Chapter_09

Coordination Compounds

Practice Questions

 Which one of the following complexes will consume more equivalents of aqueous solution of AgNO₃?
 (a) Na [CrCl]
 (b) [Cr(H Q) Cl[Cl]

(a) $\operatorname{Na}_{2}[\operatorname{CrCl}_{6}]$	$(b) [Cr(H_2O)_5CI]CI_2$
$(c) [Cr(H_2O)_6]Cl_3$	(d) $\operatorname{Na}_{2}[\operatorname{CrCl}_{5}(\operatorname{H}_{2}\operatorname{O})]$

- How many ions obtain after dissociation of this complex [Co(NH₃)₆]Cl₃?
 (a) 3 (b) 2 (c) 5 (d) 4
- **3.** The primary and secondary valencies of chromium in the complex ion, dichlorodioxalato chromium (III) respectively are

(a)	3 and 4	(b)	4 and 3
(c)	6 and 3	(d)	3 and 6

4. Coordination complex X gives white ppt. with $AgNO_3$ solution while its isomer Y gives white ppt but with $BaCl_2$. Two compounds are isomer of $CuClSO_4 \cdot 5NH_3$. The possible formula of X and Y are

 $\begin{array}{ccc} X & Y \\ (a) \left[{\rm Cu}({\rm NH}_3)_5 {\rm SO}_4 \right] {\rm Cl} & \left[{\rm Cu}({\rm NH}_3)_5 {\rm Cl} \right] {\rm SO}_4 \\ (b) \left[{\rm Cu}({\rm NH}_3)_5 {\rm Cl} \right] {\rm SO}_4 & \left[{\rm Cu}({\rm NH}_3)_5 {\rm SO}_4 \right] {\rm Cl} \\ (c) \left[{\rm Cu}({\rm NH}_3)_4 {\rm ClSO}_4 \right] {\rm NH}_3 & \left[{\rm Cu}({\rm NH}_3)_5 {\rm Cl} \right] {\rm SO}_4 \\ (d) \left[{\rm Cu}({\rm Br})_5 {\rm NH}_3 \right] {\rm SO}_4 & \left[{\rm Cu}({\rm Br})_4 {\rm (NH}_3) {\rm SO}_4 \right] {\rm Br} \end{array}$

- **5.** The most stable system for a chelate is
 - (a) five fused cyclic system
 - (b) four fused cyclic system
 - (c) three fused cyclic system
 - (d) two fused cyclic system
- **6.** Coordination number of Pt and Ni in $[PtCl_6]^{2-}$ and

(<i>a</i>) 4 and 6	(b)	6 and 4
c) 4 and 4	(d)	6 and 6

7. The oxidation state of Fe in the brown ring complex $[Fe(H_2O)_5 NO]SO_4$ is (b) 0

u)	13	(D)	U
c)	+2	(d)	+1

8. The pair of compounds having metals in their highest oxidation states is

(a)	$[MnO_4]^-, CrO_2Cl_2$	(b) $[NiCl_4]^{2-}, [CoCl_4]^{-}$
(c)	MnO_2 , FeCl ₃	$(d) [Fe(CN)_6]^{3-}, [Co(CN)_6]^{-3}$

9. Which among the following will be named as dibromido*bis* (ethylenediammine) chromium (III) bromide ?

 (a) [Cr(en)₃] Br₃
 (b) [Cr(en)₂ Br₂]Br

(/ L (/) J)	
(c) $[Cr(en)Br_4]^-$	(d) [Cr(en)Br ₂]Br

- **10.** According to IUPAC nomenclature sodium nitroprusside is named as
 - (a) sodium pentacyanonitrosyl ferrate (II)
 - (b) sodium pentacyanonitrosyl ferrate (III)
 - (c) sodium nitroferricyanide
 - (d) sodium nitroferrocyanide

- Write the formula for the coordination compund dichloridobis (ethane-1, 2-diamine) platinum (IV) nitrate
 (a) [PtCl₂(en)₂](NO₃)₂ (b) [PtCl₂(NO₃)₂](en)₂
 (c) [Pt(en)₂(NO₃)]Cl₂ (d) None of these
- 12. Which type of ligand is contained in linkage isomerism?
 (a) Unidentate
 (b) Bidentate
 (c) Polydentate
 (d) Ambidentate
- 13. [Co(NH₃)₅SO₄]Br and [Co(NH₃)₅Br]SO₄ are
 (a) linkage isomers
 (b) coordination isomers
 (c) ionisation isomers
 (d) solvate isomers
- **14.** The complex, $[Pt(py)(NH_3)BrCl]$ will have how many geometrical isomers? (a) 2 (b) 3 (c) 4 (d) 0
- **15.** Which one of the following has an optical isomer ? (en = ethylenediamine) (a) $[Zn(en)(NH_3)_2]^{2+}$ (b) $[Co(en)_3]^{3+}$ (c) $[Co(H_2O)_4(en)]^{3+}$ (d) $[Zn(en)_2]^{2+}$
- 16. Which of the following complex ions is diamagnetic in nature?
 (a) [CoF_c]³⁻ (b) [NiCl₄]²⁻ (c) [Ni(CN)₄]²⁻ (d) [CuCl₂]²⁻
- **17.** Which of the following has square planar geometry? (a) $[CoCl_4]^2$ (b) $[FeCl_4]^{2-}$ (c) $[NiCl_4]^{2-}$ (d) $[PtCl_4]^{2-}$
- **18.** The magnetic moment of Ni^{2+} ion (atomic number of Ni = 28) in BM unit is

