Empirical Formula of Magnesium Oxide

Answer all questions in this text document. Submit your document to be graded. You may print, hand write and scan. Or you can word process directly on this document.

Introduction

Chemical formulas are used to describe the atomic ratio of atoms in a compound. In *molecular formula*s, the ratios relate to the molecule as a whole. Benzene, for example, has a molecular formula of C_6H_6, which means that there are 6 carbon atoms and 6 hydrogen atoms in each benzene molecule. In other words, the ratio of carbon to hydrogen is 6:6.

Empirical formulas give the simplest whole-number ratio of the atoms in a compound. For benzene, this is CH (carbon to hydrogen ratio of 1:1). For propylene, C_3H_6, the empirical formula is CH_2. Empirical formulas are an important part of analytical chemistry because they are simple to determine experimentally (or, *empirically*).

Say you have 13.8 g of a compound that contains only nitrogen and oxygen. By decomposing the compound, you determine that it contains 4.2 g of nitrogen. How would you determine the empirical formula?

Remember that atomic ratios and molar ratios are the same. If you find the molar ratio of the nitrogen and oxygen, it will be the same as the atomic ratio of the nitrogen and oxygen. The atomic ratio is your empirical formula.

So, first, find the number of moles of nitrogen and oxygen in your sample:

$$4.2 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 0.30 \text{ mol N}$$

$$(13.8 \text{ g} - 4.2 \text{ g}) \text{ O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 0.60 \text{ mol O}$$

Divide each of those by the smallest number to get the formula:

N: 0.30/0.30 = 1

O: 0.60/0.30 = 2

Thus, the empirical formula of your compound is NO_2.

In the following experiment, you will determine the empirical formula of magnesium oxide, using the same thinking as the nitrogen dioxide determination you just read about here.

Pre-Lab Questions

Heating 1.29 g of gallium gives a gallium-oxygen compound with a mass of 1.73 g. Calculate the empirical formula of the compound.

Step 1: Figure out how many grams of oxygen are in the 1.73 grams of gallium-oxygen compound by subtracting.

Step 2: Convert the 1.29 g of gallium to moles:

Step 3: Convert the grams of oxygen you calculated in step 1 to moles:

Step 4: Figure out the formula.

Empirical Formula: _____

Name of Compound: _____

Empirical Formula of Magnesium Hydroxide
Procedures and Data

Watch the following video and answer the following questions> I suggest you use a split screen so that you can watch the experiment as you collect the data. https://www.youtube.com/watch?v=OuFqtxZJRvM

STEP 1: Determine the mass of the Magnesium. Record the data in the table below with all Sig. fig. and units:

Mass of Crucible and Lid	
Mass of Crucible and Lid and Magnesium	
Mass of Magnesium (show calculation)	

STEP 2: Heat the Magnesium

What are two safety warnings?

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-

The author provides several tips for successfully heating the magnesium. List two here:

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STEP 3: Run the reaction to completion

Write the reaction equation that is occurring while you are heating magnesium with the Bunsen Burner. Remember, oxygen is diatomic. Balance the equation.

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How do you know when the reaction is done, and the magnesium is completely changed to magnesium oxide?

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NEXT STEPS:

List the next five steps with a brief rationale for each step (why is it done?)

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-
-
-
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FINAL RESULTS

Observation of product	
Mass of product and crucible	
Mass of crucible (from first data table)	
Mass of product (show calculation).	

DATA ANALYSIS

1) Determine the empirical formula of MgO based on your data recorded. Follow the steps used in the introduction to find the empirical formula of NO_2. (In brief: Subtract Mg mass from Step 1 from product mass of Final results step to calculate mass of oxygen, then convert the grams of Mg to moles, convert the grams of O to moles, divide by the smallest number to get whole numbers, write the formula).

2) Determine the theoretical formula of MgO using the periodic table. To do this: find the most stable ion of magnesium and the most stable ion of oxygen. Use that to predict the formula for magnesium oxide:
   - Mg ion →
   - O ion →
   - Formula for Magnesium oxide

3) Compare what you got in #1 to what you should have got in #2. How close were you? How might you explain the difference?

Post-Lab Question

1) Hypothetical Data for Analysis
An oxide of iron is 69.94% iron by mass. Calculate its empirical formula and determine the name of the ionic compound. (Hint: assume you have a 100 g sample of the oxide of iron. How many grams would be iron? Then how many grams would be oxygen? Convert those to moles. Find the ratio. Find the nearest whole number ratio). Then determine its name.

Empirical Formula: _____

Name of Compound: _____