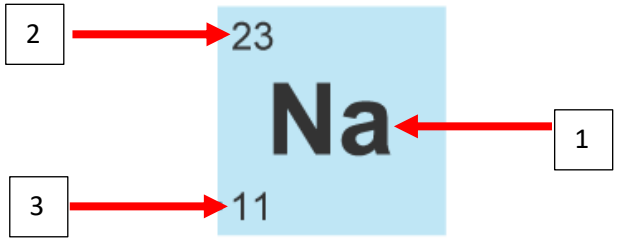
Science: Quantitative Chemistry

1. Key Words

Relative atomic mass (A_r)	This is the relative mass of an atom of an element compared to other elements.
Relative formula mass (M_r)	This is the sum total of the relative atomic mass of all the atoms in a compound

2. Calculating M_r



1	Element symbol
2	Atomic mass (total number of protons and neutrons in the nucleus)
3	Atomic number (number of protons in the nucleus)

Example 1: Sodium Chloride (NaCl)

Atomic mass of Na = 23
Atomic mass of Cl = 35.5
M_r = 23 + 35.5 = **58.5**

Example 2: Aluminium Oxide (Al_2O_3)

Atomic mass of Al = 27 There are 2 atoms of Al, so 27 x 2 = 54
Atomic mass of O = 16 There are 3 atoms of O, so 16 x 3 = 48
M_r = 54 + 48 = **102**

3. Percentage by mass

$$\text{Percentage by mass} = \frac{\text{total atomic mass of element in the compound} \times 100}{\text{Relative formula mass of the compound}}$$

Example 1: Percentage by mass of sodium in sodium chloride

Atomic mass of Na = 23
M_r of NaCl = 58.5

$$\text{Percentage by mass} = \frac{23 \times 100}{58.5} = \mathbf{39.3\%}$$

Example 2: Percentage by mass of oxygen in aluminium oxide

Atomic mass of O = 16 There are 3 atoms of O, so 16 x 3 = 48
M_r of Al_2O_3 = 102

$$\text{Percentage by mass} = \frac{48 \times 100}{102} = \mathbf{47\%}$$

4. Calculating Moles (HT only)

Mole	Number of particles needed to make the mass equal to the relative atomic mass
Avogadro constant	6.022×10^{23} particles in 1 mole

$$\text{Moles (M)} = \frac{\text{mass (g)}}{\text{Relative formula mass}}$$

Example: 27.4g of sodium chloride is made in a reaction, how many moles have been made?

M_r of NaCl = 58.5

$$\text{Moles (M)} = \frac{27.4}{58.5} = 0.47\text{M}$$

Science: Quantitative Chemistry

5. Calculating concentration

Conversions: there are $1000cm^3$ in $1dm^3$

$128cm^3$ in to dm^3	$128 \div 1000 = 0.128dm^3$
$1.45dm^3$ in to cm^3	$1.45 \times 1000 = 1450cm^3$

$$\text{Concentration } (g/dm^3) = \frac{\text{mass (g)}}{\text{Volume } (dm^3)}$$

Example: 27.4g of sodium chloride is added to $500cm^3$ of water. What is the concentration in g/dm^3?

Conversion: $500cm^3 \div 1000 = 0.5dm^3$

$$\text{Concentration} = \frac{27.4}{0.5} = 54.8\ g/dm^3$$

6. Calculating concentration in Moles (HT only)

$$\text{Concentration } (M/dm^3) = \frac{\text{Moles(M)}}{\text{Volume } (dm^3)}$$

Example: 27.4g of sodium chloride is added to $500cm^3$ of water. What is the concentration in g/dm^3?

Conversion: $500cm^3 \div 1000 = 0.5dm^3$

$$\text{Concentration} = \frac{27.4}{0.5} = 54.8\ g/dm^3$$