(a) 1.73 (b) 4.81 (c) 5.96 (d) 2.84

19. In tetrahedral complexes, low spin complexes are not formed.

(a) $\Delta_o > P$	(b) $\Delta_o < P$
$(c) \Delta_o = P$	(d) None of these

- **20.** Which of the following complex ions has electrons that are symmetrically filled in both t_{2g} and e_g orbitals? (a) $[FeF_6]^{3-}$ (b) $[Mn(CN)_6]^{4-}$
 - (c) $[CoF_6]^{3-}$ (d) $[Co(NH_3)_6]^{2+}$
- **21.** Iron carbonyl, $Fe(CO)_5$ is

	5,	10	
(a)	trinuclear	(b)) mononuclear
(c)	tetranuclear	(d) dinuclear

- 22. An example of a sigma bonded organometallic compound is
 (a) ruthenocene
 (b) Grignard's reagent
 (c) ferrocene
 (d) cobaltocene
- **23.** In which compound, synergic effect is present? (a) [Ni(CO)₄] (b) [NiCl₄]²⁻
 - (c) $[CuCl_4]^{2-}$ (d) $[Mn(H_2O)_6]^{2+}$

24. Gold combines with cyanide in the presence of oxygen and water to form coordination entity in aqueous solution. The coordination entity is

(a)	$[Au(CN)_2]^-$	(b)	$[\operatorname{Au(CN)}_2]^{2-1}$
(c)	$[Au(CN)_{2}]^{3-}$	(d)	$[Au(CN)_{2}]^{4-}$

25. For lead-poisoning, the antidote used is

(a)	white of an egg	<i>(b)</i>	cis-platin
2 \		(1)	

<i>(c)</i> 1	nickel	(d)	EDTA
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ANSWERS

1. (C)	2. (d)	3. (d)	4. (a)	5. (a)	6. (b)	7. (d)	8. (a)	9. (b)	10. (b)
11. (a)	12. (d)	13. (c)	14. (b)	15. (b)	16. (c)	17. (d)	18. (d)	19. (b)	20. (a)
21. (b)	22. (b)	23. (a)	24. (a)	25. (d)					

Hints & Solutions

1. (c)

Complex	Dissociation in aqueous solution of AgNO ₃				
(a) Na[CrCl ₆]	$3Na^{+} + [CrCl_{6}]^{3-}$				
(b) $[Cr(H_2O_5 Cl]Cl_2$	$[Cr(H_2O)_5Cl]^{2+} + 2Cl^{-}$				
(c) $[Cr(H_2O)_6]Cl_3$	$[Cr(H_2O)_6]^{3+} + 3Cl^-$				
(d) Na ₂ [CrCl ₅ (H ₂ O)]	$2Na^{+} + [CrCl_{5}(H_{2}O)]^{2-}$				

 $[Cr(H_2O)_6]Cl_3$ contains maximum number of ionisable anion $(3Cl^-)$.

Hence, it will consume more equivalents of aqueous solution of $AgNO_3$ and forms three moles of AgCl (white ppt.).

2. (*d*) Primary valency of coordination compounds are ionisable. Thus, dissociation of the complex, $[Co(NH_3)_6] Cl_3$ takes place as follows.

 $[Co(NH_3)_6] Cl_3 \longrightarrow [Co(NH_3)_6]^{2+} + 3 Cl^-$

Therefore, total number of ions obtained after dissociation are 4.

- **3.** (*d*) The primary and secondary valencies of chromium in the complex ion, dichlorodioxalato chromium (III) [CrCl₂(O_x)₂]3⁻ are 3 and 6 respectively.
- **4.** (*a*) As, isomer X gives white ppt. with AgNO₃ solution this shows that it contains Cl⁻ as counter ion while isomer Y gives white ppt. with BaCl₂ this suggest that SO₄²⁻ is present as counter ion. Thus, so possible formula of X and Y are

 $X = [Cu(NH_3)_5 SO_4]Cl$ $Y = [Cu(NH_5)_5 Cl]SO_4$

5. (*a*) Greater is the number of chelate rings, greater is the stability of the chelate.

Hence, five fused cyclic system is most stable for a chelate.

7. (*d*) Let the oxidation state of Fe in brown ring complex $[Fe(H_2O)_5NO]SO_4$ be x.

 $[Fe(H_2O)_5NO]^{2+}$

$$\therefore \qquad x + 0 + 1 = 2 \implies x = + 1$$

Here, NO exists as a nitrosyl ion (NO^+) .

