

Unit 12 Important Types of AP Reactions:

Hints:

- 1) Keep it simple!
- 2) Reactions do not always need to be balanced.
- 3) Reactions do need charges and subscripts (especially precipitation reactions).
- 4) If H & OH around, then make H₂O.
- 5) **Write reactions as net ionic reactions, cancel out spectator ions!**

Keywords:

- 1) **Excess, Concentrated:** This is not a precipitate reaction!
- 2) **Excess, Concentrated or excess concentrated or excess saturated:** Usually a redox or complex ion reaction.
- 3) **One drop of a reactant:** complex ion or redox
- 4) **Solution:** Write compound as ions.
- 5) **Two solutions:** precipitate reaction
- 6) **Wire/ metal bar/ solid/ strip/ powdered metals put into solution:** redox
- 7) **Acidified:** usually redox reaction with H⁺ as a reactant.
- 8) **Equimolar or Equal volumes:** usually acid/base reaction.
- 9) If there are no keywords and there is an ion that can cancel: precipitate reaction.
- 10) If all of the ions are soluble, then not a precipitate reaction.

For Precipitation Reactions: (See Unit 3)

Solubility Rules ** soluble = aqueous
marginally/slightly soluble = solid

Solubility Table

1. Nitrate (NO₃⁻¹) salts are soluble.
2. Ammonium (NH₄⁺¹) and Group I Alkali metal (Li⁺¹, Na⁺¹, K⁺¹, Cs⁺¹, Rb⁺¹) salts are soluble.
3. Chloride, Bromide, Iodide (Cl⁻¹, Br⁻¹, I⁻¹) salts are soluble, except for salts with Ag⁺¹, Pb²⁺ and Hg₂²⁺.
4. Sulfate (SO₄²⁻) salts are soluble, except Ba²⁺, Ca²⁺, Pb²⁺, and Hg₂²⁺.
5. Soluble Hydroxides are LiOH, NaOH and KOH. Marginally soluble: Ba(OH)₂, Sr(OH)₂ and Ca(OH)₂. The rest are slightly soluble.
6. Carbonates (CO₃²⁻), Sulfides (S²⁻), Chromates (CrO₄²⁻) and Phosphates (PO₄³⁻) are slightly soluble. (All with ammonium or Group 1 Alkali metals are soluble.)

For Complex Ions (see Unit 7)

Usually involve excess concentrated ammonia (NH₃ as ligand), excess concentrated HCl (Cl⁻¹ as ligand), excess concentrated metal ion hydroxide (OH⁻¹ as ligand), excess concentrated metal ion fluoride (F⁻¹ as ligand), a drop of SCN⁻¹, etc. See ligands in Unit 7. The previous ligands will be mixed with Transition Metals to get the complex ion. Ligand number is usually 2X charge of metal.

Combustion Reactions:

Organic compound (C, H) or (C, H, O) + O₂ → CO₂ + H₂O

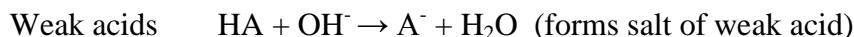
Important Reactions:

**** You may see the reverse of these reactions too.****

Acid/Base Reactions:

For General Acid/Base Reactions (See Unit 10)

**Write weak acids not as HC₂H₃O₂, but as CH₃CO₂H



Remember all variations from unit 10 (see notes): A⁻ + OH⁻ etc.

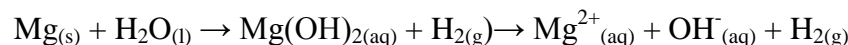
Special Acid/Base Reactions:

****Metal Oxides are basic (produce hydroxides)****: M_xO_y + H₂O_(l) → MOH → M⁺ + OH⁻



If weak base, don't ionize it. Use Bronsted-Lowry (donating/accepting protons (H⁺)).

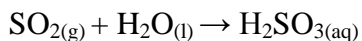
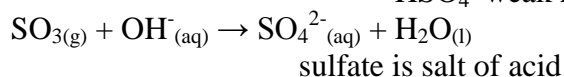
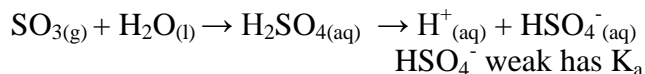
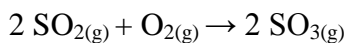
Metals (Grp #1 & 2) and Water: react with water to make H_{2(g)} and base.
(metal oxidation)



****Non-metal Oxides are acidic (N,S,C Oxides)****:

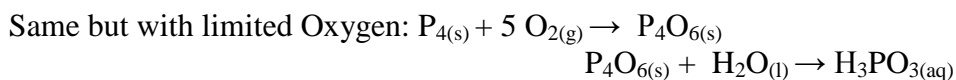
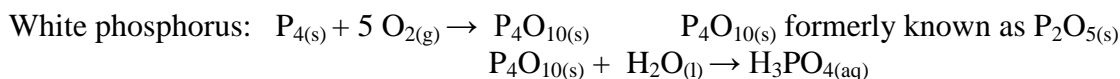
Non-metal oxides usually form by burning compounds, containing N, S, or C.
(i.e. combustion produces NO₂, N₂O₅, SO₂, CO₂ etc.)

