Review Questions -- Chapter 25

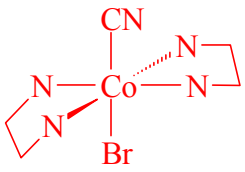
1. For each of the following metal complexes, give the ***oxidation state*** of the metal and the ***complete, systematic name*** of the compound or ion.

   (a) $[Fe(CN)_3(NH_3)_3]^-$ Fe^{2+}
   triamminetricyanoferrate(II) ion

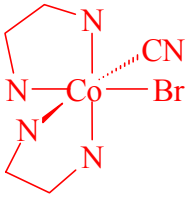
   (b) $[Cr(en)_2Br_2]_2SO_4$ Cr^{3+}
   dibromobis(ethylenediamine)chromium(III) sulfate

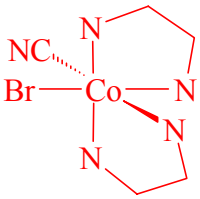
2. Draw ***clear, 3-dimensional structures*** of all of the isomers, geometric and/or optical, of the following complex. Points will be deducted if the same structure is drawn more than once.

$Co(en)_2(CN)Br$



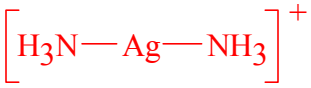
trans
(not optically active)



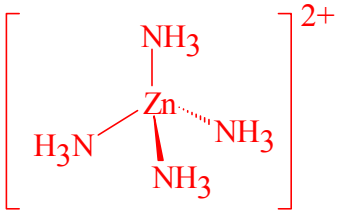


cis
(optically active)

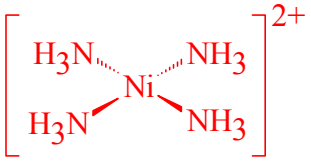
3. When an excess of ammonia (NH_3) is added to aqueous solutions of each of the following metal ions, complexes having various coordination numbers and/or structures are produced. Write the ***formula*** for each metal-NH_3 complex and clearly draw it's ***3-dimensional structure***.



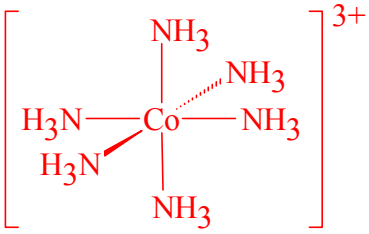
linear



tetrahedral



square planar

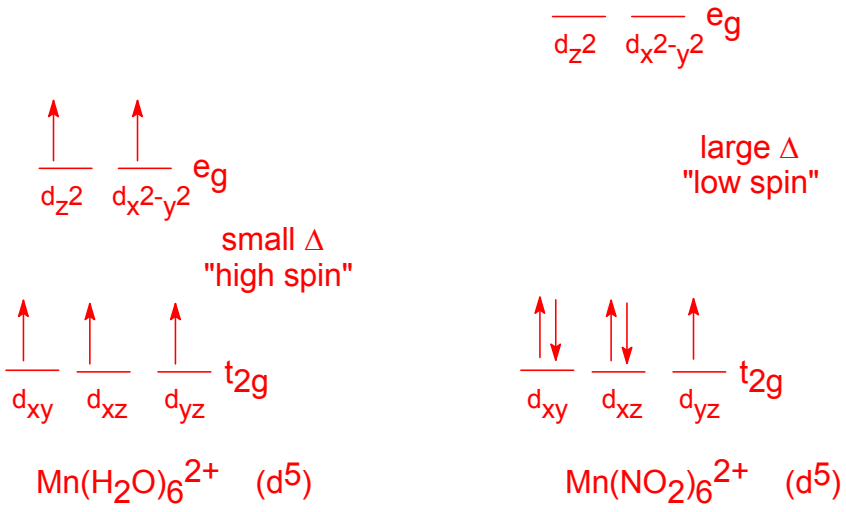


octahedral

4. For each of the following complexes, **A** and **B**, sketch a ***properly-labeled d-orbital splitting diagram***. Then answer the questions below in a manner consistent with your diagrams.

A: $[Mn(H_2O)_6]^{2+}$ **B**: $[Mn(NO_2)_6]^{4-}$

The complexes are both Mn^{2+}, d^5 cases but with different ligands. However, NO_2^- is a stronger field ligand than is H_2O which leads to a greater d-orbital splitting energy (Δ) in Complex **B**.



(a) How many unpaired electrons does complex **A** have? 5

(b) Which complex, **A** or **B**, will absorb light of longer wavelength?

Since $Mn(H_2O)_6^{2+}$ has a smaller d-orbital splitting energy (Δ), it should absorb light of lower energy (i.e., longer wavelength) than $[Mn(NO_2)_6]^{4-}$.