Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_\_\_\_\_

Determining the Simplest Formula of a Compound

**Purpose**: To produce a compound through a chemical reaction and determine its formula.

**Discussion**: In a compound, the atoms of different elements are present in numbers whose ratio is usually an integer or a simple fraction. The simplest formula of the compound expresses that ratio and, in the case of ionic compounds, identifies the ratio for us. For example, the simplest formula for potassium chlorate, KClO3, tells us that in that compound, for every atom of K, there is an atom of Cl, and three atoms of O. The ratio of K : Cl is 1 : 1 and the K : O ratio is 1 : 3.

To find the mass of each element in a compound, you must carry out at least one chemical reaction involving that compound and other known substances. Sometimes, it is possible to form the compound directly from the elements that make it up. This type of reaction is known as a synthesis reaction. In the experiment you are conducting today, you will synthesize magnesium oxide from the elements magnesium and oxygen. In general terms, the chemical reaction is:

magnesium + oxygen 🡪 magnesium oxide

By weighing the magnesium before it reacts with the oxygen and then weighing the magnesium oxide product, you can determine the mass of the oxygen used in the reaction. From the masses of the magnesium and the oxygen, you can then determine the percent mass of each element in the compound and use that along with the atomic masses of the elements to determine the simplest formula of the compound.

**Safety**: Be sure to wear your apron and goggles during all steps of this lab. If you are unfamiliar with lighting matches, please ask for assistance with this part of the lab.

**Materials**: metal crucible with cover, ring stand, crucible tongs, clay triangle, stirring rod, distilled water, magnesium ribbon

**Procedure**:

1. Place a cleaned crucible and cover on a clay triangle resting on an iron ring support stand. The crucible cover should be slightly tilted on top of the crucible, leaving a small opening. Heat the crucible over a strong flame for about 3 minutes to drive off any excess moisture. Remove the crucible from the clay using the tongs and allow it to cool on a heat resistant pad.
2. While the crucible is cooling, obtain a piece of magnesium ribbon between 15 and 30 cm in length. **Rub the ribbon with a paper towel to remove any of the coating from the surface.**
3. Once the crucible and lid are cooled, measure the mass of the crucible and lid and record it in your data table.
4. Wrap the ribbon around a pencil or pen, allow it to uncoil, and place it in the crucible. The ribbon should not be coiled so tightly that the coils touch. This is to allow oxygen to reach all parts of the ribbon so that the reaction is completely carried out and all the magnesium reacts with some oxygen.
5. Weigh the crucible and the lid with the magnesium inside it and record it in your data table.
6. With the lid off, heat the crucible, slowly increasing the temperature. Once the magnesium ribbon glows red or ignites, quickly cover the crucible with the lid and reduce the heat. (WARNING: If the magnesium actually ignites, some of the magnesium oxide will vaporize and lost to the air. To prevent this loss, cover the crucible immediately if you observe a flame.) After about one minute of heating with the cover on, briefly lift the cover using your tongs to let in more oxygen. Repeat the process until the magnesium no longer ignites upon heating. Once you observe that the magnesium does not ignite, cover it and heat it strongly for 3 minutes.
7. Allow the crucible to cool completely before handling.
8. Remove the cover from the crucible. Use the stirring rod to ***GENTLY*** grind the contents of the crucible into small particles. Rinse the particles from the stirring rod BACK INTO THE CRUCIBLE using a few drops of distilled water.
9. Replace the cover, leaving a small opening for the water vapor to escape. Heat the crucible gently until the water has boiled off and the residue is thoroughly dry (about five minutes).
10. Let the crucible cool and then weigh the crucible, lid, and magnesium oxide and record it in your data table.
11. Clean the crucible as best you can and leave all of your equipment in the designated place.

Data Table:

|  |  |
| --- | --- |
| Mass of crucible and lid |  |
| Mass of crucible, lid, and magnesium |  |
| Mass of crucible, lid, and magnesium oxide |  |

1. Determine the mass of magnesium used in the reaction. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Determine the mass of the magnesium oxide produced. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Determine the mass of the oxygen used in the reaction. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Determine the mass percent of each element in the compound using your data.  
     
   Mg % - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ O % - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Calculate the actual mass percent of each element from the known formulas and information from the periodic table.  
     
   Mg % - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ O % - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Determine the simplest formula by dividing the mass percent by the atomic mass of each element and comparing the ratio of magnesium to oxygen.
7. How can you confirm that magnesium is the limiting reagent in this reaction?

1. Write the balanced chemical equation for the reaction of magnesium and oxygen to produce magnesium oxide, using the proper state symbols.