WORKSHOP on TYPES OF CHEMICAL REACTIONS

COMBUSTION

- Hydrocarbons and other organic compounds combine with excess oxygen to form carbon dioxide and water.
- Metals combine with oxygen to form metallic oxides.
- If sulfur is present, SO_2 is formed; if nitrogen is present, NO_2 is formed.
- Nonmetallic hydrides combine with oxygen to form water and nonmetal oxides.
- Nonmetallic sulfides combine with oxygen to form sulfur dioxide and nonmetal oxides.

SYNTHESIS

- A metal combines with a nonmetal to form a binary salt.
- Nonmetallic oxides and water form acids. The nonmetal retains its oxidation number.
- Metallic oxides and nonmetallic oxides form salts.

DECOMPOSITION

- Metallic carbonates decompose into metallic oxides and carbon dioxide.
- Metallic chlorates decompose into metallic chlorides and oxygen.
- Ammonium carbonate decomposes into ammonia, water, and carbon dioxide.
- Sulfurous acid (H_2SO_3) decomposes into sulfur dioxide and water.
- Carbonic acid (H_2CO_3) decomposes into carbon dioxide and water.
- Hydrogen peroxide decomposes into water and oxygen.
- Ammonium hydroxide decomposes into ammonia and water.

DOUBLE REPLACEMENT (or metathesis) $AB + CD \rightarrow AD + CB$

All double replacement reactions must have a driving force to allow for it to go to completion. This driving force is the removal of at least one pair of ions from solution, which can occur in one of two ways:

1. formation of a precipitate
2. formation of a gas

- formation of a precipitate – apply solubility rules

Solubility Rules*: Please note that "soluble" refers to the ability to dissolve in a solvent, while "insoluble" refers to a solid or precipitate*.

NEGATIVE ION	*POSITIVE ION*	*SOLUBILITY*
Chloride (Cl^-), Bromide (Br^-), Iodide (I^-)	**Ag^+, Pb^{2+}, Hg_2^{2+}, Cu^+**	**Insoluble**
Phosphate (PO_4^{3-}), Carbonate (CO_3^{2-}), Sulfite (SO_3^{2-}), Hydroxide (OH^-)	**All positive ions EXCEPT alkali ions and NH_4^+**	**Insoluble**
Sulfate (SO_4^{2-})	**Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+}, Ag^+, Pb^{2+}**	**Insoluble**
Sulfide (S^{2-})	**All positive ions EXCEPT alkali ions, alkaline earth ions, NH_4^+**	**Insoluble**

* All nitrates, perchlorates, and acetates are soluble.

- formation of a gas – common gases formed in metathesis reaction are listed below:

	Common Gases
H_2S	**Any sulfide (salt of S^{2-}) plus any acid form $H_2S(g)$ and a salt.**
CO_2	**Any carbonate (salt of CO_3^{2-}) plus any acid form $CO_2(g)$, H_2O, and a salt.**
SO_2	**Any sulfite (salt of SO_3^{2-}) plus any acid form $SO_2(g)$, H_2O, and a salt.**
NH_3	**Any ammonium salt (salt of NH_4^+) plus any soluble strong hydroxide react upon heating to form $NH_3(g)$, H_2O, and a salt.**

SINGLE REPLACEMENT: $A + BC \rightarrow B + AC$

ACID/BASE: Acid + Base $\rightarrow$ Salt + Water

Workshop on Chemical Reactions (101) Name:

Predict and balance the following reactions, making sure to include the phases of all reactants and products where possible. Write NR if No Reaction occurs.

1. A piece of sodium is added to a container of iodine vapor.

2. An aluminum strip is immersed in a solution of silver nitrate.

3. Cobalt(II) chloride is combined with silver nitrate.

4. Potassium sulfide is reacted with nitric acid.

5. Iodine crystals are added to a solution of sodium chloride.

6. Zinc acetate and cesium hydroxide are mixed.

7. Butanol (C_4H_9OH) is burned completely in air.

8. A solution of iron(III) chloride is poured over a piece of platinum wire.

9. Magnesium turnings are added to a solution of lead(II) acetate.

10. Iron(III) sulfate and barium iodide are mixed.

11. Excess potassium hydroxide solution is added to a solution of potassium dihydrogen phosphate.

12. Gold metal will not dissolve in either concentrated nitric acid or concentrated hydrochloric acid. It will dissolve, however, in aqua regia, a mixture of the two concentrated acids. The products of the reaction are the $AuCl_4^-$ ion and gaseous NO. Write a balanced equation for the dissolution of gold in aqua regia