6. a) 6, +3  b) 6, +2  c) 6, +4  d) 6, +2  e) 6, +3  f) 6, +3

14. a) Monodentate. It bonds through the lone pair on nitrogen.
   
   b) It would be small. bpy is a bidentate ligand and would have a smaller tendency to dissociate from the complex than two pyridine ligands. Thus, Ru(py)_6^{2+} would have a smaller $K_f$.

16. a) [Mn(H_2O)_5Br]SO_4  
   b) [Ru(bpy)_3(NO_3)_2]  
   c) [Fe(o-phen)_2Cl_2]ClO_4  
   d) Na[Co(en)Br_4]  
   e) [Ni(NH_3)_6]_3[Cr(ox)_3]_2

18. a) trichloro(ethylene diamine)niobium(V) sulfate  
   b) tricarbonyltripyridinemolybdenum(0)  
   c) ammonium tetrachloroauroate(III)  
   d) tetramminediaquoiridium(III) nitrate

20. a)  

\[
\begin{array}{c}
\text{NH}_3 \\
\text{H}_3\text{N} \\
\text{SCN}
\end{array}
\hspace{2cm}
\begin{array}{c}
\text{NH}_3 \\
\text{H}_3\text{N} \\
\text{NCS}
\end{array}
\]

b)  

\[
\begin{array}{c}
\text{Cl} \\
\text{NH}_3 \\
\text{Cl}
\end{array}
\hspace{2cm}
\begin{array}{c}
\text{Cl} \\
\text{NH}_3 \\
\text{Cl}
\end{array}
\]

Coordination sphere isomerism

32. Imagine a metal ion possessing one e\textsuperscript{-} in its $d$-orbitals. Put it at the center of a set of coordinate axes with one ligand at the end of each axis. The ligands are an infinite distance from the metal and, therefore, do not affect it. In this state the $d$-orbitals are degenerate (equal in energy). Now move the ligands closer. Ligand e\textsuperscript{-} are attracted to the metal nucleus but they repel e\textsuperscript{-} on the metal. Two of the $d$-orbitals point along the axes ($z^2$ and $x^2-y^2$) while 3 point between the axes ($xy$, $yz$, and $xz$). The e\textsuperscript{-} in orbitals lying on the axes will be repelled
by ligand e\textsuperscript{−} more than those lying between the axes because there is greater overlap. Thus an energy differentiation develops between the orbitals with the between axes orbitals lying lower in energy than those on the axes.

36. Green ion absorbs red light, purple absorbs yellow (their respective complements). Yellow light is shorter wavelength (higher energy), than red. This is consistent with the spectrochemical series.

38. a) 6 b) 9 c) 7 d) 10 e) 0

42. a) \[
\begin{array}{c}
\uparrow \\
\uparrow \\
\uparrow \\
\end{array}
\]
   c) \[
\begin{array}{c}
\uparrow \\
\uparrow \\
\downarrow \\
\end{array}
\]
   e) \[
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]
   b) \[
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]
   d) \[
\begin{array}{c}
\uparrow \\
\uparrow \\
\end{array}
\]
   f) \[
\begin{array}{c}
\downarrow \\
\downarrow \\
\end{array}
\]

44. In both complexes, iron is in the +3 oxidation state and has 5 \(d\)-electrons. The splitting diagram shows that one unpaired electron results from a low-spin configuration, while 5 unpaired electrons is high spin. Therefore, SCN\textsuperscript{−} is lower on the spectrochemical series than CO.

46. \[
\begin{align*}
\text{Pt(NH}_3\text{)}_6\text{Cl}_4 & = [\text{Pt(NH}_3\text{)}_6]\text{Cl}_4 \\
\text{Pt(NH}_3\text{)}_4\text{Cl}_4 & = [\text{Pt(NH}_3\text{)}_4\text{Cl}_2]\text{Cl}_2 \\
\text{Pt(NH}_3\text{)}_3\text{Cl}_4 & = [\text{Pt(NH}_3\text{)}_3\text{Cl}_3]\text{Cl}
\end{align*}
\]

47. a) [Ru(H\textsubscript{2}O\textsubscript{5}Cl]Cl\textsubscript{2}

b) A water molecule has displaced the chloride ion in the coordination sphere to generate [Ru(H\textsubscript{2}O\textsubscript{6})Cl\textsubscript{3}.

51. a) The span of ethylene diamine is too small to reach across a platinum atom in a \textit{trans} configuration.

b) One with a long chain of atoms between the donor atoms.