

**CBSE Test Paper-02**  
**Class - 12 Chemistry (Coordination Compounds)**

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1. The isomers  $[(C_6H_5)_3P_2Pd(SCN)_2]$  and  $[(C_6H_5)_3P_2Pd(NCS)_2]$  show
  - a. Linkage isomerism
  - b. Coordination isomerism
  - c. Geometrical isomerism
  - d. Ionization isomerism
2. According to Werner's theory, the secondary valences of the central atom correspond to its
  - a. Charge
  - b. Oxidation number
  - c. Effective atomic number
  - d. Coordination number
3. Which of the following complexes can form d and l isomers?
  - a. Trans -  $[Co(en)_2Cl_2]^+$
  - b.  $[Co(NH_3)_3Cl_3]$
  - c. Cis -  $[Co(en)_2Cl_2]^+$
  - d.  $[Co(NH_3)_4Cl_2]^+$
4. Sodium pentacyanonitrosylferrate(II) is also called
  - a. Sodium ferrocyanide
  - b. Sodium sulphocyanide
  - c. Sodium nitroprusside
  - d. Sodium cobalt nitrite
5. The oxidation state of Ag in Tollen's reagent is
  - a. +2
  - b. 0
  - c. +1
  - d. +1.5
6. Write formula for triamminediaquachlorocobalt (III) Chloride.

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7. What is the IUPAC name of  $[\text{Co}(\text{en})_3]\text{Cl}_3$ .
  8. Give examples of complexes in
    - a. Chemical analysis
    - b. Industries
  9. What is the difference between a double salt and a complex? Explain with an example.
  10. What is the basis of formation of spectro-chemical series?
  11. Write IUPAC names of the following coordination compounds:
    - a.  $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
    - b.  $\text{Hg}[\text{Co}(\text{SCN})_4]$
    - c.  $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$
  12. Using the valence bond approach, deduce the shape and magnetic character of  $[\text{Cr}(\text{CO})_6]$  [At. No. of Cr = 24]
  13. What will be the correct order for the wavelengths of absorption in the stable region for the following:  
 $[\text{Ni}(\text{NO}_2)_6]^{4-}$ ,  $[\text{Ni}(\text{NH}_3)_6]^{2+}$ ,  $[\text{Ni}(\text{H}_2\text{O})_6]^{2-}$
  14. Give evidence that  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$  and  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$  are ionization isomers.
  15. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes:
    - i.  $\text{K}_3[\text{Co}(\text{C}_2\text{O}_4)_3]$
    - ii.  $\text{cis}-[\text{Cr}(\text{en})_2\text{Cl}_2]\text{Cl}$
    - iii.  $(\text{NH}_4)_2[\text{CoF}_4]$
    - iv.  $[\text{Mn}(\text{H}_2\text{O})_6]\text{SO}_4$

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**Solutions**

1. (a) Linkage isomerism

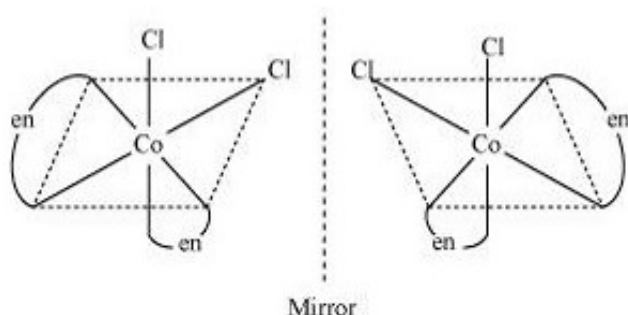
**Explanation:**  $\text{SCN}^-$  is an ambidentate ligand i.e it can bind through two different donor atoms, either through S in  $\text{SCN}^-$  or through N in  $\text{NCS}^-$ . So it shows linkage isomerism which arises when an ambidentate ligand is present in the complex.

2. (d) Coordination number

**Explanation:** According to Werner's theory, secondary valences are non-ionisable and are satisfied by neutral molecules or negative ions. Secondary valence is equal to the coordination number and is fixed for a metal.

3. (c) Cis -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$

**Explanation:** Cis -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$  has non superimposable mirror images as shown.



Hence, it shows optical isomerism and can form d (dextrorotatory) and l (laevorotatory) isomers.

4. (c) Sodium nitroprusside

**Explanation:**  $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$  i.e. Sodium pentacyanonitrosylferrate(II) is also called Sodium nitroprusside.

5. (c) +1

**Explanation:** Tollen's reagent contains diamminesilver(I) complex. So oxidation state of Ag in Tollen's reagent is +1.

