

AP REACTION TYPE NOTES

IMPORTANT: 15 point section (1 point for reactants and two points for products).

Average Score for this section is five points.

I. SYNTHESIS (COMBINE ELEMENTS) Make sure your compound on the product side has reasonable oxidation states for each element.

1. Hydrogen gas is burned in air. (H_2O)
2. Solid sulfur is burned in oxygen. (SO_2)
3. Solid magnesium is heated in nitrogen gas. (Mg_3N_2)
4. A piece of solid zinc is heated in chlorine gas. (ZnCl_2)
5. A piece of solid barium is placed in oxygen gas. (BaO)
6. A piece of solid sodium is placed in hydrogen gas (NaH)

II. DECOMPOSITION REACTION You will be given one reactant, so break it up. That guarantees you one point. REMEMBER: ***HYDROXIDES, CARBONATES, AND CHLORATES DECOMPOSE UPON HEATING!***

- A. Hydroxides form metal oxide and water.
- B. Chlorates form chloride salt and oxygen gas.
- C. Carbonates form metal oxide and carbon dioxide gas.

1. A solution of hydrogen peroxide is placed under a bright light. ($\text{H}_2\text{O} + \text{O}_2$)
2. Solid calcium carbonate is heated. ($\text{CaO} + \text{CO}_2$)
3. Solid potassium chlorate is heated in the presence of a catalyst. ($\text{KCl} + \text{O}_2$)
4. A Sample of solid ammonium carbonate is heated. ($\text{NH}_3 + \text{CO}_2 + \text{H}_2\text{O}$) *There is no such compound as ammonium oxide. Remember, when in doubt, change ammonia to ammonium hydroxide and water.*
5. A piece of solid potassium nitrate is heated. ($\text{KNO}_2 + \text{O}_2$) *There is no water in this reaction so it cannot dissociate, so reduce the oxidation state of nitrogen.*

III. WATER AS A REACTANT

Generally, water will react with:

Metal to form a base

Nonmetal to produce an acid (Remember to dissociate strong acids/bases)

Basic rules:

- A. a pure metal or a metal hydride \rightarrow base and hydrogen gas
- B. a metal oxide (basic anhydride) in water \rightarrow base
- C. a nonmetal oxide (acidic anhydride) in water \rightarrow acid

Practice equations:

1. Sodium is added to distilled water
 $\text{Na} + \text{H}_2\text{O} \rightarrow \text{Na}^{+1} + \text{OH}^{-1} + \text{H}_2$
2. Calcium metal is added to distilled water
 $\text{Ca} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$

3. Solid calcium hydride is added to water
 $\text{CaH}_2 + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$
4. Solid lithium hydride is added to distilled water
 $\text{LiH} + \text{H}_2\text{O} \rightarrow \text{Li}^{+1} + \text{OH}^{-1} + \text{H}_2$
5. Solid potassium oxide is added to water
 $\text{K}_2\text{O} + \text{H}_2\text{O} \rightarrow \text{K}^{+} + \text{OH}^{-1}$
6. Solid barium oxide is added to water
 $\text{BaO} + \text{H}_2\text{O} \rightarrow \text{Ba}^{+2} + \text{OH}^{-1}$
7. Solid calcium oxide is added to water
 $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$
8. Solid lithium oxide is added to water
 $\text{Li}_2\text{O} + \text{H}_2\text{O} \rightarrow \text{Li}^{+1} + \text{OH}^{-1}$
9. Solid dinitrogen pentoxide is added to water
 $\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow \text{H}^{+1} + \text{NO}_3^{-1}$
10. Carbon dioxide gas is bubbled through water
 $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{HCO}_3$
11. Solid phosphorous (V) oxide is bubbled through water
 $\text{P}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4$
12. Sulfur dioxide gas is bubbled through water
 $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{HSO}_3$
13. Sulfur trioxide gas is bubbled through water
 $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}^{+1} + \text{HSO}_4^{-1}$

V. MIXTURE OF TWO SALT SOLUTIONS (Ppt rxn, double displacement rxn)

General Rules:

- A. DO NOT include any soluble ions.
- B. NO spectators!!!
- C. KNOW YOUR SOLUBILITY RULES!!!!!!
- D. Write net ionic equations!!!!

