Quantitative Analysis and the Mole

Ever look at the label on the side of a bottle of water? It usually gives two types of analysis:

- **qualitative** analysis - this tells which chemical species are in a mixture
- **quantitative** analysis - this tells how much of each species in a mixture/compound

We're going to look at several different types of quantitative analysis:

1. Percentage composition
2. Empirical formula
3. Molecular formula

1. Percentage Composition

This finds the percent by mass of each element in a substance

Percentage composition is a key step in determining a chemical formula

- We look at the formula and its subscripts and think in moles.
- Then we convert those moles to mass by using the molar masses of the elements involved
- We calculate the entire molar mass of the compound.
- We divide the mass of the element by the entire molar mass of the compound and convert to a percentage by moving the decimal two places to the right.

Example:

Find the percentage composition of $AlBr_3$

In the formula there is one mole of Al and 3 moles of Br

mass of Al = 1 mol x 26.98 g/mol = 26.98 g

mass of bromine = 3 mol x 79.90 g/mol = 239.70 g

mass of 1 mol of $AlBr_3$ = 266.68 g

$$\% \text{ Al} = \frac{\text{mass of Al}}{\text{mass of } AlBr_3} \times 100\ \% = \frac{26.98\ \text{g}}{266.68\ \text{g}} \times 100\% = 10.12\ \%$$

$$\% \text{ Br} = \frac{\text{mass of Br}}{\text{mass of } AlBr_3} \times 100\ \% = \frac{239.70\ \text{g}}{266.68\ \text{g}} \times 100\% = 89.88\ \%$$

Use two values after the decimal for all percentage composition

Calculate the percentage composition of each compound: (make sure your formula is correct!)

1. calcium fluoride
2. dinitrogen tetrafluoride
3. iron (III) oxide
4. manganese (IV) oxide
5. dichlorine heptaoxide