6.  $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_2\text{Cl}]\text{Cl}_2$

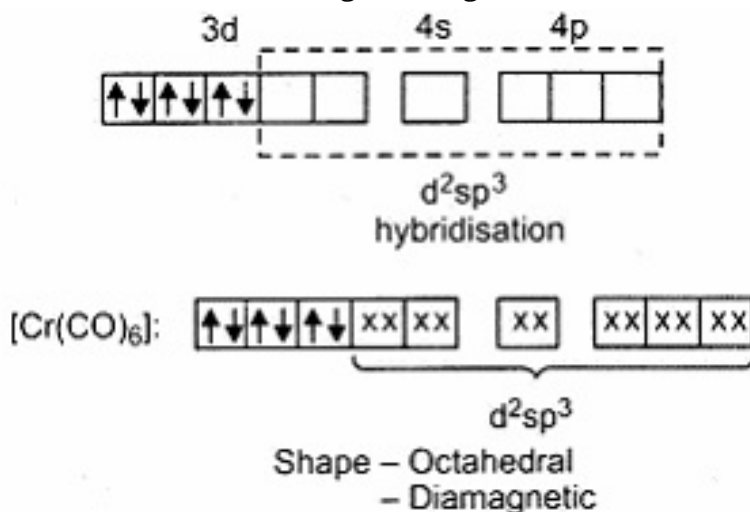
7. Tris (ethylenediamine) Cobalt (III) Chloride

8. 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.
9. Double salts dissociate completely into simple ions when dissolved in water e.g., Mohr salt,  $\text{FeSO}_4(\text{NH}_4)_2 \cdot \text{SO}_4 \cdot 6\text{H}_2\text{O}$  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  $\text{K}_4[\text{Fe}(\text{CN})_6]$  will dissociate to give potassium ions and  $[\text{Fe}(\text{CN})_6]^{4-}$  ions only.
10. **Spectrochemical series:** The arrangements of ligands in order of their increasing field strength, i.e. increasing crystal field splitting energy (CFSE) value is called spectrochemical series.  
Crystal field splitting energy is the basis of formation of the spectrochemical series.
11. a. Potassium trioxalato chromate III  
b. Mercuric tetrathiocyanatocobaltate III  
c. Pentaamminecarbonatocobalt (III) chloride.

12. Cr (24) Electronic configuration  $[\text{Ar}]4s^13d^5$

Oxidation state of Cr = 0

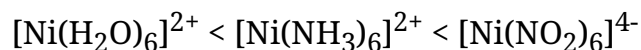
In  $[\text{Cr}(\text{CO})_6]$  has electronic configuration  $[\text{Ar}] 4s^03d^5$  because CO will cause pairing of electrons as it is a strong field ligand.



13. As metal ion is fixed, the increasing field strengths (CFSE) values of the ligands from the spectrochemical series are in order



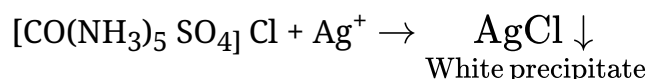
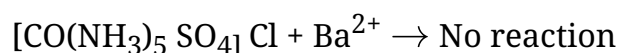
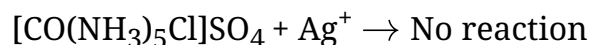
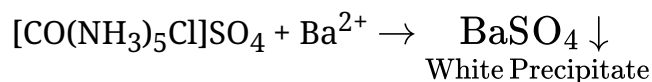
Thus, the energies absorbed for excitation will be in the order



The order of wavelength absorbed will be opposite of it.

$$\text{Since, } E = \frac{hc}{\lambda}$$

14. When ionization isomers are dissolved in water, they ionize to give different ions. These ions then react differently with different reagents to give different products.



15. i.  $K_3 [Co(C_2O_4)_3]$

The central metal ion is Co.

Its coordination number is 6.

The oxidation state can be given as:

$$x - 6 = -3$$

$$x = +3$$

The d orbital occupation for  $Co^{3+}$  is,  $t_{2g}^6 e_g^0$

- ii.  $cis-[Cr(en)_2Cl_2] Cl$

The central metal ion is Cr.

The coordination number is 6.

The oxidation state can be given as:

$$x + 2(0) + 2(-1) = +1$$

$$x - 2 = +1$$

$$x = +3$$

The d orbital occupation for  $Cr^{3+}$  is  $t_{2g}^3$ .

- iii.  $(NH_4)_2 [CoF_4]$

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The central metal ion is Co.

The coordination number is 4.

The oxidation state can be given as:

$$x - 4 = -2$$

$$x = +2$$

The d orbital occupation for

$Co^{2+}$  is,  $e_g^4 t_{2g}^3$ .

iv.  $[Mn(H_2O)_6]SO_4$

The central metal ion is Mn.

The coordination number is 6.

The oxidation state can be given as:

$$x + 0 = +2$$

$$x = +2$$

The d orbital occupation for Mn is

$t_{2g}^3 e_g^2$ .