{AgCl}$  are precipitated per mole of the compound. Write  
 (i) structural formula of the complex.  
 (ii) IUPAC name of the complex.
9. Write the hybridisation and shape of the following complexes.  
 (i)  $[\text{CoF}_6]^{3-}$  (ii)  $[\text{Ni}(\text{CN})_4]^{2-}$
10. State reason for each of the following  
 (i) CO is stronger complexing reagent than  $\text{NH}_3$ .  
 (ii) The molecular shape of  $\text{Ni}(\text{CO})_4$  is not the same as that of  $[\text{Ni}(\text{CN})_4]^{2-}$ .
11. Explain the following observations:  
 (i)  $\text{Co}^{2+}$  is easily oxidised to  $\text{Co}^{3+}$  in the presence of a strong ligand.  
 (ii) CO is a stronger complexing reagent than  $\text{NH}_3$ .
12. What is meant by crystal field splitting energy? How does the magnitude of splitting decide the actual configuration of  $d$ -orbitals in an octahedral field for a coordination entity?
13. What do you understand by stepwise stability constant and overall stability constant of a coordination compound? How are these two constants related?

14. Describe the shape and magnetic behaviour of the following complex.  
 $[\text{Ni}(\text{CN})_4]^{2-}$
15. Using the valence bond theory predict the geometry and magnetic behaviour of the  $[\text{CoF}_6]^{3-}$ . (Atomic number of Co = 27)
16. Describe the state of hybridisation, shape and the magnetic behaviour of the following complexes.  
 (i)  $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$   
 (ii)  $[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$   
 (Atomic no. of Cr = 24, Co = 27)
17. Explain the following terms:  
 (i) Crystal field splitting in an octahedral field.  
 (ii) Spectrochemical series.
18. Using valence bond approach, deduce the magnetic character of  $[\text{Co}(\text{NH}_3)_6]^{3+}$  ion. (Atomic no. of Co = 27)

## 3 Marks Questions

19. Write the hybridisation and magnetic character of the following complexes:  
 (i)  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  (ii)  $[\text{Ni}(\text{CN})_4]^{2-}$   
 [Atomic number : Fe = 26, Ni = 28]
20. Out of  $[\text{CoF}_6]^{3-}$  and  $[\text{Co}(\text{en})_3]^{3+}$ , which one complex is  
 (i) paramagnetic  
 (ii) more stable  
 (iii) inner orbital complex and  
 (iv) high spin complex  
 (Atomic number of Co = 27)
21. What is meant by crystal field splitting energy? On the basis of crystal field theory, write the electronic configuration of  $d^4$  in terms of  $t_{2g}$  and  $e_g$  in an octahedral field when  
 (i)  $\Delta_0 > P$  (ii)  $\Delta_0 < P$

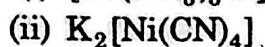
21 Write the state of hybridisation, the shape and the magnetic behaviour of the following complex entities.

- (i)  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$  (ii)  $[\text{Co}(\text{en})_3]\text{Cl}_3$   
(iii)  $\text{K}_2[\text{Ni}(\text{CN})_4]$

Explain the following cases giving appropriate reasons:

- (i) Nickel does not form low spin octahedral complexes.  
(ii) The  $\pi$ -complexes are known for the transition metals only.  
(iii)  $\text{Co}^{2+}$  is easily oxidised to  $\text{Co}^{3+}$  in the presence of a strong ligand.

