Formula Lab Worksheet

Percent composition, empirical and molecular formulas · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will use Formula Lab to practice molar calculations, calculate percent composition, find the percent water in a hydrate, determine empirical formulas from percent and lab data, and find molecular formulas.

Link: www.logicalhomeschooling.com/formula-lab.html

Objectives

By the end of this lab you will be able to:

- Calculate molar mass and convert between grams and moles.
- Calculate percent composition from a formula, and percent water from lab data.
- Determine an empirical formula from percent composition or mass data.
- Determine a molecular formula from an empirical formula and molar mass.

Materials: a computer or tablet with Formula Lab open, a calculator, a periodic table, a pencil, this worksheet. Time: about 60 minutes.

Key formulas. moles = grams ÷ molar mass · % element = (mass of element ÷ molar mass) × 100 **Empirical formula:** percent to mass, mass to mole, divide by small, multiply 'til whole. **Molecular formula:** n = molar mass ÷ empirical formula mass.

Part 1: Stage 1, Warm-up

Problem	Work	Answer
Molar mass of H_2O		
Molar mass of CO_2		
Moles in 36.04 g of H_2O		
Grams in 0.500 mol of CO_2		

Part 2: Stage 2, Percent composition

Compound	Molar mass (g/mol)	Percent of each element
H_2O		%H = %O =
CO_2		%C = %O =
$C_6H_{12}O_6$		%C = %H = %O =
$NaHCO_3$		%Na = %O =

1. Hydrogen atoms make up 12 of the 24 atoms in glucose. Why is glucose only about 7% hydrogen by mass?

Hydrate lab: $CuSO_4 \cdot 5H_2O$

Measurement	Mass (g)
Hydrate before heating	
After heating 1	
After heating 2	
After heating 3	
Mass of water lost	

Percent water from data: _____ % Percent water from formula: _____ %

2. Why do you keep heating until the mass stops changing? What color change showed the water was gone?

Part 3: Stage 3, Empirical formulas

Problem	Moles of each element	Ratio (÷ smallest)	× ?	Empirical formula
40.0% C, 6.7% H, 53.3% O				
69.9% Fe, 30.1% O				
0.486 g Mg + 0.320 g O				
26.6% K, 35.4% Cr, 38.0% O				

1. Why can you treat percents as grams when finding an empirical formula?

2. In the iron oxide problem the ratio came out 1 : 1.5. Why can't the formula be $FeO_{1.5}$?

3. In the magnesium lab, where did the extra 0.320 g come from?

Part 4: Stage 4, Molecular formulas

Compound	Empirical formula	Empirical formula mass	Molar mass	n	Molecular formula
Glucose	CH_2O		180.18		
Hydrogen peroxide	HO		34.02		
Benzene	CH		78.12		
Mystery gas			56.12		

Part 5: Practice problems

Answer these **without** Formula Lab. Show your work and units. (Extra atomic masses: Al 26.98, Ba 137.33)

1. What is the molar mass of $CaCO_3$? How many moles are in 25.0 g of it?

2. Find the percent composition of ammonia, NH_3.

3. What percent of rust, Fe_2O_3, is iron?

4. A compound is 75.0% carbon and 25.0% hydrogen. Find its empirical formula.

5. 2.50 g of aluminum reacts with 2.22 g of oxygen. Find the empirical formula of the product.

6. A compound has the empirical formula CH and a molar mass of 26.04 g/mol. Find its molecular formula.

7. A 2.50 g sample of $BaCl_2 \cdot xH_2O$ is heated to constant mass, leaving 2.13 g of $BaCl_2$. Find x.

Conclusion

Write 3 to 5 sentences explaining how chemists use mass data to figure out a compound's formula. Use the words **percent composition**, **moles**, **empirical formula**, and **molecular formula**.