

# Chemical Quantities

Molar mass (formula mass, molecular mass, atomic mass) is the mass in grams of one mole ( $6.022 \times 10^{23}$  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?  $\text{Mg}(\text{NO}_3)_2$

1 - Mg

2 - N

6 - O

1 - Mg

2 - N

6 - O

1 (24.305 g/mole)

2 (14.0067 g/mole)

6 (15.9994 g/mole)

148.3148 g/mole

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

$\text{Na}_2\text{SO}_4$  142.04314 g/mole

$$35.76 \text{ g Na}_2\text{SO}_4 \times \frac{1 \text{ mole Na}_2\text{SO}_4}{142.04314 \text{ g Na}_2\text{SO}_4} \times \frac{4 \text{ moles O atoms}}{1 \text{ mole Na}_2\text{SO}_4}$$

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

$6.064 \times 10^{23}$  oxygen atoms

# Percent composition

Percent  $\rightarrow$  parts per 100  $\rightarrow$   $x/100$

How do you find percent

$(\text{part} \div \text{total}) \times 100$

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.



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

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

61.53 % O

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

78.003558 g/mole total

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?

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

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