Practice Equations:

1. Solutions of calcium nitrate and sodium sulfate are mixed.
 $\text{Ca}^{+2} + \text{SO}_4^{-1} \rightarrow \text{CaSO}_4$

2. A solution of silver nitrate is added to a solution of potassium iodide.
 $\text{Ag}^{+1} + \text{I}^{-1} \rightarrow \text{AgI}$
3. Solutions of lead (II) nitrate and tri-potassium phosphate are mixed.
 $\text{Pb}^{+2} + \text{PO}_4^{-3} \rightarrow \text{Pb}(\text{PO}_4)_2$
4. A solution of ammonium sulfide is added to a solution of magnesium iodide.
 $\text{Mg}^{+2} + \text{S}^{-2} \rightarrow \text{MgS}$
5. A solution of barium chloride is mixed with a solution of silver (I) sulfate.
 $\text{Ba}^{+2} + \text{Cl}^{-1} + \text{Ag}^{+1} + \text{SO}_4^{-2} \rightarrow \text{BaSO}_4 + \text{AgCl}$

VI. COMBUSTION REACTIONS

General Rules:

- A. Carbon compounds always burn to form oxide gases. (Even if you can't get the reactant formula from the name of a hydrocarbon compound, you can probably get the two product points by knowing that it produces carbon dioxide and water when it burns.)
- B. Products are always carbon dioxide and water.
- C. If carbon is bonded to an atom other than hydrogen, form the appropriate gas with that atom.

Practice Equations:

1. Carbon disulfide gas is burned in excess oxygen
 $\text{CS}_2 + \text{O}_2 \rightarrow \text{CO}_2 + \text{SO}_2$ (no H for water, must use S)
2. Ethane is burned in air
 $\text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
3. Methanol is burned in oxygen
 $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
4. Propane is burned in air
 $\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

VII. METALLIC OXIDE AND ACIDS

Metallic oxide + acid \rightarrow water + salt

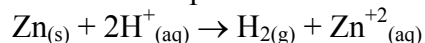
1. Ferric oxide is added to hydrochloric acid.
 $\text{Fe}_2\text{O}_{3(s)} + 6\text{H}^{+}_{(aq)} \rightarrow 2\text{Fe}^{+3}_{(aq)} + 3\text{H}_2\text{O}_{(l)}$
2. Copper (II) oxide is added to nitric acid.
 $\text{CuO}_{(s)} + 2\text{H}^{+}_{(aq)} \rightarrow \text{Cu}^{+2}_{(aq)} + \text{H}_2\text{O}_{(l)}$

VIII. METALLIC OXIDE + NONMETALLIC OXIDE \rightarrow SALT

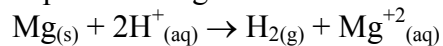
1. Magnesium oxide is heated strongly in carbon dioxide gas.
 $\text{MgO}_{(s)} + \text{CO}_{2(g)} \rightarrow \text{MgCO}_{3(s)}$
2. Calcium oxide is heated in sulfur trioxide gas.
 $\text{CaO}_{(s)} + \text{SO}_{3(g)} \rightarrow \text{CaSO}_{4(s)}$

IX. ACID + METAL → SALT + HYDROGEN GAS (LAB)

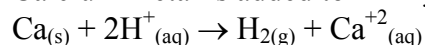
1. Solid zinc strip is added to sulfuric acid.



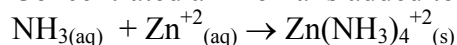
2. A piece of magnesium metal is dropped into hydrochloric acid.



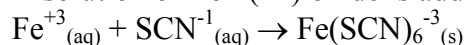
3. Calcium metal is added to 4M hydrochloric acid.

**X. OXIDIZED METAL + BASE → COMPLEX ION**

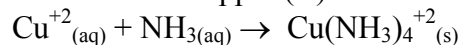
1. Concentrated ammonia is added to a solution of zinc nitrate.



2. A solution of iron (III) oxide is added to a solution of ammonia thiocyanate.



3. A solution of copper (II) nitrate is added to a strong solution of ammonia.



The ligands that have been used to form complex ions in AP reactions since 1980 and the complexes that have been formed are:

<u>LIGAND</u>	<u>COMPLEX ION FORMED</u>
NH ₃	Ag(NH ₃) ₂ ⁺ Cu(NH ₃) ₄ ⁺² Zn(NH ₃) ₄ ⁺²
OH ⁻	Zn(OH) ₄ ⁻ Al(OH) ₄ ⁻
CN ⁻	Ag(CN) ₂ ⁻
SCN ⁻	FeSCN ⁺²