Ch 12 Electrolysis in water

- Electrolysis is a fairly simple process.
- There are two plates in a solution, and an electric current is sent through.
- The plates are the cathode, where reduction takes place, and the anode, where oxidation takes place.
- cathode-reduction anode-oxidation

Rules for cathode reaction

- A cation may be reduced to a metal
- $Cu^+ + 1\ e^- \rightarrow Cu$
- Or water way be reduced to hydrogen
- $2\ H_2O + 2\ e^- \rightarrow H_2 + 2\ OH^-$
- Transition metals tend to reduce before water, main group metals tend to reduce after

Rules for anode reactions

- An anion nonmetal may be oxidized to a nonmetal
- $2\ Cl^- \rightarrow Cl_2 + 2\ e^-$
- Water may be oxidized to oxygen
- $2\ H_2O \rightarrow O_2 + 4\ H^+ + 4\ e^-$
- Chlorine, bromine and iodine will oxidize before oxygen. That is it.

Insoluble compounds

1. **Halogens** with Silver, Mercury(I), and Lead.
2. **Sulfates** with barium, strontium, calcium, lead, silver, and mercury (I).
3. **Fluorides, carbonates, oxalates, sulfites, chromates, oxides, silicates, and phosphates** are insoluble.
4. **Hydroxides** are insoluble except Ba, Sr, and Ca
5. **Sulfides** are insoluble except for calcium, barium, strontium, magnesium.

Decomposition Rules

Metal oxides and water make bases
Nonmetal oxides and water make acids
Metal oxides and nonmetal oxides make salts
Carbonates decompose into carbon dioxide and oxides
Chlorates decompose into oxygen and chloride
Ammonium with a base decomposes into ammonia and water
Hydrogen peroxide decomposes into water and oxygen

Electrolysis in water
Transition metals will reduce before hydrogen gas
$2\ H_2O + 2\ e^- \rightarrow H_2 + 2\ OH^-$

Chlorine Bromine and Iodine will oxidize before oxygen
$2\ H_2O \rightarrow O_2 + 4\ H^+ + 4\ e^-$

Rules for molten binary salts

- Molten means melted, with no water.
- These are straightforward and easy!
- Molten magnesium chloride is electrolyzed
- $MgCl_2 \rightarrow Mg + Cl_2$

Examples

- Aqueous calcium bromide is electrolyzed
- Aqueous chromium (III) nitrate is electrolyzed
- Aqueous cobalt (II) iodide is electrolyzed
- Aqueous potassium nitrate is electrolyzed
- Molten sodium chloride is electrolyzed

Ch 13 Complex ion reactions

- Formation of complex ions. Complex ions are when ligands bond around a transition metal to make a new ion
- Common complex ions transition metals
- Fe Co Ni Cr Cu Zn Ag
- Common ligands
- NH_3 CN^- OH^- SCN^-
- General rule: the number of ligands will be twice the charge of the metal ion

Example

- Iron (III) chloride reacts with potassium cyanide
- $Fe^{3+} + 6\ CN^- \rightarrow Fe(CN)_6^{3-}$
- How did I get the charge? Iron is 3+ , 6 cyanides at 1-

Examples

- Zinc (II) fluoride reacts with sodium thiocyanate to form a complex ion
- Concentrated ammonia is reacted with cobalt (III) iodide to form a complex ion
- Barium hydroxide reacts with nickel (II) nitrate to form a complex ion