

1. What is the coordination number of the central metal ion in $[\text{Co}(\text{en})_2\text{Cl}_2]^+$?

- A. 2
- B. 4
- C. 6
- D. 3

Answer: C. 6

Explanation: Each 'en' (ethylenediamine) is bidentate (2 donor atoms). So, $2 \times 2 (\text{en}) + 2 \times 1 (\text{Cl}^-) = 6$ coordination sites.

2. Which one of the following is a tridentate ligand?

- A. EDTA
- B. ox^{2-}
- C. dien
- D. en

Answer: C. dien

Explanation: Dien (diethylenetriamine) has 3 nitrogen donor atoms, making it tridentate.

3. What is the IUPAC name of $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$?

- A. Tetraamminedichloridochromium(III) chloride
- B. Tetraamminedichloridochromium(I) chloride
- C. Tetrachloridodiaminechromium(III) chloride
- D. Tetraamminedichloridochromium(II) chloride

Answer: A. Tetraamminedichloridochromium(III) chloride

Explanation: Chromium is in +3 oxidation state; 4 NH_3 and 2 Cl as ligands.

4. Which of the following shows geometrical isomerism?

- A. $[\text{Pt}(\text{NH}_3)_4]^{2+}$
- B. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- C. $[\text{Co}(\text{NH}_3)_6]^{3+}$
- D. $[\text{CrCl}_3(\text{NH}_3)_3]$

Answer: B. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

Explanation: It is square planar and shows cis-trans geometrical isomerism.

5. The complex $[\text{Fe}(\text{CN})_6]^{3-}$ is:

- A. Paramagnetic with one unpaired electron
- B. Paramagnetic with five unpaired electrons
- C. Diamagnetic
- D. Paramagnetic with three unpaired electrons

Answer: A. Paramagnetic with one unpaired electron

Explanation: CN^- is a strong field ligand. Low spin $d^5 \rightarrow 1$ unpaired electron.

6. The effective atomic number (EAN) of Fe in $[\text{Fe}(\text{CN})_6]^{3-}$ is:

- A. 36
- B. 35
- C. 34
- D. 33

Answer: B. 35

Explanation: Fe^{3+} has 23 electrons. CN^- donates 12 electrons (6×2).

$23 + 12 = 35$.

7. In the complex $[\text{Ni}(\text{CO})_4]$, the hybridisation and geometry are:

- A. sp^3 , tetrahedral
- B. dsp^2 , square planar
- C. sp^2 , trigonal planar
- D. d^2sp^3 , octahedral

Answer: A. sp^3 , tetrahedral

Explanation: $\text{Ni}(0)$ forms sp^3 hybridisation with weak field CO ligands \rightarrow tetrahedral.

8. Which of the following ligands causes pairing of electrons in 3d orbital of metal ion?

- A. Cl^-

- B. CN^-
- C. OH^-
- D. H_2O

Answer: B. CN^-

Explanation: CN^- is a strong field ligand \rightarrow causes pairing \rightarrow low spin complex.

9. What is the charge on the central metal ion in $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$?

- A. +4
- B. +2
- C. +3
- D. 0

Answer: B. +2

Explanation: NH_3 is neutral; Cl^- contributes -2. For a neutral complex, Pt must be +2.

10. Which of the following complexes will be optically active?

- A. $[\text{Co}(\text{en})_3]^{3+}$
- B. $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
- C. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- D. $[\text{Fe}(\text{CN})_6]^{4-}$

Answer: A. $[\text{Co}(\text{en})_3]^{3+}$

Explanation: It has no plane of symmetry and is chiral \rightarrow optically active.

11. The chelating ligand among the following is:

- A. CN^-
- B. NH_3
- C. en
- D. Cl^-

Answer: C. en

Explanation: en (ethylenediamine) has two donor atoms and forms a ring \rightarrow chelate.

12. The geometry of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is:

- A. Tetrahedral
- B. Square planar
- C. Octahedral
- D. Trigonal planar

Answer: A. Tetrahedral

Explanation: Cu^{2+} forms tetrahedral geometry with neutral NH_3 ligands.

13. The central atom in $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ has an oxidation state of:

- A. +2
- B. +3
- C. +4
- D. +6

Answer: B. +3

Explanation: Each oxalate is -2, so $3 \times -2 = -6$. The charge on the complex is -3, so $\text{Fe} = +3$.

14. Which one is NOT a correct match?

- A. EDTA – Hexadentate
- B. en – Bidentate
- C. CO – Anionic ligand
- D. Cl^- – Monodentate

Answer: C. CO – Anionic ligand

Explanation: CO is a neutral ligand.

15. In a coordination compound, secondary valency refers to:

- A. Charge on central atom
- B. Number of ions outside coordination sphere
- C. Coordination number
- D. Oxidation state

Answer: C. Coordination number

Explanation: Secondary valency = number of ligands directly bonded to metal.

