Percent Composition

**Purpose:** During today’s lesson, we will learn about percent composition, a concept that you are likely to be familiar with from math class and from your own life. It is a helpful mathematical concept to use in chemistry, because it allows us to determine just *how much of an element (by weight)* is present in a molecule or a mole of molecules. This knowledge will become increasingly important as we talk about *chemical reactions* and *how much of each reactant* will be needed to produce a certain amount of product. **This worksheet will be turned in the day of the test.**

**Task:** We will be working as a class to build the mathematical formula for percent composition. This will be done through class discussion and individual and pairs-work. Be prepared to use your problem-solving skills to determine a procedure for attacking problems involving percent composition!

## Bellwork:

## General formula for Percent Composition:

% by mass of an element present in a compound:

$$\% \left(by mass\right) A= \frac{\# grams A}{\# grams A+\# grams B}=\frac{\# moles A×(molar mass of A)}{\# moles A×\left(molar mass of A\right)+\# moles B×(molar mass of B)}$$

These questions will typically be written as, “What is the percent composition of (name a compound)?” This is asking you to determine the percentage of the mass of the compound that is made up by each type of element present.

## Percent composition of a molecule:

PCl5

Molar mass of P: 30.97 g/mol

Molar mass of Cl: 35.453 g/mol

Molar mass of PCl5: 30.97 g/mol + (5x35.453 g/mol) = 208.235 g/mol

$$\% \left(by mass\right) P= \frac{30.97 g P}{208.235 g PCl\_{5}}×100\%=14.9 \%$$

$$\% \left(by mass\right) Cl= \frac{5(35.453 g Cl)}{208.235 g PCl\_{5}}×100\%=85.1 \% OR just do 100\%-14.9\%=85.1\% Cl$$

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| --- | --- | --- | --- | --- | --- |
|  | Chemical Name | Drawing | Mole fraction for each element | Molar Mass for each element | Percent compositionfor each element |
| NaCl | Sodium chloride | X \* | 1 mol Na: 1 mol Cl | Molar mass of Na: 22.99 g/molMolar mass of Cl: 35.453 g/molMolar mass of NaCl: 58.44 g/mol | $$\% \left(by mass\right) Na= \frac{22.99 g Na}{58.44 g NaCl}×100\%=39.3 \% Na$$$$\% \left(by mass\right) Cl= \frac{35.453 g Cl}{58.44 g NaCl}×100\%=60.7 \% Cl$$ |
| FeSO4 | Iron (II) sulfate | X $ # # # # | 1 mol Fe: 1 mol S: 4 mol O | Molar mass of Fe: 55.85 g/molMolar mass of S: 32.07 g/molMolar mass of O: 15.9994 g/molMolar mass of FeSO4: 151.92 g/mol | $$\% \left(by mass\right) Fe= \frac{55.85 g Fe}{151.92 g FeSO\_{4}}×100\%=36.8 \% Fe$$$$\% \left(by mass\right) S= \frac{32.07 g S}{151.92 g FeSO\_{4}}×100\%=21.1 \% S$$$$\% \left(by mass\right) O= \frac{4(15.9994 g O)}{151.92 g FeSO\_{4}}×100\%=42.1 \% O$$ |
| H2SO4 | Sulfuric acid | X X $ # # # # | 2 mol H: 1 mol S: 4 mol O | Molar mass of H: 1.0079 g/molMolar mass of S: 32.07 g/molMolar mass of O: 15.9994 g/molMolar mass of H2SO4: 98.08 g/mol  | $$\% \left(by mass\right) H= \frac{2(1.0079 g H)}{98.08 g H\_{2}SO\_{4}}×100\%=2.0 \% H$$$$\% \left(by mass\right) S= \frac{32.07 g S}{98.08 g H\_{2}SO\_{4}}×100\%=32.7 \% S$$$$\% \left(by mass\right) O= \frac{4(15.9994 g O)}{98.08 g H\_{2}SO\_{4}}×100\%=65.3 \% O$$ |