Coordination Compounds

- Transition metal ions can form coordination compounds.
- Coordination compounds typically consist of a *complex ion*, a transition metal ion with its attached ligands and counterions (anions or cations as needed to make a neutral compound).
- Ligands = a Lewis Base- a molecule having an unshared pair of electrons that can be donated to an empty orbital on the metal ion.

Complex Ions

- A complex ion is a charged species that has a metal ion surrounded by ligands.
- Some common ligands are H_2O, NH_3, Cl^- and CN^-.
- Coordination Number = # of ligands attached to the metal ion.
- The most common coordination number is 6.
- For example: $Co(H_2O)_6^{2+}$ and $Ni(NH_3)_6^{2+}$
- Other complex ions have 4 or 2 ligands…

$CoCl_4^{2-}$, $Cu(NH_3)_2^{2+}$

Reactions involving Coordination Compounds

- Reactions like these are sometimes included in the net ionic type reactions in the AP Chem test

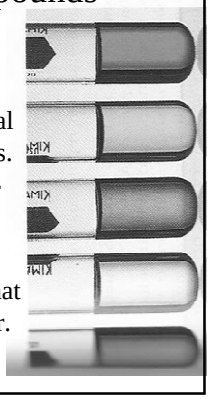
$$[Co(NH_3)_5Cl]Cl_{2(s)} \xrightarrow{H_2O} Co(NH_3)_5Cl^{2+}_{(aq)} + 2\ Cl^-_{(aq)}$$

Coordination compound

- In this reaction the brackets indicate the complex ion and two Cl^- are the counter ions.
- There are 5 NH_3 ligands and one Cl^- ligand that create the complex ion.
- When dissolved in water, the solid behaves like any ionic solid (the cations and anions dissociate)

Coordination Compounds

- The reason they are named this is due to the fact that the resulting bond between the Lewis base (ligands) and the Lewis acid (metal ion) are coordinate covalent bonds.
- This means that both electrons for the bond are donated by the base.
- One property of most transition metal coordination compounds, that is especially striking, is their color.



Naming Coordination Compounds

- See p.1001 in text
- Excess hydrochloric acid is added to a solution of diamminesilver (I) nitrate.

$2H^+ + Cl^- + Ag(NH_3)_2NO_3 \rightarrow AgCl_{(s)} + 2NH_4NO_3$

Nitrate is a spectator ion

$2H^+ + Cl^- + Ag(NH_3)_2^+ \rightarrow AgCl_{(s)} + 2NH_4^+$

Excess concentrated hydrochloric acid is added to a 1.0 M solution of cobalt (II) chloride hexahydrate

$4\ Cl^- + Co(H_2O)_6^{2+} \rightarrow 6\ H_2O + CoCl_4^{2-}$