Coordination Compounds

Examples of
Multiple Choice Questions

1.

The _____ sphere is enclosed in brackets in formulas for complex species, and it includes the central metal ion plus the coordinated groups.
(a) ligand
(b) donor
(c) oxidation
(d) coordination
(e) chelating

2.

In coordination chemistry, the **donor atom** of a ligand is
(a) a Lewis acid.
(b) the counter ion
(c) the central metal atom.
(d) the atom in the ligand that shares an electron pair with the metal.
(e) the atom in the ligand that accepts a share in an electron pair from the metal.

3.

Consider the coordination compound, $Na_2[Pt(CN)_4]$. The Lewis acid is
(a) $[Pt(CN)_4]^{2-}$
(b) Na^+
(c) Pt
(d) Pt^{2+}
(e) CN^-

4.

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^-
(e) K^+ and Cu^{2+}

5.

Given the list of ligands and their corresponding names, choose the pair that disagree.

	LIGAND	NAME
(a)	OH^-	hydroxo
(b)	CN^-	cyanide
(c)	Cl^-	chloro
(d)	H_2O	aqua
(e)	NH_3	ammine

6.

Select the **correct** IUPAC name for: $[FeF_4(OH_2)_2]^-$

(a) diaquatetrafluoroiron(III) ion
(b) diaquatetrafluoroferrate(III) ion
(c) diaquatetrafluoroiron(I) ion
(d) diaquatetrafluoroferrate(I) ion
(e) none of these

7.

Select the **correct** IUPAC name for: $[Co(NH_3)_6]^{2+}$

(a) hexammoniacobaltate(II) ion
(b) hexaamminecobaltate(II) ion
(c) hexammoniacobalt(II) ion
(d) hexaamminecobalt(II) ion
(e) hexammoniacobalt ion

8.

Which name-formula combination is NOT correct?

	FORMULA	NAME
(a)	$[Co(NH_3)_4(OH_2)I]SO_4$	tetraammineaquaiodocobalt(III) sulfate
(b)	$K[Cr(NH_3)_2Cl_4]$	potassium diamminetetrachlorochromate(III)
(c)	$[Mn(CN)_5]^{2-}$	pentacyanomanganate(II) ion
(d)	$[Ni(CO)_4]$	tetracarbonylnickel(0)
(e)	$Ca[PtCl_4]$	calcium tetrachloroplatinate(II)

9.

What is the oxidation number of the central metal atom in the coordination compound

$[Pt(NH_3)_3Cl]Cl$?

(a) -1
(b) 0
(c) +1
(d) +2
(e) +3

10.

(Valance Bond Theory) Magnetic measurements indicate that $[Co(OH_2)_6]^{2+}$ has 3 unpaired electrons. Therefore, the hybridization of the metal's orbitals in $[Co(OH_2)_6]^{2+}$ is:
(a) sp^3
(b) sp^2d
(c) dsp^2
(d) sp^3d^2
(e) d^2sp^3

11.

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)
(e) $[Cu(CN)_2]^-$ (linear)

12.

A molecule that cannot be superimposed on its mirror image is said to exhibit which of the following?
(a) geometrical isomerism
(b) optical isomerism
(c) linkage isomerism
(d) reactive isomerism
(e) coordination isomerism

13.

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) $[Fe(CN)_6]^{3-}$
(e) $[Ni(OH_2)_6]^{2+}$

14.

(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
(e) 4, 5

15.

(Crystal Field Theory) Which one of the following statements is **FALSE**?
(a) In an octahedral crystal field, the d electrons on a metal ion occupy the e_g set of orbitals before they occupy the t_{2g} set of orbitals.
(b) Diamagnetic metal ions cannot have an odd number of electrons.
(c) Low spin complexes can be paramagnetic.
(d) In high spin octahedral complexes, Δ_{oct} is less than the electron pairing energy, and is relatively very small.
(e) Low spin complexes contain strong field ligands.

16.

(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-y2}
(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-y2} and d_{z2}

17.