16. In which of the following compounds, the metal exhibits zero oxidation state?

- A. $[\text{Ni}(\text{CN})_4]^{2-}$
- B. $[\text{Ni}(\text{CO})_4]$
- C. $[\text{Co}(\text{NH}_3)_6]^{3+}$
- D. $[\text{Fe}(\text{CN})_6]^{3-}$

Answer: B. $[\text{Ni}(\text{CO})_4]$

Explanation: CO is a neutral ligand and the complex is neutral, so Ni is in 0 oxidation state.

17. Which type of isomerism is shown by $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ and $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2$?

- A. Geometrical isomerism
- B. Ionisation isomerism
- C. Linkage isomerism
- D. Hydrate isomerism

Answer: D. Hydrate isomerism

Explanation: Water is present inside and outside the coordination sphere.

18. Which complex shows linkage isomerism?

- A. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
- B. $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]\text{Cl}_2$
- C. $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
- D. $[\text{Ni}(\text{CO})_4]$

Answer: B. $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]\text{Cl}_2$

Explanation: NO_2^- can bind via N (nitro) or O (nitrito) \rightarrow linkage isomerism.

19. The number of unpaired electrons in $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is:

- A. 0
- B. 1
- C. 3

D. 5

Answer: D. 5

Explanation: Fe^{3+} is d^5 and H_2O is a weak field ligand \rightarrow no pairing \rightarrow 5 unpaired electrons.

20. In the complex $[\text{Zn}(\text{NH}_3)_4]^{2+}$, the geometry is:

- A. Octahedral
- B. Square planar
- C. Tetrahedral
- D. Trigonal bipyramidal

Answer: C. Tetrahedral

Explanation: Zn^{2+} forms tetrahedral complexes with weak field ligands like NH_3 .

21. What is the oxidation number of cobalt in $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$?

- A. +3
- B. +2
- C. +6
- D. +1

Answer: A. +3

Explanation: Each oxalate ($\text{C}_2\text{O}_4^{2-}$) is -2. $3 \times (-2) = -6$. Complex charge = -3 \rightarrow Co = +3.

22. Which of the following is a homoleptic complex?

- A. $[\text{Co}(\text{NH}_3)_6]^{3+}$
- B. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
- C. $[\text{Ni}(\text{CO})_4]$
- D. Both A and C

Answer: D. Both A and C

Explanation: Homoleptic = only one kind of ligand. Both have only one type of ligand.

23. Which of the following is not a correct statement?

- A. Ligands are Lewis bases
- B. CN^- is a strong field ligand
- C. Cl^- is a weak field ligand
- D. Coordination number is always 6

Answer: D. Coordination number is always 6

Explanation: It varies. For example, $[\text{Ni}(\text{CO})_4]$ has coordination number 4.

24. Which hybridisation is involved in $[\text{Ni}(\text{CN})_4]^{2-}$?

- A. sp^3
- B. dsp^2
- C. sp^2
- D. d^2sp^3

Answer: B. dsp^2

Explanation: CN^- is a strong field ligand \rightarrow pairing occurs $\rightarrow \text{dsp}^2 \rightarrow$ square planar geometry.

25. Which one does not show optical isomerism?

- A. $[\text{Cr}(\text{en})_3]^{3+}$
- B. $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
- C. $[\text{PtCl}_2(\text{NH}_3)_2]$
- D. $[\text{Co}(\text{en})(\text{NH}_3)_4]^{3+}$

Answer: C. $[\text{PtCl}_2(\text{NH}_3)_2]$

Explanation: Square planar complexes do not show optical isomerism.

26. The total number of ions produced in aqueous solution by $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is:

- A. 2
- B. 3
- C. 4
- D. 1

Answer: C. 4

Explanation: $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $3\text{Cl}^- \rightarrow$ total 4 ions.

27. Which complex will have the highest molar conductivity in aqueous solution?

- A. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
- B. $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
- C. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
- D. $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$

Answer: A. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$

Explanation: Gives 4 ions in solution \rightarrow highest conductivity.

28. Which of the following is not a polydentate ligand?

- A. EDTA
- B. en
- C. NH_3
- D. $\text{C}_2\text{O}_4^{2-}$

Answer: C. NH_3

Explanation: NH_3 is monodentate. Others are polydentate.

29. Which statement is true for $[\text{Fe}(\text{CN})_6]^{4-}$?

- A. It is paramagnetic with 4 unpaired electrons
- B. It is diamagnetic
- C. It has 2 unpaired electrons
- D. It is tetrahedral

Answer: B. It is diamagnetic

Explanation: CN^- is strong field \rightarrow all electrons paired \rightarrow diamagnetic.

30. Which is the correct IUPAC name for $\text{K}_3[\text{Fe}(\text{CN})_6]$?

- A. Potassium hexacyanoferrate(III)
- B. Potassium hexacyanoferrate(II)
- C. Hexacyanoferrate(III) potassium
- D. Potassium hexacyanoiron(II)

Answer: A. Potassium hexacyanoferrate(III)

Explanation: Fe oxidation state is +3 → correct name.

