Name: ______________________________

Types of Chemical Reactions

Background

Chemical reactions can be represented qualitatively by word equations, for example, sulfur + oxygen yields sulfur dioxide. These descriptive equations lack quantitative significance, however, and are not very useful in chemistry. A balanced chemical equation is a more useful way to express the same information.

The reactants are placed to the left of the arrow and the products are placed to the right. By applying the law of conservation of matter, the coefficients are adjusted so that equal numbers of each element appear on both sides of the equation. The resulting balanced equation has quantitative as well as qualitative significance.

In this experiment you will investigate four types of chemical reactions and write balanced equations. **Composition (Combination) reactions** involve the combination of two reactants to form one product:

$$A + B \rightarrow AB$$

$$Fe + S \rightarrow FeS$$

Decomposition reactions involve the separation of a compound into elements or simpler compounds:

$$AB \rightarrow A + B$$

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Replacement reactions involve the replacement of one element in a compound by a more active element:

$$A + BX \rightarrow AX + B$$

$$Cl_2 + 2HBr \rightarrow 2HCl + Br_2$$

Double replacement reactions involve two compounds exchanging parts. Often a precipitate forms or a gas is given off:

$$AX + BY \rightarrow AY + BX$$

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow 2KNO_3(aq) + PbI_2(s)$$

Objective: To become familiar with evidence of chemical change and the various types of chemical reactions, and to write balanced equations.

Safety: Wear chemical splash goggles, gloves, and an apron. Use caution when heating objects with a Bunsen burner. Tie back long hair. *Do not observe the burning magnesium directly.*

Disposal: Follow your instructor's directions regarding disposal.

Materials

Bunsen burner	6 M hydrochloric acid	distilled water
ceramic plate	0.5 M copper(II) chloride solution	4 cm magnesium ribbon
test tube rack	0.1 M silver nitrate	cupric carbonate
crucible tongs	0.1 M zinc acetate	4 cm strip of copper foil
test tube holder	0.1 M sodium phosphate tribasic	sodium hydrogen carbonate
spatula	0.1 M sodium chloride	copper sulfate pentahydrate
beral pipets	0.1 M sodium sulfide	zinc piece
Small test tubes	7 test tubes (15 x 180 mm)	5 wood splints
150 ml beaker	Weigh boats or paper	balance

Procedure

Note: For each reaction, observe what happens and record your observation(s) of the reactions and the products in the Data Table.

Part l. Composition Reactions

Reaction 1A

1. Using crucible tongs, heat a strip of copper foil in the inner cone of the Bunsen burner flame. Note any changes in the copper.
2. Allow the strip to cool and use your spatula to scrape some of the product from the foil. Note your observations in the Data Table.

Reaction 1B

1. Place a ceramic plate next to the Bunsen burner. Using crucible tongs, heat a 4 cm strip of magnesium ribbon in the Bunsen burner flame. *Do not look directly at the burning magnesium.* As soon as the magnesium ignites, remove it from the flame and hold it over the ceramic plate.
2. After the reaction has stopped, examine the product and record your observations in the Data Table.

Part 2. Decomposition Reactions

In these reactions you will test for production of various gases. Recall that hydrogen is combustible, oxygen supports the combustion of flammable materials, carbon dioxide is used as a flame retardant, a water vapor may condense when it hits the cooler glass near the top of the test tube. Be sure to test an empty test tube first so that you have a controlled comparison.

Reaction 2A

Place approximately 1 g of sodium hydrogen carbonate in a 15 x 180 mm test tube. Clamp the tube in a buret clamp or test tube holder and heat the tube gently with your Bunsen burner. Hold a burning splint in the mouth of the test tube. Record your observations.

Reaction 2B

Using a clean test tube, repeat Reaction 2A using 1 g of copper(II) sulfate pentahydrate.

Reaction 2C

Using a clean test tube, repeat Reaction 2A using 1 g of copper(II) carbonate. Heat the tube intensely for two minutes.

Part 3. Single Replacement Reactions

Reaction 3A

Place a small test tube in the test tube rack. Add 2 ml of 6 M hydrochloric acid. Place a zinc piece in the tube and using your test tube clamp, invert a clean test tube over the reacting tube for one minute. Light a wood splint and hold it to the mouth of the inverted tube. Record your results.

Reaction 3B

Place a clean test tube in the test tube rack. Put a zinc trimming into the test tube. Add a squirt from a beral pipet of 0.5 M copper(II) chloride to it. Observe the zinc piece for a few minutes. What happens to it? Record your observations.

Part 4. Double Replacement Reactions

Reaction 4A

Place 2 drops of 0.1 M silver nitrate in a small test tube. Add 2 drops of 0.1 M sodium chloride. Record your results.

Reaction 4B

Place 2 drops of 0.1 M zinc acetate in a small test tube. Add 2 drops of 0.1 M sodium phosphate tribasic. Record your observations.

Reaction 4C

Place 2 drops of 0.1 M sodium sulfide in a small test tube. Add 1 drop of 6 M hydrochloric acid. Test the odor by using your hand to waft the air toward your nose. Record your observations.

Report

Tables

Once you have recorded all your observations in the Data Table (10 points), complete the Equations table as directed (10 points).

Discussion

(2 points) Did any of the reactions form any products in common?

(8 points) Compare and contrast the reactions within each category (Composition reactions with

each other, decomposition reactions with each other, etc.)

Data Table

Rxn	Appearance of reactant(s)	Observations of reaction	Appearance of product(s)
1A			
1B			
2A			
2B			
2C			
3A			
3B			
4A			
4B			
4C			

Equations

Below are the equations for the reactions you observed. Each one is missing either a reactant or a product. All are missing phase symbols.

1. In the first column, enter the "Rxn" number corresponding to the Equation in the second column.
2. Fill in the missing element or compound.
3. Add appropriate phase symbols (s, l, g or aq) to each reactant and product.
4. Balance the equations.

Rxn	Equation
	Na_2S ( ) + HCl ( ) → ______ ( ) + H_2S ( )
	HCl ( ) + Zn ( ) → $ZnCl_2$ ( ) + _____ ( )
	$AgNO_3$ ( ) + NaCl ( ) → _____ ( ) + $NaNO_3$ ( )
	$CuCO_3$ ( ) → CuO ( ) + _____ ( )
	_____ ( ) + O_2 ( ) → CuO ( )
	______ ( ) → Na_2CO_3 ( ) + CO_2 ( ) + H_2O( )
	$Zn(C_2H_3O_2)_2$ ( ) + Na_3PO_4 ( ) → _______ ( ) + $Zn_3(PO_4)_2$ ( )
	Mg ( ) + O_2 ( ) → _______ ( )
	$CuSO_4{\bullet}5H_2O$ ( ) → $CuSO_4$ ( ) + _____ ( )
	_____ ( ) + $CuCl_2$ ( ) → Cu ( ) + $ZnCl_2$ ( )