(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
(e) 6

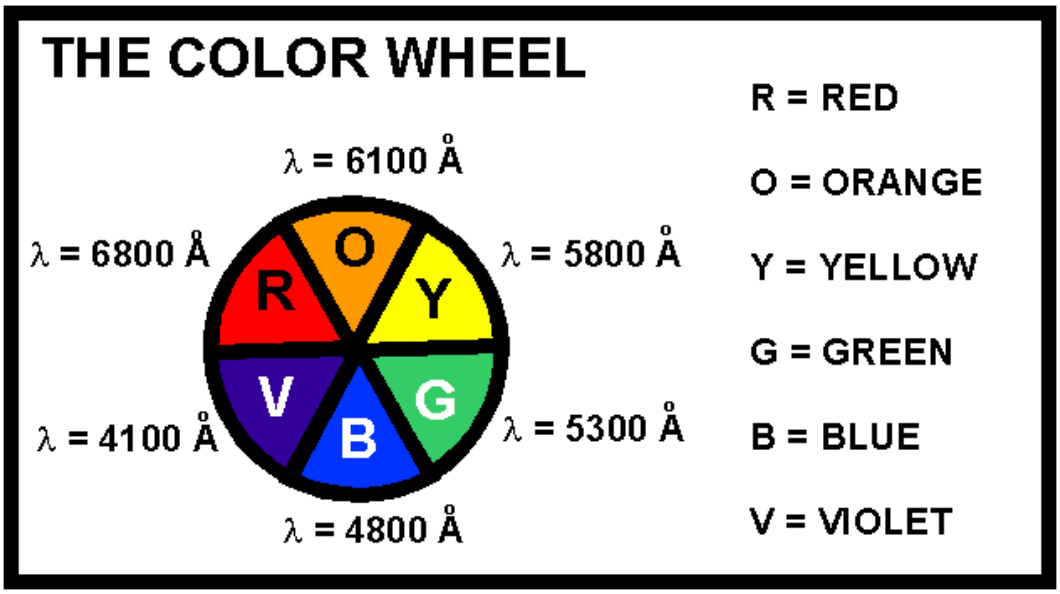
18.

(Crystal Field Theory) Consider the complex ion $[Mn(OH_2)_6]^{2+}$ with 5 unpaired electrons. Which response includes all the following statements that are **true**, and no false statements?
I. It is diamagnetic.
II. It is a low spin complex.
III. The metal ion is a d^5 ion.
IV. The ligands are weak field ligands.
V. It is octahedral.
(a) I, II
(b) III, IV, V

(c) I, IV
(d) II, V
(e) III, IV

19.

(Crystal Field Theory) Consider the violet-colored compound, $[Cr(OH_2)_6]Cl_3$ and the yellow compound, $[Cr(NH_3)_6]Cl_3$. Which of the following statements is false?



(a) Both chromium metal ions are paramagnetic with 3 unpaired electrons.
(b) Δ_{oct} for $[Cr(NH_3)_6]^{3+}$ is calculated directly from the energy of yellow light.
(c) Δ_{oct} for $[Cr(OH_2)_6]^{3+}$ is less than Δ_{oct} for $[Cr(NH_3)_6]^{3+}$.
(d) A solution of $[Cr(OH_2)_6]Cl_3$ transmits light with an approximate wavelength range of 4000 - 4200 angstroms.
(e) The two complexes absorb their complementary colors.

20.

(Crystal Field Theory) Strong field ligands such as CN^-:
(a) usually produce high spin complexes and small crystal field splittings.
(b) usually produce low spin complexes and small crystal field splittings.
(c) usually produce low spin complexes and high crystal field splittings.
(d) usually produce high spin complexes and high crystal field splittings.
(e) cannot form low spin complexes.

Answers:

1. (d) **2.** (d) **3.** (d) **4.** (b) **5.** (b) **6.** (b) **7.** (d) **8.** (c) **9.** (d) **10.** (d) **11.** (a) **12.** (b) **13.** (a) **14.** (b) **15.** (a) **16.** (b) **17.** (a) **18.** (b) **19.** (b) **20.** (c)