Lab 9. Determination of an Empirical Formula

Background: The empirical formula of a compound is the simplest whole-number ratio of the atoms making up the compound. In this experiment the law of conservation of mass will be used to determine the empirical formula of magnesium oxide. A known mass of magnesium will be burned in the presence of oxygen. From the known mass of the magnesium and the known mass of the product, the mass of the oxygen can be determined.

Objective: To determine the empirical formula of an oxide of magnesium.

Safety: Wear chemical splash goggles. Do not view burning magnesium directly; eye injury may result.

Disposal: Place the crucible residue in the nonhazardous waste container.

Materials

• crucible	• crucible cover
• iron ring	• burner and flint
• ring stand	• centigram or electronic balance
• 25 cm length of magnesium ribbon	• crucible tongs
• triangle pipe stem (clay triangle)	• ceramic plate

Procedure

1. Heat a crucible assembly (crucible and cover) to dryness in the drying oven.
2. Remove the assembly from the drying oven and set it on a ceramic tile to cool.
3. After the crucible assembly has cooled, determine its mass and record it in the Data Table.
4. Obtain a length of magnesium ribbon from your instructor and coil it loosely in the bottom of the crucible.
5. Determine the mass of the crucible, cover, and contents and record it in the Data Table.
6. Place the crucible containing the magnesium on the triangle pipe stem. Place the crucible cover on the crucible slightly ajar. This will allow oxygen to enter.
7. Heat the crucible gently for two minutes.
8. Heat the crucible intensely for an additional ten minutes. Allow to cool.
9. When the crucible has cooled, remove the crucible and cover from the pipe stem and place them on a clean ceramic plate. Check that the magnesium ribbon is no longer metallic.
10. Transfer the cool crucible and cover to a balance and determine the mass. Record the mass in the Data Table.
11. Repeat Steps 7–10.
12. If the difference between mass measurements is less than 0.01 g, record the mass as the constant mass; if the mass is greater than 0.0l g, repeat Steps 7–10 until the mass measurements differ by 0.01 g or less. Record this mass in the Data Table as the constant mass.
13. Place the magnesium oxide in the non-hazardous waste container; clean the crucible.

Calculations

Show all work below or in the Calculations Table. Be sure to record all calculated values in the Calculations Table. Be mindful of significant figures. Be sure you retain adequate digits when you calculate moles and ratios of moles.

1. Determine the initial mass of magnesium metal.
2. Use the molar mass of magnesium to determine the number of moles of magnesium atoms reacted.
3. Determine the mass of the magnesium oxide product.
4. Use the mass of the product and the mass of the magnesium to find the mass of oxygen reacted.
5. Use the molar mass of oxygen to determine the number of moles of oxygen atoms reacted.
6. Determine the ratio of moles of Mg to moles of O.
7. Determine the empirical formula for this oxide of magnesium.
8. Use your knowledge of formulas of ionic compounds to determine the accepted ratio of O to Mg.
9. Calculate your absolute error and percent error.

Determination of an Empirical Formula

Data Table

mass of dry crucible assembly	
mass of crucible assembly and Mg	
mass of crucible assembly and product (first heating)	
constant mass of crucible assembly and product	

Calculations Table

mass of Mg reacted (initial mass)	
moles of Mg reacted	
mass of product	
mass of oxygen reacted	
moles of oxygen (atoms) reacted	
experimental molar ratio (Mg:0)	
accepted molar ratio (Mg:0)	
absolute error	
percentage error	