

6.8: Percent-By-Mass Composition

Learning Objectives

- Determine percent composition of each element in a compound based on mass.

Packaged foods that you eat typically have nutritional information provided on the label. The label on a jar of peanut butter reveals that one serving size is considered to be 32 g. The label also gives the masses of various types of compounds that are present in each serving. One serving contains 7 g of protein, 15 g of fat, and 3 g of sugar. By calculating the fraction of protein, fat, or sugar in one serving size of peanut butter and converting to percent values, we can determine the composition of peanut butter on a percent by mass basis.

Percent Composition

Chemists often need to know what elements are present in a compound and in what percentage. In general, percentages may be found by taking the part, dividing it by the whole and multiplying by 100:

$$\% = \frac{\text{part}}{\text{whole}} \times 100 \quad (6.8.1)$$

The **percent-by-mass composition** is the percent by mass of each element in a compound. It is calculated in a similar way to that of the composition of the peanut butter.

$$\% \text{ by mass} = \frac{\text{mass of element in compound}}{\text{mass of compound}} \times 100\% \quad (6.8.2)$$

The sample problem below shows the calculation of the percent composition of a compound based on mass data.

Example 6.8.1: Percent Composition from Mass Data

A certain newly synthesized compound is known to contain the elements zinc and oxygen. When a 20.00 g sample of this compound is decomposed, 16.07 g of zinc remains. Determine the percent-by-mass composition of the compound.

Solution

Steps for Problem Solving

Identify the "given" information and what the problem is asking you to "find."

Given : Mass of compound = 20.00 g

Mass of Zn = 16.07 g

Find: % Composition (%Zn and %O)

List known relationships.

Subtract to find the mass of oxygen in the compound.

Mass of oxygen = 20.00 g - 16.07 g = 3.93 g O

Steps for Problem Solving

Calculate the answers.

Calculate the percent by mass of each element by dividing the mass of that element by the mass of the compound and multiplying by 100%.

$$\% \text{ Zn} = \frac{16.07 \text{ g Zn}}{20.00 \text{ g}} \times 100\% = \boxed{80.35\% \text{ Zn}}$$

$$\% \text{ O} = \frac{3.93 \text{ g O}}{20.00 \text{ g}} \times 100\% = \boxed{19.65\% \text{ O}}$$

Think about your result.

The calculations make sense because the sum of the two percentages adds up to 100%. By mass, the compound is mostly zinc.



Exercise 6.8.1

Sulfuric acid, H_2SO_4 is a very useful chemical in industrial processes. If 196.0 g of sulfuric acid contained 64.0 g of sulfur and 4.0 g of hydrogen, what is the percent composition of the compound?

Answer

2.0% H, 32.65% S, and 65.31% O

Summary

- Processes are described for calculating the percent composition of a compound based on mass.

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