- (a) The oxidation states of metals in given pairs are follows:
 (a) In [MnO₄]⁻ and CrO₂Cl₂ oxidation states of Mn
 - and Cr are +7 and +6 respectively.
 - (b) In [NiCl₄]²⁻ and [CoCl₄]⁻, oxidation states of Ni and Co are +2 and +3 respectively.
 - (c) In MnO₂ and FeCl₃ oxidation states of Mn and Fe are +4 and +3 respectively.
 - (d) In [Fe(CN)₆]³⁻ and [Co(CN)₆]⁻³ oxidation states of Fe and Co are +3 and +3 respectively.

Thus, option (a), Mn and Cr are in their highest oxidation states.

9. (*b*) Two Br, two (en) and one Cr are parts of the complex. Charge on the complex is +1.

$$2 (Br) = -2 2 (en) = 0 1 (Cr) = + 3 = +1$$

Thus, complex ion is $[Cr(en)_2 Br_2]^+$

Since, anion is bromide, thus complex dibromido *bis* (ethylenediamine) chromium (III) bromide is written as $[Cr(en)_2Br_2]Br$.

- **12.** (*d*) Linkage isomerism arises in a coordination compound containing ambidentate ligand.
- **13.** (c) [Co(NH₃)₅SO₄]Br and [Co(NH₃)₅Br]SO₄ are ionisation isomers, because there is exchange of Br⁻ and SO₄²⁻ ions.
- **14.** (b) M(ABCD) type complex have three geometrical isomers as

15. (b) Complex $[Co(en)_3]^{3+}$ is of type $[M(AA)_3]$ has no plane of symmetry and centre of symmetry, so it is an optical isomer.



16. (c) Ni in $[Ni(CN)_4]^{2-}$ has dsp^2 hybridisation, where CN^- is a strong field ligand.



Since, all the electrons are paired, it is diamagnetic in nature.

17. (d) Among the given complexes, only PtCl₄ has square planar geometry, rest have tetrahedral geometry.

This can be explained as:

Cl⁻ is a weak field ligand but Cl⁻ causes the pairing of electron with large Pt²⁺ and consequently give dsp^2 hybridisation with square planar geometry.

The electronic configuration of Pt^{2+} is $4d^85s^0$.



18. (d)
$$N_{1_{28}} = [Ar]_{1_8} 3d^6 4s^2$$
, $N_{1^2} = [Ar]_{1_8} 3d^6$

Number of unpaired electrons = 2

Magnetic moment,

$$\mu = \sqrt{n(n+2)} = \sqrt{2(2+2)} = \sqrt{8} = 2.84$$
 BM

- **19.** (b) In tetrahedral complex, low spin complexes are not formed because, the crystal field splitting Δ_o is not large enought to overcome pairing energy i.e $\Delta_o < P$.
- **20.** (a) $[FeF_6]^{3-}$ oxidation state of Fe = +3

So, $Fe^{3+} = [Ar]3d^5$ where, F^- is weak field ligand.

$$3d^{5}$$

$$1 1 1 e_{g} \text{ (Symmetrical field) } [t_{2g}^{3} e_{g}^{2}]$$

$$1 1 1 1 t_{1}$$

$$1 1 1 t_{2g}$$

Hence, $[FeF_3]^{3-}$ produces more symmetrical field.

(b) $[Mn(CN)_6]^{4-}$ oxidation state of Mn = +2

So, $Mn^{2+} = [Ar]3d^5$ where, CN^- is strong field ligand, so , it produce unsymmetrical field i.e. $t_{2\sigma}5e_{\sigma^0}$



(c) $[CoF_6]^{3-}$ oxidation state of Co = +3

So, $Co^{3+} = [Ar]3d^6$

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Due to weak field ligand of F⁻, it produces unsymmetrical field

i.e.
$$t_{2g}^4, e_g^2$$

(d) $[Co(NH_3)_6]^{2+}$ oxidation state of Co= +2

So,
$$Co^{2+} = [Ar]3d^7$$

where, NH₃ is strong field ligand,



 t_{2g}^{6}, e_{g}^{1} (unsymmetrical field).

21. (*b*) Fe(CO)₅ is a stable complex/ion. Since, there is only one central metal atom present in iron carbonyl, Fe(CO)₅, thus it is mononuclear.

The structure of $Fe(CO)_5$ is shown below :

$$\begin{array}{c} CO \\ CO \\ Fe \\ CO \\ CO \\ CO \end{array}$$

The examples of dinuclear, trinuclear complexes are $Co_2(CO)_{18}$, $Fe_3(CO)_{12}$ respectively.

22. (*b*) The organometallic compounds having sigma bond between carbon and metal are called sigma bonded organometallic. An example of a sigma bonded organometallic compound is Grignard's reagent.

$$\underbrace{R-Mg}_{\sigma\text{-bond}} -X$$

23 (*a*) The M—C π -bond in metal carbonyl which is formed by the donation of an electron pair from a filled *d*-orbital of metal into the vacant antibonding π -orbital of CO, strengthens the M—C σ -bond.

This is called synergic effect and is usually observed in metal carbonyls. Thus, $[Ni(CO)_4]$ being metal exhibits synergic effect.