Chemical Quantities

Molar mass (formula mass, molecular mass, atomic mass) is the mass in grams of one mole (6.022×10^{23} particles) of a substance.

We have already done problems using the molar mass (average atomic mass) of elements.

Now we need to extend this to compounds.

Calculating molar mass

Consider the formula of magnesium nitrate.

How many of each kind of atom are present in the formula? $Mg(NO_3)_2$

1 - Mg

2 - N

6 - O

1 - Mg	1 (24.305 g/mole)
2 - N	2 (14.0067 g/mole)
6 - O	6 (15.9994 g/mole)
	148.3148 g/mole

How many atoms of oxygen are in 35.76 grams of sodium sulfate?

Na_2SO_4 142.04314 g/mole

$$35.76 \text{ g } Na_2SO_4 \times \frac{1 \text{ mole } Na_2SO_4}{142.04314 \text{ g } Na_2SO_4} \times \frac{4 \text{ moles O atoms}}{1 \text{ mole } Na_2SO_4}$$

$$\times \frac{6.022 \times 10^{23} \text{ O atoms}}{1 \text{ mole O atoms}}$$

6.064×10^{23} oxygen atoms

Percent composition

Percent → parts per 100 → x/100

How do you find percent

(part÷total) x 100

To find the percent composition (by mass) we divide the mass of each element by the total and then multiply by 100

Example

Determine the percent composition from the formula of aluminum hydroxide.

$Al(OH)_3$

1 - Al 1(26.981538 g/mole)

3 - O 3(15.9994 g/mole)

3 - H 3(1.00794 g/mole)

78.003558 g/mole

$$\frac{26.981538 \text{ g/mole Al}}{78.003558 \text{ g/mole total}} \times 100$$

34.59 % Al

$$\frac{3(15.9994 \text{ g/mole) O}}{78.003558 \text{ g/mole total}} \times 100$$

61.53 % O

$$\frac{3(1.00794 \text{ g/mole) H}}{78.003558 \text{ g/mole total}} \times 100$$

3.88 % H

Example

What is the percent composition of a compound where 32.0 grams of the compound was analyzed and found to contain 24.0 grams of carbon and the remainder is hydrogen?

$$\frac{24.0 \text{ g C}}{32.0 \text{ g total}} \times 100 = 75.0 \% \text{ C}$$

$$\frac{8.0 \text{ g H}}{32.0 \text{ g total}} \times 100 = 25.0 \% \text{ H}$$