Academic Chemistry **Name ______________________________**
Synthesis of Magnesium Oxide **Date ____________________ Block ___**

Background

All forms of matter are composed of elements. Elements combine in simple whole number ratios of atoms to form compounds in which electrons are distributed in more stable arrangements. You already know that most elements react in order to acquire the **octet** arrangement of valence electrons. One of the simplest types of compounds is a **binary ionic compound** - formed when a metallic element transfers electrons to a non-metallic element. You will observe changes that occur during a chemical reaction and will witness energy changes involved in forming ionic attractions. Finally, you will verify mass relationships between elements in the compound.

The specific elements involved in this lab activity are magnesium and oxygen. They will react to form magnesium oxide. According to the Law of Conservation of Mass, the following word equation should make sense.

mass of magnesium + mass of oxygen = mass of magnesium oxide

Every element has a certain "combining capacity" when it is attracted to another element, determined by each one's valence electrons. The combining capacity of magnesium with oxygen can be predicted by each one's electron distribution. This can be **proven** experimentally by obtaining mass data of the elements when they combine. The mass of each element that combines can be used to derive a simple ratio of atoms by applying appropriate **mole** identities. And if the mass of each element in the compound is known you can also determine the **percent composition** of the compound.

Objectives – At the end of the experiment you should be able to:

a) Synthesize a compound and compare its properties to those of the elements from which it is formed.
b) Determine the composition of the compound in terms of masses and mass percentages of the elements of which it is composed.
c) To learn to express a reaction in terms of a simple equation.
d) To observe changes which occur during a chemical reaction.

Procedure:

1. Obtain a crucible and lid.
2. Heat both crucible and lid on a clay triangle and ring for 2 minutes.
3. Let cool for 5 minutes. When cooled, determine the mass of the crucible and lid.
4. Obtain a 30.0 cm piece of Mg ribbon (cut into small pieces, 1 cm or less) and place Mg in the crucible. Record the mass of crucible, lid, and magnesium ribbon.
5. Heat the crucible and lid (strongly) with a Bunsen burner until the bottom becomes reddish. Open the lid, periodically, to allow air to enter. The contents will flare up. Continue to do this until the sample no longer flares. *It might be necessary to stir the contents gently with a glass stirring rod so that non-reacted magnesium will be able to react completely.*
6. Shut off the burner and place the crucible on the ring stand base to cool for 5 minutes.
7. After it has cooled, carefully crush the contents with a glass rod and add a *few drops* of water.
8. CAREFULLY WAFT the contents in the crucible. Do you detect an odor? Add a few more drops of water until the substance is fully moist and the odor is gone.
9. Heat the crucible strongly again for 2 minutes and allow to completely cool before recording the mass of the crucible, contents and lid.

***Caution*: Do not touch the ring stand and ring, they will still be VERY hot.**
***Clean-up*: Clean the crucible with a DRY towel…scrap the contents into the sink.**

Data

Mass of crucible and cover	g
Mass of crucible, cover, and Mg ribbon	g
Mass of Mg ribbon used	g
Mass of crucible, cover and product	g
Mass of compound formed	g
Mass of oxygen in compound	g

Questions – *Please show all work on a separate sheet of paper!*

1) Why is it necessary to preheat the crucible?

2) Why was it necessary to open the crucible lid to allow more air to enter during the reaction?

3) Using your mass data, calculate the experimental percentage of magnesium in the product. Next, calculate the experimental % oxygen in the product.

4) Write the formula for magnesium oxide: ___________. Calculate the theoretical percent composition of the elements in this compound by using atomic masses from the periodic table.

5) Determine the % error for both magnesium and oxygen. *(equation in chapter 3)*

6) Air is a mixture of several gases, including a large amount of nitrogen. When magnesium burned in air, some **magnesium nitride** was formed. It is black, magnesium oxide is white. In this lab, whatever magnesium nitride formed was converted to ammonia gas plus magnesium oxide when you added water to the crucible. Maybe you smelled the ammonia? Use your knowledge of ion charges to write the formula for magnesium nitride.

7) Using the mass of magnesium ribbon used, determine the number of moles of magnesium used.

8) Using the mass of oxygen in the compound, determine the number of moles of oxygen used.

9) Calculate the empirical formula of the compound formed by using the mole ratio from answers #7 & #8.

10) How does your calculated empirical formula for magnesium oxide compare to the expected formula for magnesium oxide in #4? Explain.

11) We can actually predict the expected amount of product that should have formed, assuming a perfect outcome. Use the theoretical percent composition information from #4. If you know the mass of magnesium you started with, and you know that *all* of that mass is expected to end up in the magnesium oxide, simply use the percent composition you calculated in #4 to figure out the ideal mass of product.

Plan it this way: mass of Mg used = % Mg from #4 (as a decimal) * **mass of MgO expected** (*solve for this)*

12) How well does your data support the Law of Conservation of Mass (If it supports, you should have a % yield close to 100)? You can express the "yield" as a percent:

$$\text{Percent Yield} = \frac{\text{Actual Yield (from data)}}{\text{Theoretical Yield (expected, as calculated in \#11)}} \times 100$$