# Coordination compounds

## Multiple choice questions

1. In the complex formation, the central metal atom / ion acts as

   a) Lewis base b) Bronsted base c) Lewis acid d) Bronsted acid

2. The groups satisfying the secondary valencies of a cation in a complex are called

   a) Ligands b) Radicals c) Primary valencies d) None of these

3. The number of ions formed on dissolving one molecule of $FeSO_4(NH_4)_2SO_4.6H_2O$ in water is

   a) 4 b) 5 c) 3 d) 6

4.The number of unidentate ligands in the complex ion is called

   a. Effective atomic number b. Coordination number

   c. Primary valency c. Oxidation number

5.The oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$ is

   a. +3 b. +2 c. +1 d. 0

6.Which response gives the correct coordination number and oxidation number of the transition metal atom in $[Co(NH_3)_2(H_2O)_2Cl_2]^+$?

   a. C.N. = 2; O.N. = +3 b. C.N. = 3; O.N. = +1
   c. C.N. = 4; O.N. = +2 d. C.N. = 6; O.N. = +3

7.Which one of the following is a monodentate ligand?

   a. $CN^-$ b. EDTA
   c. $C_2O_4^-$ d. $H_2NCH_2CH_2NH_2$

8.Which of the following can function as a chelating agent?

   a. $SH^-$ b. $H_2O$ c. $H_2NCH_2CO_2^-$ d. $SCN^-$

9.Consider the coordination compound, $Na_2[Pt(CN)_4]$. The Lewis acid is

   (a) $[Pt(CN)_4]^{2-}$ (b) Pt (c) $Pt^{2+}$ (c) $CN^-$

10. Consider the coordination compound, $K_2[Cu(CN)_4]$. A coordinate covalent bond exists between

   (a) $K^+$ and $CN^-$ (b) $Cu^{2+}$ and $CN^-$
   (c) $K^+$ and $[Cu(CN)_4]^{2-}$ (d) C and N in $CN^-$

11. Which of the following compound will furnish $Fe^{3+}$ ions in solution?

   a) $[Fe(CN)_6]^{3-}$ b) $Fe_2(SO_4)_3$ c) $[Fe(CN)_6]^{4-}$ d) None of these

## 9.3 Nomenclature of coordination compounds

12. The IUPAC name for the complex $[Co(NO_2)(NH_3)_5]Cl_2$ is
    a. nitrito-N-pentaamminecobalt (III) chloride
    b. nitrito-N-pentaamminecobalt (II) chloride
    c. pentaamminenitrito-N-cobalt (II) chloride
    d. pentaamminenitrito-N-cobalt (III) chloride
13. The IUPAC name of the coordination compound $K_3[Fe(CN)_6]$ is
    a. Potassium hexacyanoferrate (II)
    b. Potassium hexacyanidoferrate (III)
    c. Potassium hexacyanoiron (II)
    d. tripotassiumhexcyanoiron (II)

14. Which coordination compound is named incorrectly?

    A. $[Co(NH_3)_5Cl]SO_4$ pentaamminechloridocobalt(III) sulphate
    B. $[Ag(CN)_2]^-$ dicyanidoargentate(I) ion
    C. $[Co(NH_3)_4Cl_2]Cl$ tetraamminedichloridocobalt(III) chloride
    D. $[Pt(en)_2Cl_2]Cl_2$ diethylenediaminedichloroplatinum(IV) chloride
    D. $[Cr(en)_2Cl_2]^+$.

15. Determine the chemical formula for the compound, diamminetetraaquairon(II)chloride.
    A. $[Fe(NH_3)_2(H_2O)_4Cl]$
    B. $[Fe(NH_3)_2][(H_2O)_4Cl]$
    C. $[Fe(NH_3)_2(H_2O)_4]Cl_2$
    D. $[Fe(H_2O)_4][(NH_3)_2Cl]$

## 9.4 Isomerism in coordination compounds

16. Which one of the following compounds will exhibit linkage isomerism
    (a) $[Pt(NH_3)_2Cl_2]$ (b) $[Co(NH_3)_5NO_2]Cl_2$
    (c) $[Co(NH_3)_4Cl_2]NO_2$ (d) $[Ag(NH_3)_2]NO_2$
17. 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. $[Zn(en)_2]^{2+}$
18. Which complex cannot ionize in solution?
    a. $[Pt(NH_3)_6]Cl_4$

c. $K_2[pt(F_6)]$
c. $K_4[Fe(CN)_6]$
d. $[CoCl_3(NH_3)_3]$

19.Excess of silver nitrate solution is added to 100 ml of 0.01 M Pentaaquachlorido chromium (III) chloride solution. The mass of silver chloride obtained in grams is
[Atomic mass of silver is 108].

a. $287 \times 10^{-3}$

b.$143.5 \times 10^{-3}$

c. $143.5 \times 10^{-2}$

d. $287 \times 10^{-2}$

20.Which of the following square planar complex ions can have cis-trans isomers?

