Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Student Activity- Empirical and Molecular Formulas**

In chemistry, the **empirical formula** of a chemical compound is the simplest positive integer ratio of atoms present in a compound. A simple example of this concept is that the empirical formula of sulfur monoxide, or SO, would simply be SO, as is the empirical formula of disulfur dioxide, S2O2. This means that sulfur monoxide and disulfur dioxide, both compounds of sulfur and oxygen, will have the same empirical formula. However, their chemical formulas, which express the number of atoms in each molecule of a chemical compound, may not be the same. The **molecular formula** shows the number of each type of atom in a molecule.

**Model 1: Comparison of Percent Composition and Empirical Formula**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Name | Molecular Formula | Molar Mass (g/mol) | Empirical Formula | % Composition of Carbon | % Composition of Hydrogen |
| 1 | ethane | C2H6 |  |  |  |  |
| 2 | propene | C3H6 |  |  |  |  |
| 3 | ethyne | C2H2 |  |  |  |  |
| 4 | benzene | C6H6 |  |  |  |  |
| 5 | pentene | C5H10 |  |  |  |  |

1. Fill out the chart above

2. Identify the substances in Model 1 that have the same empirical formula.

3. Identify the substances in Model 1 that have the same percent composition.

4. Using the examples in Model 1, suggest an explanation as to why substances with different

 molecular formulas (but the same empirical formula) can have the same percent composition.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Below are three empirical formulas for three different compounds. Determine the molecular

 formula for each compound below, given the compound’s molar mass:

1. Empirical formula is NaO, molar mass of actual compound is 78 g/mole.
2. Empirical formula is CH2Cl, molar mass of actual compound is 99.0 g/mole.
3. Empirical formula is C3H4, molar mass of actual compound is 121 g/mole.

6.. An oxide of nitrogen is found to contain 69.6% oxygen and has a molar mass of 92.0 g/mole.

a. What is the % nitrogen in this compound?

b. Find the empirical formula and molecular formula for this compound.

7. Calculate the molecular formula for caffeine, (molar mass of 195 g/mol) and the following

percent composition: 49.5% C, 5.15% H, 28.9% N, 16.5% O.