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 CO_2 27.29% C

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

Ex. The % composition of $C_8H_8O_3$ 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.

$$\% Mg = \frac{\text{mass Mg}}{\text{total mass}} \times 100 = \frac{22.69\,g}{38.72\,g} \times 100 = 58.60\,\%$$

$$\% S = \frac{\text{mass S}}{\text{total mass}} \times 100 = \frac{16.03\,g}{38.72\,g} \times 100 = 41.40\,\%$$

check → add together
→ should be 100 %

Ex 2.What is the % composition of $FeBr_2$?

1. Calculate the molar mass

$$M_{FeBr_2} = \underbrace{55.845}_{Fe} + \underbrace{2(79.904)}_{Br}$$

$$= 215.653\ g/mol \text{ or } u$$

↑ total

2. Calculate the % composition for each element

* don't lose the subscripts *

$$\% Fe = \frac{55.845\,u}{215.653\,u} \times 100 = 25.90\,\%$$

$$\% Br = \frac{2(79.904)\,g/mol}{215.653\,g/mol} \times 100 = 74.10\,\%$$

HW: Q#11,12,15,17 pg. 264 Q#21,22,25 pg. 266

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).

Ex. Molecular Formula: $C_6H_{12}O_6$ ÷ 6 MgF_2

Empirical Formula: CH_2O MgF_2

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

Benzene	molecular: C_6H_6 ÷ 6	empirical: CH
Acetylene	molecular: C_2H_2 ÷ 2	empirical: CH

<u>Finding Empirical Formulas</u>

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

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

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

3. Convert to moles

$n_C = 81.9\,g \times \frac{mol}{12.011\,g} = 6.819\ mol$

$n_H = 6.12\,g \times \frac{1\,mol}{1.008\,g} = 6.071\ mol$

$n_O = 12.1\,g \times \frac{1\,mol}{15.999\,g} = 0.7563\ mol$

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

C : H : O

$\frac{6.819}{0.7563}$ $\frac{6.071}{0.7563}$ $\frac{0.7563}{0.7563}$

* you need these #s to be <u>very</u> 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