A. $[Pt(NH_3)_4]^{2+}$
B. $[Ni(NH_3)_4]^{2+}$
C. $[Pt(NH_3)_2Cl_2]$
D. $[Pt(NH_3)Cl_3]^{-}$

21.A complex with the composition $[MA_2B_2]X_2$ is found to have no geometrical isomers. Both A and B are monodentate ligands. The structure of the complex is

A. linear.
B. square planar.
C. tetrahedral.
D. octahedral.

22.Which of the following pairs of coordination compounds or complex ions are examples of linkage isomers?

A) $[Cu(NH_3)_5Br]Cl$ and $[Cu(NH_3)_5Cl]Br$
B) $[Fe(NH_3)_2(H_2O)_4]Cl_2$and $[Fe(NH_3)_4(H_2O)_2]Cl_2$
C) $[Fe(CO)_5NO_2]^{2+}$ and $[Fe(CO)_5ONO]^{2+}$
D) $[Fe(NH_3)_2(H_2O)_4]Cl_2$ and $[Fe(NH_3)_2(H_2O)_4]Br_2$

23.Which of the following compounds can exhibit cis-trans isomerism?

A) $[Fe(CO)_5NO_2]^{2+}$
B) $[Cu(CO)_5Cl]^{+}$
C) $[MnClBr_3]^{2-}$
D) $[Ni(CO)_2(NH_3)_2]^{2+}$

24.Which of the following compounds can exhibit fac-mer isomerism?

A) $[Cu(CO)_5Cl]^{+}$
B) $[Co(H_2O)_3(CO)_3]^{3+}$

C) $[Fe(CO)_5NO_2]^{2+}$

D) $[Fe(NH_3)_2(H_2O)_4]^{2+}$

25.Which of the following compounds can exhibit fac-mer isomerism?

A) $[Cr(H_2O)_4Br_2]^{+}$

B) $[Fe(CO)_5ONO]^{2+}$

C) $[Fe(CO)_3(NH_3)_3]^{3+}$

D) $[Cu(CO)_5Br]^{+}$

26.Which one of the following complexes can exhibit geometrical isomerism?

(a) $[Pt(NH_3)_2Cl_2]$ (square planar)

(b) $[Zn(NH_3)_2Cl_2]$(tetrahedral)

(c) $[Cu(NH_3)_4]^{2+}$ (square planar)

(d) $[Co(NH_3)_5Cl]^{2+}$ (octahedral)

27.Exchange of co-ordination group by a water molecule in complex molecule results in

a) Ionisation isomerism b) Ligand isomerism

c) Hydration isomerism d) Geometrical isomerism

28.Which of the following complex will give white precipitate with barium chloride solution?

a) $[Cr(NH_3)_5Cl]\ SO_4$ b) $[Cr(NH_3)SO_4]Cl$ c) $[Co(NH_3)_6]\ Br_3$ d) None of these

## 9.5 Bonding in coordination compounds

29.An octahedral complex is formed when central metal atom undergoes hybridization among the _____ orbitals

a) $sp^3$ b) $dsp^2$ c) $sp^3d$ d) $sp^3d^2$

30.In which one of the following species does the transition metal ion have $d^3$ electronic configuration?

(a) $[Cr(NH_3)_6]^{3+}$

(b) $[Co(OH_2)_6]^{2+}$

(c) $[CoF_6]^{3-}$

(d) $[Fe(CN)_6]^{3-}$

31.(Valence Bond Theory) The coordination complex, $[Cu(OH_2)_6]^{2+}$ has one unpaired electron. Which of the following statements are **true**?

(1) The complex is octahedral.

(2) The complex is an outer orbital complex.

(3) The complex is $d^2sp^3$ hybridized.

(4) The complex is diamagnetic.

(5) The coordination number is 6.

(a) 1, 4

(b) 1, 2, 5

(c) 2, 3, 5

(d) 2, 3

32.(Crystal Field Theory) When the valence d orbitals of the central metal ion are split in energy in an octahedral ligand field, which orbitals are raised **least** in energy?

(a) $d_{xy}$ and $d_x2_{-y}2$
(b) $d_{xy}$, $d_{xz}$ and $d_{yz}$
(c) $d_{xz}$ and $d_{yz}$
(d) $d_{xz}$, $d_{yz}$ and $d_z2$
(e) $d_x2_{-y}2$ and $d_z2$

33.(Crystal Field Theory) How many unpaired electrons are there in a strong field iron(II) octahedral complex?

(a) 0
(b) 1
(c) 2
(d) 4

34.Among the following ions which one has the highest paramagnetism

(a) $[Cr(H_2O)_6]^{3+}$
(b) $[Fe(H_2O)_6]^{2+}$
(c) $[Cu(H_2O)_6]^{2+}$
(d) $[Zn(H_2O)_6]^{2+}$

35.The magnetic moment of $[NiX_4]^{2-}$ ion is found to be zero. Then the metal of the complex ion is (X = monodentate anionic ligand).

(a) $sp^3$ hybridized
(b) $spd^2$ hybridised
(c) $dsp^2$ hybridized
(d) $d^2sp$ hybridized