3. Give the name, the stereochemistry and the magnetic behaviour of the following complexes.



### 3 Marks Questions

4. (i) Write the formula of the following coordination compound:  
Iron (III) hexacyanoferrate(II)
- (ii) What type of isomerism is exhibited by the complex  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ ?
- (iii) Write the hybridisation and number of unpaired electrons in the complex  $[\text{CoF}_6]^{3-}$ . (Atomic number of Co = 27)
5. (i) What type of isomerism is shown by the complex  $[\text{Co}(\text{NH}_3)_5(\text{SCN})]^{2+}$ ?
- (ii) Why  $[\text{NiCl}_4]^{2-}$  is paramagnetic while  $[\text{Ni}(\text{CN})_4]^{2-}$  is diamagnetic?  
(Atomic number of Ni = 28)
- (iii) Why are low spin tetrahedral complexes rarely observed?
6. (i) What type of isomerism is shown by the complex  $[\text{Co}(\text{en})_3]\text{Cl}_3$ ?
- (ii) Write the hybridisation and magnetic character of  $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ .  
(Atomic number of Co = 27)
- (iii) Write IUPAC name of the following complex  $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$ .
7. (i) What type of isomerism is shown by the complex  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ ?
- (ii) Why a solution of  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  is green while a solution of  $[\text{Ni}(\text{CN})_4]^{2-}$  is colourless?  
(Atomic number of Ni = 28)
- (iii) Write the IUPAC name of the following complex:  
 $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$
8. (i) For the complex,  $[\text{Fe}(\text{CN})_6]^{3-}$ , write the hybridisation type, magnetic character and spin nature of the complex. (Atomic number of Fe = 26)

## Miscellaneous Questions

### 2 Marks Questions

Write the hybridisation, shape and IUPAC name of the complex  $[\text{CoF}_6]^{3-}$   
(Atomic no. of Co = 27).

Write the state of hybridisation, shape and IUPAC name of the complex  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (Atomic no. of Co = 27).

- (ii) Draw one of the geometrical isomers of the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$  which is optically active.
9. (i) For the complex  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ , write the hybridisation, magnetic character and spin nature of the complex. (Atomic number of Fe = 26)
- (ii) Draw one of the geometrical isomers of the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$  which is optically inactive.
10. (i) What type of isomerism is shown by the complex  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ ?
- (ii) On the basis of crystal field theory, write the electronic configuration for  $d^4$  ion if  $\Delta_0 > P$ .
- (iii) Write the hybridisation and shape of  $[\text{CoF}_6]^{3-}$ . (Atomic number of Co = 27)
11. (i) Draw the geometrical isomers of complex  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ .
- (ii) On the basis of crystal field theory, write the electronic configuration for  $d^4$  ion if  $\Delta_0 < P$ .
- (iii) Write the hybridisation and magnetic behaviour of the complex  $[\text{Ni}(\text{CO})_4]$ . (Atomic number of Ni = 28)
12. (i) Draw the geometrical isomers of complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ .
- (ii) On the basis of crystal field theory, write the electronic configuration for  $d^4$  ion, if  $\Delta_0 > P$ .
- (iii) Write the hybridisation type and magnetic behaviour of the complex  $[\text{Ni}(\text{CN})_4]^{2-}$ . (Atomic number of Ni = 28)
13. (i) Write the IUPAC name of the complex  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ .
- (ii) What type of isomerism is exhibited by the complex  $[\text{Co}(\text{en})_3]^{3+}$ ?
- (iii) Why is  $[\text{NiCl}_4]^{2-}$  paramagnetic but  $[\text{Ni}(\text{CO})_4]$  is diamagnetic? (Atomic no. of Cr = 24, Co = 27, Ni = 28)
14. For the complex  $[\text{NiCl}_4]^{2-}$ , write,
- (i) the IUPAC name
- (ii) the hybridisation type
- (iii) the shape of the complex (Atomic no. of Ni = 28)
15. (i) Using valence bond theory, explain the geometry and magnetic behaviour of  $[\text{Cr}(\text{NH}_3)_6]^{3+}$ . (Atomic no. of Cr = 24).
- (ii) Write the IUPAC name of ionisation isomer of  $[\text{Ni}(\text{NH}_3)_3\text{NO}_3]\text{Cl}$ .
16. Write the name, structure and the magnetic behaviour of each one of the following complexes:
- (i)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
- (ii)  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
- (iii)  $\text{Ni}(\text{CO})_4$  (Atomic no. of Co = 27, Ni = 28, Pt = 78)
17. Name the following coordination entities and describe their structures : (Atomic no. of Fe = 26, Cr = 24, Ni = 28)
- (i)  $[\text{Fe}(\text{CN})_6]^{4-}$  (ii)  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$
- (iii)  $[\text{Ni}(\text{CN})_4]^{2-}$
18. Give the formula of each of the following coordination entities:
- (i)  $\text{Co}^{3+}$  ion is bound to one  $\text{Cl}^-$ , one  $\text{NH}_3$  and two bidentate ethylene diamine (en) molecules.
- (ii)  $\text{Ni}^{2+}$  ion is bound to two water molecules and two oxalate ions. Write the name and magnetic behaviour of each of the above coordination entities. (Atomic no. of Co = 27, Ni = 28)
19. Write the name, stereochemistry and magnetic behaviour of the following:
- (i)  $\text{K}_4[\text{Mn}(\text{CN})_6]$
- (ii)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
- (iii)  $\text{K}_2[\text{Ni}(\text{CN})_4]$



