

Percent Composition

Law of definite proportions: elements in a compound have fixed proportions by mass (Joseph Proust)

Different mass percents of elements give you unique chemical compounds.

Ex CO 42.88% C CO₂ 27.29% C

Percent Composition: List of mass percents of each element in a compound

Ex. The % composition of C₈H₈O₃ is 63.1% C, 5.3% H and 31.6 % O.

Calculating % composition:

Ex 1. A 38.72 g sample contains 22.69 g of Mg and 16.03 g of S. Find the % composition.

$$\begin{aligned}\% \text{Mg} &= \frac{\text{mass Mg}}{\text{total mass}} \times 100 \\ &= \frac{22.69 \text{ g}}{38.72 \text{ g}} \times 100 \\ &= 58.60 \%\end{aligned}$$

$$\begin{aligned}\% \text{S} &= \frac{\text{mass S}}{\text{total mass}} \times 100 \\ &= \frac{16.03 \text{ g}}{38.72 \text{ g}} \times 100 \\ &= 41.40 \%\end{aligned}$$

check → add together
→ should be 100%

Ex 2. What is the % composition of FeBr₂?

1. Calculate the molar mass

$$\begin{aligned}M_{\text{FeBr}_2} &= \underbrace{55.845}_{\text{Fe}} + \underbrace{2(79.904)}_{\text{Br}} \\ &= 215.653 \text{ g} \text{ or } \text{u} \\ &\quad \uparrow \\ &\quad \text{total mol}\end{aligned}$$

2. Calculate the % composition for each element
* don't lose the subscripts *

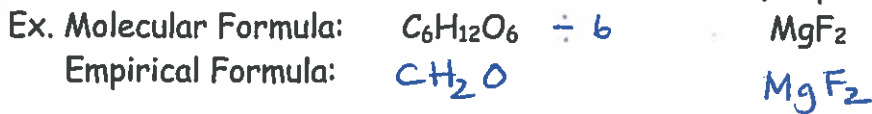
$$\begin{aligned}\% \text{Fe} &= \frac{55.845 \text{ u}}{215.653 \text{ u}} \times 100 \\ &= 25.90 \%\end{aligned}$$

$$\begin{aligned}\% \text{Br} &= \frac{2(79.904) \text{ g/mol}}{215.653 \text{ g/mol}} \times 100 \\ &= 74.10 \%\end{aligned}$$

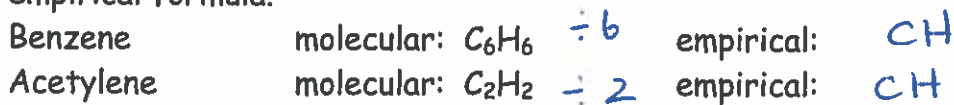
Empirical Formulas

Molecular Formula: shows the number of atoms that make up each molecule or formula unit.

Empirical Formula: shows the lowest whole number ratio (simplest formula).



* It is possible for compounds with different molecular formulas to have the same empirical formula.



Finding Empirical Formulas

Ex 1. Find the empirical formula for a compound that is 81.9% C, 6.12% H and 12.1% O.

1. Assume a 100g sample *write this everytime
2. Write each % as a mass value

$$m_C = 81.9g \qquad m_H = 6.12g \qquad m_O = 12.1g$$

3. Convert to moles

$$n_C = 81.9g \times \frac{1 \text{ mol}}{12.011g} = 6.819 \text{ mol} \qquad n_H = 6.12g \times \frac{1 \text{ mol}}{1.008g} = 6.071 \text{ mol} \qquad n_O = 12.1g \times \frac{1 \text{ mol}}{15.999g} = 0.7563 \text{ mol}$$

4. Set up a ratio of each element and divide by the smallest # of moles

$$\begin{array}{ccc} C & : & H & : & O \\ \frac{6.819}{0.7563} & & \frac{6.071}{0.7563} & & \frac{0.7563}{0.7563} \end{array}$$

* you need these #s to be very close to a whole #
→ if you get a decimal then try
x2 x3 x4 x5 etc until each # is a whole number

9 : 8 : 1

∴ the empirical formula is C_9H_8O

Q # 9, 11, 12 pg. 270

Q # 31, 32, 33, 35 pg. 273

