B. Double Displacement Reactions
Predicting Products in Chemical Reactions

If I pour a beaker containing a solution of potassium carbonate in water into a beaker containing a solution of calcium chloride in water, will a chemical reaction occur?

**Beaker 1:**

**Beaker 2:**
Beaker 1 + Beaker 2
B) Double Displacement Reactions

\[ AX + BY \rightarrow AY + BX \]

**Steps**

1. Identify the cations and anions

2. **Identify the products by combining the cations and anions via double displacement**

3. Use the solubility rules to predict the physical states of the products

4. **Balance the equation (ions in ppt first)**
3 Types of Equations Describe Reaction
1. Complete Equation (complete chemical formulas)
2. Total Ionic Equation (what the chemicals exist as in soln)
3. Net Ionic Equation (only the ions that do something)
Example Problem
What is the complete, total ionic, and net ionic equation for the reaction of lead(II) nitrate and potassium phosphate?
Example Problem
What is the complete, total ionic, and net ionic equation for the reaction of sodium chloride and potassium nitrate in water?
Compounds included in Net-Ionic Equations

\[ \text{Ionic(aq)} + \text{Ionic(aq)} \rightarrow \text{1. Ionic(aq)} + \text{Ionic(aq)} \]

\[ \text{2. Ionic(aq)} + \text{Ionic(s)} \]
\[ \text{Or} \]
\[ \text{Ionic(s)} + \text{Ionic(aq)} \]

\[ \text{3. Ionic(s)} + \text{Ionic(s)} \]
I II. Acid Base Reactions

Acid - a substance that increases the \( \text{H}_3\text{O}^+ \) concentration when placed in water

Base - a substance that increases the \( \text{OH}^- \) concentration when placed in water

Strong and Weak Acids

\[
\text{HCl, HBr, HI, HNO}_3, \text{H}_2\text{SO}_4, \text{HClO}_4 \\
\text{All others weak}
\]

Strong and Weak Bases

\[
\text{LiOH, NaOH, KOH, RbOH, CsOH, Ca(OH)}_2, \text{ Ba(OH)}_2
\]
Acid – Base Reactions

Acid-Base Reactions That Always Occur

1. Strong Acid + Strong Base → Reaction Will Occur

2. Weak Acid + Strong Base → Reaction Will Occur

3. Strong Acid + Weak Base → Reaction Will Occur

4. Weak Acid + Weak Base → Reaction May or May Not Occur
3 Types of Equations Describe Reactions

1. Complete Equation (complete chemical formulas)
2. Total Ionic Equation (what the chemicals exist as in soln)
3. Net Ionic Equation (only the ions that do something)
Example
Example
**MIRACLE MAX (HEALER AND CHEMIST)**

He is only mostly dead!

Insoluble means only mostly insoluble. Have fun studying chemistry!!
Difficult problem
III. Oxidation Reduction Reactions

**So Far**
1. Ionic(aq) + Ionic(aq) $\rightarrow$ Transfer of ions
2. Acid + Base $\rightarrow$ Transfer of acidic H’s
3. Oxidation Reduction $\rightarrow$ Transfer of e$^-$

**Terminology**
- **Oxidation** - when a lone atom or atom within a molecule or ion loses an electron(s)
- **Reduction** - when a lone atom or atom within a molecule or ion gains an electron(s)
- **Reducing Agent** - element that forces another element to gain electrons
- **Oxidizing Agent** - element that forces another element to lose electrons
REDOX Reactions
Keeping Track of Electrons
Oxidation State (#) –

Rules For Obtaining Oxidation States
1. Each atom in a neutral cmpd. containing only one type of element has an ox. st. = 0

2. For monoatomic ions, the ox. st. is equal to the charge on the ion
Keeping Track of Electrons Cont’d

3. In its compounds and ions, the following elements usually have a specific ox. st.

A. Fluorine (F)
   - when combined with other, different elements, F always has and ox. st. = -1

B. Hydrogen (H)
   - when combined with other, different elements, H usually has and ox. st. = +1

C. Oxygen (O)
   - when combined with other, different elements, O usually has and ox. st. = -2
Examples
What is the oxidation # of
Reaction Examples and Prediction of Products

1. Ionic(aq) + Ionic(aq) →
2. Acid(aq) + Base(aq) or (s) →

3. Metal(s) + Non-Metal →
4. Combustion →
More Examples of Redox Reactions
IV. Combustion