20. For the complex  $[\text{Fe}(\text{en})_2\text{Cl}_2]\text{Cl}$ , identify the following :
- Oxidation number of iron.
  - Hybrid orbitals and shape of the complex.
  - Magnetic behaviour of the complex.
  - Number of its geometrical isomers.
  - Whether there may be optical isomer also.
  - Name of the complex.
21. Explain the following terms giving a suitable example in each case.
- Ambidentate ligand.
  - Denticity of ligand.
  - Crystal field splitting in an octahedral field.
22. Write the name, state of hybridisation, shape and magnetic behaviour of the following complexes :
- $[\text{CoCl}_4]^{2-}$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2]^-$   
(Atomic no. of Co = 27, Ni = 28, Cr = 24)
23. Write the IUPAC name and deduce the geometry and magnetic behaviour of the complex  $\text{K}_4[\text{Mn}(\text{CN})_6]$ .  
(Atomic no. of Mn = 25)

# Objective Questions

(For Complete Chapter)

## 1 Mark Questions

1. In  $[\text{CoF}_6]^{3-}$ ,  $\text{Co}^{3+}$  uses outer  $d$ -orbitals ( $4d$ ) in  $sp^3d^2$  hybridisation. The number of unpaired electrons present in complex ion is  
(a) 0 (b) 4  
(c) 2 (d) 3
2. A magnetic moment of 1.73 BM will be shown by one among the following.  
(a)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  (b)  $[\text{Ni}(\text{CN})_4]^{2-}$   
(c)  $\text{TiCl}_4$  (d)  $[\text{CoCl}_6]^{4-}$
3. The coordination number of platinum in  $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]^{2+}$  ion is  
(a) 2 (b) 4  
(c) 6 (d) 8
4. The oxidation number of Co in  $[\text{Co}(\text{NH}_3)(\text{NO}_2)_3]$  is  
(a) +3 (b) 0  
(c) -3 (d) +6

5. IUPAC name of  $[K_3Fe(CN)_6]$  is
- potassium ferricyanide
  - potassium hexacyanoferrate (I)
  - potassium hexacyanoferrate (III)
  - potassium hexacyanoferrate (II)
6. The IUPAC name of  $K_2[Ni(CN)_4]$  is
- potassium tetracyanonickelate (II)
  - potassium tetracyanonickelate (III)
  - potassium tetracyanonickel (II)
  - potassium tetracyanonickel (III)
7. The existence of two different coloured complexes with the composition  $[Co(NH_3)_4Cl_2]^+$  is due to
- Ionisation isomerism
  - Linkage isomerism
  - Geometrical isomerism
  - Coordination isomerism
8. How many ions are produced from  $[Co(NH_3)_6]Cl_3$  in solution?
- |       |       |
|-------|-------|
| (a) 6 | (b) 4 |
| (c) 3 | (d) 2 |
9. What is (are) number(s) of unpaired electrons in the square planar  $[Pt(CN)_4]^{2-}$  ion?
- |          |       |
|----------|-------|
| (a) zero | (b) 1 |
| (c) 4    | (d) 6 |
10.  $[Fe(CN)_6]^{3-}$  ion is
- hexacyanoferrate (II) ion
  - hexacyanoferrate (III) ion
  - hexacyanide iron (III) ion
  - iron (III) hexacyanide ion
11. The IUPAC name of  $[Co(NH_3)_5ONO]^{2+}$  ion is
- pentaamminenitritocobalt (III) ion
  - pentaamminenitrocobalt (III) ion
  - pentaamminenitrocobalt (IV) ion
  - pentaamminenitritocobalt (II) ion
12. The geometry of  $Ni(CO)_4$  and  $Ni(PPh_3)_2Cl_2$  are
- both square planar
  - tetrahedral and square planar respectively
  - both tetrahedral
  - square planar and tetrahedral respectively