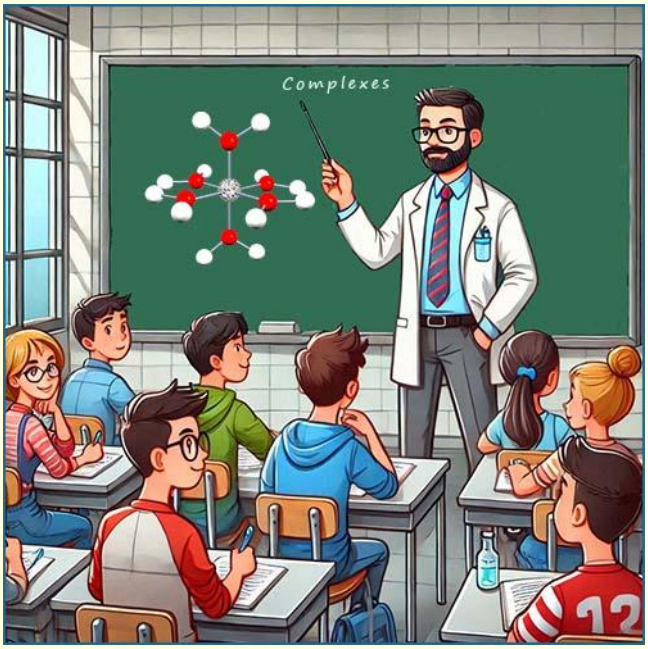
Answer all the questions below as fully as you can then check your answers

1. Define the term coordination compound.



2. In the complex $[Cu(H_2O)_6]^{2+}$, what roles do the copper ion and water molecules play in terms of Lewis acid-base theory?

3. Name the following ligands based on their chemical formulas when they act in complexes:
a. H_2O b. NH_3 c. CN^- d. OH^- e. Cl^-

4. Write the formula and name the complex ion formed when silver ions (Ag+) react with two ammonia molecules.

5. Determine the oxidation state of chromium in the complex $[Cr(H_2O)_4Cl_2]^+$.

5b. Why does the complex $[Co(NH_3)_6]Cl_3$ have a +3 overall charge?

6. State the coordination number and geometry of $[FeF_6]^{3-}$.

7. Explain why the complex $[FeCl_4]^-$ has a coordination number of 4 while $[FeF_6]^{3-}$ complex has a coordination number of 6.

8. Which geometry is typically observed for four-coordinate complexes with bulky ligands? Provide an example.

8b. Will there be more room for the ligands around a tetrahedral or square planar complex?

9. Describe the bonding in the neutral complex $Ni(CO)_4$.

10. In the linear complex $[Ag(CN)_2]^-$, what is the coordination number of silver, and why is the geometry linear?

11. Why do ligands with high charges limit the coordination number in a complex?

12. Explain why $[Pt(NH_3)_4]^{2+}$ has a square planar geometry instead of tetrahedral geometry which is more common in complexes containing four ligands.

Answers:

1. Define the term coordination compound.

Answer: A coordination compound consists of a central transition metal ion or atom surrounded by a number of atoms, molecules, or ions bonded to it via coordinate (dative covalent) bonds.

2. In the complex $[Cu(H_2O)_6]^{2+}$, what roles do the copper ion and water molecules play in terms of Lewis acid-base theory?

Answer: The copper ion acts as a Lewis acid (lone pair acceptor), while the water molecules act as Lewis bases (electron pair donors).

3. Name the following ligands based on their chemical formulas when they act in complexes:

a. H_2O b. NH_3 c. CN^- d. OH^- e. Cl^-

Answer:

a. Aqua b. Ammine c. Cyano d. Hydroxo e. Chloro

4. Write the formula and name the complex ion formed when silver ions (Ag+) react with two ammonia molecules.

Answer: The formula is [Ag(NH3)2]+, and it is named diamminesilver(I) ion.

5. Determine the oxidation state of chromium in the complex $[Cr(H_2O)_4Cl_2]^+$.

Answer: The oxidation state of chromium is +3.

5b. Why does the complex $[Co(NH_3)_6]Cl_3$ have a +3 overall charge?

Answer: The complex $[Co(NH_3)_6]^{3+}$ has a +3 charge due to the Co^{3+} ion, and the three chloride ions (Cl-) balance this charge in the ionic salt.

6. State the coordination number and geometry of $[FeF_6]^{3-}$.

Answer: Coordination number: 6; Geometry: Octahedral.

7. Explain why the complex $[FeCl_4]^-$ has a coordination number of 4 while $[FeF_6]^{3-}$ complex has a coordination number of 6.
Answer: The larger size of the chloride ions (Cl^-) compared to fluoride ions (F^-) limits the number of ligands that can surround the iron ion.

8. Which geometry is typically observed for four-coordinate complexes with bulky ligands? Provide an example.
Answer: Tetrahedral geometry is typically observed; an example is $[ZnCl_4]^{2-}$

8b. Will there be more room for the ligands around a tetrahedral or square planar complex?

Answer: There will be more room in a tetrahedral complex since the bond angles between the ligands will be 109.5^o while it is 90^o in a square planar complex.

9. Describe the bonding in the neutral complex $Ni(CO)_4$.
Answer: The bonding within $Ni(CO)_4$ involves covalent bonds between the nickel atom and the carbon monoxide ligands. Each CO ligand donates a lone pair of electrons to the nickel atom via coordinate covalent bonding.

10. In the linear complex $[Ag(CN)_2]^-$, what is the coordination number of silver, and why is the geometry linear?
Answer: Coordination number: 2; The geometry is linear because the silver ion has a d10 electronic configuration, which favours a linear arrangement of ligands.

11. Why do ligands with high charges limit the coordination number in a complex?
Answer: Ligands with high charges cause increased electrostatic repulsions between neighbouring ligands, reducing the number that can coordinate with the metal ion.

12. Explain why $[Pt(NH_3)_4]^{2+}$ has a square planar geometry instead of tetrahedral geometry which is more common in complexes containing four ligands.
Answer: The square planar geometry arises because platinum(II) has an 8d electron configuration, which stabilises this arrangement due to ligand field effects.