Memorize these reactions!



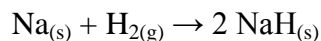
** Remember strong acid if # O - # H ≥ 2
If strong break to ions, H₂SO₄ will only loose 1 H⁺



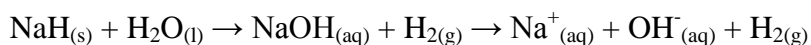


Hydrides:

Forming hydrides: $\text{metal} + \text{H}_2 \rightarrow \text{metal}^+ \text{H}^-$



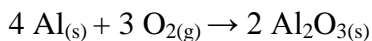
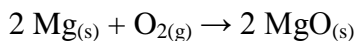
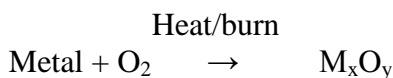
****Hydrides are strong bases:**



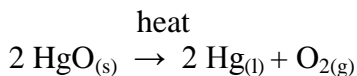
Redox (see Unit 3):

Oxides:

Forming metal oxides (add O_2 to metal):
(metal oxidation)



****unique:** $\text{PbS}_{(s)} + \text{O}_{2(g)} \rightarrow \text{PbO} + \text{SO}_2$



Carbon Reactions:

some Metal Oxides + C: $2 \text{PbO}_{(s)} + \text{C}_{(s)} \rightarrow 2 \text{Pb}_{(s)} + \text{CO}_{2(g)}$

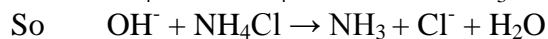
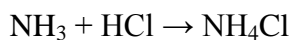
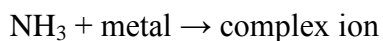
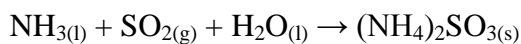
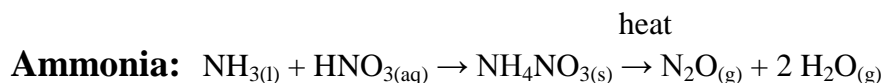
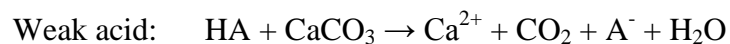
Carbide: $\text{CaC}_{2(s)} + 2 \text{H}_2\text{O}(l) \rightarrow \text{Ca}(\text{OH})_{2(aq)} + \text{C}_2\text{H}_2$
 Calcium carbide

Decompositions: $\text{compound} + \text{heat} \rightarrow \text{compound} + \text{compound}$

Carbonates: $(\text{NH}_4)_2\text{CO}_{3(s)} \xrightarrow{\text{heat}} 2 \text{NH}_{3(g)} + \text{CO}_{2(g)} + \text{H}_2\text{O}(l)$

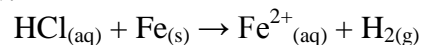
****** $\text{CaCO}_{3(s)} \xrightarrow{\text{heat}} \text{CaO}_{(s)} + \text{CO}_{2(g)}$

****** $\text{NaHCO}_{3(s)} \xrightarrow{\text{heat}} \text{Na}_2\text{CO}_{3(s)} + \text{CO}_{2(g)} + \text{H}_2\text{O}(l)$

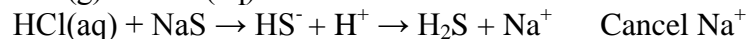
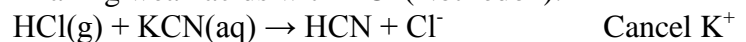


Acid Redox Reactions:

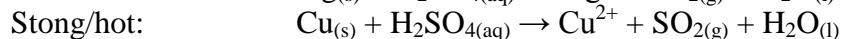
Hydrochloric Acid:



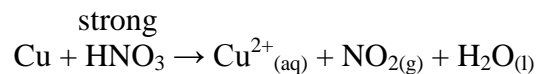
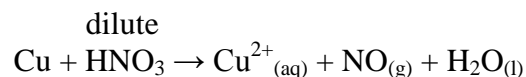
Making weak acids with HCl (Not redox):



Sulfuric Acid:



Nitric Acid:



Redox: Electrolysis of Water: $2 e^- + \text{H}_2\text{O}_{(l)} \rightarrow \text{H}_{2(g)} + \text{OH}^-_{(aq)}$

Oxidation of MnO_4^- : $5 e^- + 8 \text{H}^+_{(aq)} + \text{MnO}_4^-_{(aq)} \rightarrow \text{Mn}^{2+}_{(aq)} + 4 \text{H}_2\text{O}$

Organic Chem: (see Unit 12)

alcohol + carboxylic acid \rightarrow ester + H_2O

End of Notes