Name _____

Determining the Empirical Formula of Magnesium Oxide

 **Always wear safety goggles and a lab apron to protect your eyes and clothing.** If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the locations of the emergency lab shower and the eyewash station and the procedures for using them.

 **When using a Bunsen burner, confine long hair and loose clothing.** If your clothing catches on fire, WALK to the emergency lab shower and use it to put out the fire. When heating a substance in a test tube, the mouth of the test tube should point away from where you and others are standing. Watch the test tube at all times to prevent the contents from boiling over.

 **Never put broken glass in a regular waste container.** Broken glass should be disposed of separately according to your teacher's instructions.

INTRODUCTION

This gravimetric analysis involves the combustion of magnesium metal in air to synthesize magnesium oxide. The mass of the product is greater than the mass of magnesium used because oxygen reacts with the magnesium metal. As in all gravimetric analyses, success depends on attaining a product yield near 100%. Therefore, the product will be heated and cooled and have its mass measured until two of these mass measurements are within 0.02% of one another. When the masses of the reactant and product have been carefully measured, the amount of oxygen used in the reaction can be calculated. The ratio of oxygen to magnesium can then be established, and the empirical formula of magnesium oxide can be determined.

OBJECTIVES

- **Measure** the mass of magnesium oxide.
- **Perform** a synthesis reaction by using gravimetric techniques.
- **Determine** the empirical formula of magnesium oxide.
- **Calculate** the class average and standard deviation for moles of oxygen used.

MATERIALS

- 15 cm magnesium ribbon, 2
- 25 mL beaker
- Bunsen burner assembly
- clay triangle
- crucible and lid, metal or ceramic
- crucible tongs
- distilled water
- eyedropper or micropipet
- ring stand

PROCEDURE

1. Measure their combined mass, and record the measurement on line 3 of the **Data Table.** *NOTE: Handle the crucible and lid with crucible tongs at all times during this experiment. Such handling prevents burns and the transfer of dirt and oil from your hands to the crucible and lid.*
2. Polish a 15 cm strip of magnesium with steel wool. The magnesium should be shiny. Cut the strip into small pieces to make the reaction proceed faster, and place the pieces in the crucible.
3. Cover the crucible with the lid, and measure the mass of the crucible, lid, and metal. Record the measurement on line 1 of the **Data Table.**
4. Use tongs to replace the crucible on the clay triangle. Heat the covered crucible gently. Lift the lid occasionally to allow air in. *CAUTION: Do not look directly at the burning magnesium metal. The brightness of the light can blind you.*

5. When the magnesium appears to be fully reacted, partially remove the crucible lid and continue heating for 1 min.
6. Remove the burner from under the crucible. After the crucible has cooled, use an eyedropper to carefully add a few drops of water to decompose any nitrides that may have formed. *CAUTION: Use care when adding water. Using too much water can cause the crucible to crack.*
7. Cover the crucible. Replace the burner under the crucible, and continue heating for about 30 to 60 s.
8. Turn off the burner. Cool the crucible, lid, and contents to room temperature. Measure the mass of the crucible, lid, and product. Record the measurement in the margin of the **Data Table.**
9. Replace the crucible, lid, and contents on the clay triangle, and reheat for another 2 min. Cool to room temperature, and remeasure the mass of the crucible, lid, and contents. Compare this mass measurement with the measurement obtained in step **10.** If the new mass is ±0.02% of the mass in step **10,** record the new mass on line 2 of your data table and go on to step **12.** If not, your reaction is still incomplete, and you should repeat step **11.**
10. Clean the crucible, and repeat steps **2–11** with a second strip of magnesium ribbon. Record your measurements under Trial 2 in the **Data Table.**
11. Clean the crucible, and repeat steps **2–11** with a second strip of magnesium ribbon. Record your measurements under Trial 3 in the **Data Table.**

Data Table				
	Trial 1	**Trial 2**	**Trial 3**	**Average**
1. Mass of crucible, lid, and metal (g)				
2. Mass of crucible, lid, and product (g)				
3. Mass of crucible and lid (g)				

ANALYSIS

1. Calculate the mass of the magnesium metal and the mass of the product.

2. Determine the mass of the oxygen consumed.

3. Write the balance equation for the formula.

4. Calculate the number of moles of magnesium and the number of moles of oxygen in the product.

CONCLUSIONS

1. Define empirical formula.

2. How does empirical formula differ from a chemical formula?

3. Determine the empirical formula for magnesium oxide, Mg_xO_y.