31. Which of the following complexes is expected to be coloured?

- A. $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$
- B. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
- C. $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$
- D. $[\text{Cu}(\text{NH}_3)_4]^{2+}$

Answer: B. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$

Explanation: Ti^{3+} has d1 configuration → d-d transitions possible → coloured.

32. Which of the following shows geometrical isomerism?

- A. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ (square planar)
- B. $[\text{Co}(\text{NH}_3)_6]^{3+}$
- C. $[\text{Fe}(\text{CO})_5]$
- D. $[\text{Ni}(\text{CO})_4]$

Answer: A. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

Explanation: Square planar complexes like $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ show cis-trans isomerism.

33. Which one is a bidentate ligand?

- A. NO_2^-
- B. en (ethylenediamine)
- C. CN^-
- D. NH_3

Answer: B. en (ethylenediamine)

Explanation: en has two donor nitrogen atoms → bidentate ligand.

34. What is the coordination number of Cr in $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$?

- A. 2
- B. 4

- C. 5
- D. 6

Answer: D. 6

Explanation: 4 NH_3 and 2 Cl^- ligands \rightarrow total 6 coordination sites.

35. The complex $[\text{CoCl}_2(\text{en})_2]^+$ shows how many geometrical isomers?

- A. 1
- B. 2
- C. 3
- D. 4

Answer: B. 2

Explanation: Octahedral complex with 2 bidentate ligands + 2 monodentate \rightarrow cis & trans forms.

36. Which ligand forms chelate with a metal ion?

- A. NH_3
- B. Cl^-
- C. en
- D. H_2O

Answer: C. en

Explanation: en has two donor atoms \rightarrow forms chelate ring \rightarrow chelating ligand.

37. Which compound will have the maximum crystal field splitting energy (Δ)?

- A. $[\text{Fe}(\text{CN})_6]^{3-}$
- B. $[\text{FeF}_6]^{3-}$
- C. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
- D. $[\text{FeCl}_6]^{3-}$

Answer: A. $[\text{Fe}(\text{CN})_6]^{3-}$

Explanation: CN^- is a strong field ligand \rightarrow causes maximum crystal field splitting.

38. The complex $[\text{Ni}(\text{CN})_4]^{2-}$ is:

- A. Tetrahedral and paramagnetic
- B. Square planar and paramagnetic
- C. Square planar and diamagnetic
- D. Tetrahedral and diamagnetic

Answer: C. Square planar and diamagnetic

Explanation: CN^- is strong field ligand \rightarrow dsp^2 hybridisation \rightarrow square planar \rightarrow paired electrons.

39. Which of the following can act as ambidentate ligand?

- A. CO
- B. NO_2^-
- C. NH_3
- D. Cl^-

Answer: B. NO_2^-

Explanation: NO_2^- can bind through N (nitro) or O (nitrito) \rightarrow ambidentate ligand.

40. IUPAC name of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is:

- A. Diammineplatinum(II) chloride
- B. Diamminechloroplatinum(II)
- C. Diammineplatinum(II) dichloride
- D. Diammineplatinum(II) chloride chloride

Answer: C. Diammineplatinum(II) dichloride

Explanation: Neutral ligand NH_3 written first, followed by anionic ligands.

41. The oxidation state of metal in $[\text{Fe}(\text{CO})_5]$ is:

- A. +2
- B. +3
- C. 0
- D. +1

Answer: C. 0

Explanation: CO is neutral \rightarrow charge on Fe = 0.

42. Which of the following complexes is chiral?

- A. $[\text{Co}(\text{en})_3]^{3+}$
- B. $[\text{Co}(\text{NH}_3)_6]^{3+}$
- C. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- D. $[\text{Ni}(\text{CO})_4]$

Answer: A. $[\text{Co}(\text{en})_3]^{3+}$

Explanation: $[\text{Co}(\text{en})_3]^{3+}$ has no plane of symmetry \rightarrow exists in optical isomers (d & l forms).

43. Which one has the lowest magnetic moment?

- A. $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- B. $[\text{Fe}(\text{CN})_6]^{4-}$
- C. $[\text{FeF}_6]^{3-}$
- D. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

Answer: B. $[\text{Fe}(\text{CN})_6]^{4-}$

Explanation: Fe^{2+} with strong field ligand $\text{CN}^- \rightarrow$ all electrons paired \rightarrow lowest magnetic moment.

44. Which complex shows ionisation isomerism?

- A. $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
- B. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- C. $[\text{Fe}(\text{CO})_5]$
- D. $[\text{Ni}(\text{CN})_4]^{2-}$

Answer: A. $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$

Explanation: Br^- and SO_4^{2-} can switch inside/outside coordination sphere \rightarrow ionisation isomerism.

45. What is the IUPAC name of $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$?

- A. Tetraaquadichlorochromium(III) chloride
- B. Dichlorotetraaquachromium(III) chloride
- C. Tetrachlorodiaquachromium(III) chloride
- D. Tetraaquadichlorochromium(II) chloride

Answer: A. Tetraaquadichlorochromium(III) chloride

Explanation: Water (neutral) comes before chloride (anionic); Cr oxidation state is +3.