

## The Percent Composition of a Compound

The relative amounts of the elements in a compound are expressed as the **percent composition** or the percent by mass of each element in the compound.

The percent by mass of an element in a compound is the number of grams of the element divided by the mass in grams of the compound, multiplied by 100%

$$\% \text{ mass of element} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100\%$$

## Example:

When a 13.60 gram sample of a compound containing only magnesium and oxygen is decomposed, 5.40 grams of oxygen is obtained. What is the percent composition of this compound?

## Percent Composition from the Chemical Formula

We can also calculate the percent composition of a compound if we only know the chemical formula and the molar mass.

$$\% \text{ mass} = \frac{\text{mass of element in 1 mol compound}}{\text{molar mass of compound}} \times 100\%$$

Example:

Propane ( $C_3H_8$ ), the fuel commonly used in gas grills, is one of the compounds obtained from petroleum. Calculate the percent composition of propane.

## Percent Composition as a Conversion Factor

You can use the percent composition to calculate the number of grams of any element

Suppose you have 82.0 g of propane ( $C_3H_8$ ). How many grams of carbon and hydrogen are present?

In the last question we found that propane is 81.68% carbon and 18.32% hydrogen.

$$82.0\text{g } C_3H_8 \times \text{—————} = \quad \text{g } C$$

$$82.0\text{g } C_3H_8 \times \text{—————} = \quad \text{g } H$$

## Empirical Formula

The smallest whole number ratio of elements contained in a compound is known as the **empirical formula**

For example:  $\text{CO}_2$  has a ratio of 1:2 in carbon to oxygen atoms.

An empirical formula may or may not be the same as a molecular formula. Hydrogen peroxide,  $\text{H}_2\text{O}_2$ , has a ratio of 1:1 even though there are two of each element.

## Example:

A compound is analyzed and found to contain 25.9% nitrogen and 74.1% oxygen. What is the empirical formula of the compound?

## Molecular Formulas

The molecular formula of a compound is either the same as its experimentally determined empirical formula, or it is a simple whole-number multiple of its empirical formula.

For example, ethyne ( $C_2H_2$ ) and benzene ( $C_6H_6$ ) both have the same empirical formula - CH

The molar masses of these compounds then are just whole number multiples of their empirical formula.



## Example:

Calculate the molecular formula of a compound whose molar mass is 60.12 g/mol and empirical formula is  $\text{CH}_4\text{N}$

Try questions 32-46 on pages 306-312

### 03. Percent Composition and Chemical Formulas