

PERCENT COMPOSITION AND CHEMICAL FORMULAS

COMPOSITION

Composition- what a substance is made of

Ex: H_2O is composed of 2 H atoms and 1 O atom

LAW OF DEFINITE PROPORTIONS

in a compound, the elements combine in the same proportions by mass (g)

Ex: H_2O $\text{H} = 1 \text{ gram} \times 2 \text{ atoms} = 2\text{g}$

$\text{O} = 16 \text{ grams} \times 1 \text{ atom} = 16\text{g}$

..so for every 1 mole of H_2O you have 2g H & 16g O
(1 mole $\text{H}_2\text{O} = 18 \text{ grams total}$).

PERCENT COMPOSITION

The relative amounts of each element in a compound

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

EXAMPLE 1

An 8.20-g piece of Mg combines completely with 5.40g of O to form a compound.

What is the compound? MgO

What is the percent composition of this compound?

Use the formula:

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

Hint: Determine the molar mass of the compound

$$\% \text{ mass of Mg} = \frac{8.20 \text{ g of Mg}}{13.60 \text{ g of MgO}} \times 100 = 60.3\%$$

$$\% \text{ mass of O} = \frac{5.40 \text{ g of O}}{13.60 \text{ g of MgO}} \times 100 = 39.7\%$$

When you add them together, it should be 100% or very, very close to it:

$$60.3\% + 39.7\% = 100\%$$

EXAMPLE 2

9.03g Mg combine completely with 3.48g N to form a compound.?

What is the compound? Mg₃N₂

What is the percent composition of this compound?

Use the formula:

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

ANSWER

$$\% \text{ mass of Mg} = \frac{9.03 \text{ g of Mg}}{12.51 \text{ g of Mg}_3\text{N}_2} \times 100 = 72.2\%$$

12.51 g of Mg_3N_2

$$\% \text{ mass of N} = \frac{3.48 \text{ g of N}}{12.51 \text{ g of Mg}_3\text{N}_2} \times 100 = 27.8\%$$

12.51 g of Mg_3N_2

EXAMPLE 3

Calculate the percent composition of propane (C_3H_8).

1. Determine the molar mass of the compound:

$$\text{mass of C in 1 mol C}_3\text{H}_8 - 3 \times 12.0 \text{ g} = 36.0 \text{ g}$$

$$\text{mass of H in 1 mol C}_3\text{H}_8 - 8 \times 1.0 \text{ g} = \underline{8.0 \text{ g}}$$

44.0 g C_3H_8

2. Use the formula

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

$$\% \text{ mass C} = \frac{36.0 \text{ g C}}{44.0 \text{ g C}_3\text{H}_8} \times 100 = 81.1\%$$

$$\% \text{ mass H} = \frac{8.0 \text{ g H}}{44.0 \text{ g C}_3\text{H}_8} \times 100 = 18 \%$$