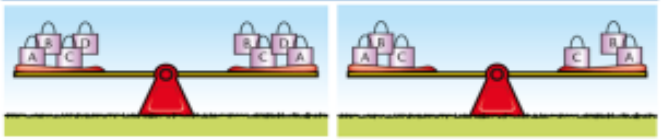
QUANTITATIVE CHEMISTRY

CONSERVATION OF MASS AND BALANCED CHEMICAL EQUATIONS

- **LAW OF CONSERVATION OF MASS:** No atoms are lost or made during a chemical reaction. $\textbf{MASS}_{\textbf{Products}} = \textbf{MASS}_{\textbf{Reactants}}$
- **CHEMICAL REACTIONS:** Represented by balanced symbol equations → numbers of atoms of each element are the same on each side



$\textbf{MASS}_{\textbf{Products}} = \textbf{MASS}_{\textbf{Reactants}}$	Numbers of atoms of the formulae are balanced

Relative atomic mass, A_r	The average mass of the atoms of an element compared with carbon-12 (which is given a mass of exactly 12). The average mass must take into account the proportions of the naturally occurring isotopes of the element.
Relative formula mass, M_r	The total of the relative atomic masses, added up in the ratio shown in the chemical formula of a substance. E.G. $M_r(NaCl) = Na + Cl = 23 = 35.5 = 58.5$ E.G. $M_r(MgF_2) = Mg + (2xF) = 24 + (2 \times 19) = 62$

MASS CHANGES WHEN A REACTANT OR PRODUCT IS A GAS

- **LOSING MASS:** In thermal decompositions of metal carbonates, CO_2 is produced → escapes into the atmosphere
- **GAINING MASS:** When a metal reacts with oxygen, mass of oxide produced is greater than the mass of the metal.

PERCENTAGE COMPOSITION BY MASS

- **% Z = (Number of atoms of Z) x (A_r of Z) / M_r of the compound x 100**
- E.G. % of oxygen in CO_2 (A_r of C = 12 and A_r of O = 16)
  % of oxygen = (2 x A_r of O) / M_r of CO_2
  % of oxygen = (2 x 16) / 12 + (2x16) = (32 / 44) x 100 = **72.7 %**

Empirical formula	The simplest ratio of elements in a compound.

EMPIRICAL FORMULA

- E.G. **5.5g** of manganese reacted with **3.2g** of oxygen. What is the **empirical formula** of the oxide of manganese that was formed? **(A_r of Mn = 55 and A_r of O = 16)**

ELEMENTS	Mn	O
mass (g)	5.5	3.2
Ar	55	16
Mass / Ar	5.5/55 = 0.10	3.2/16 = 0.20
Ratio (DIVIDE BY SMALLEST)	0.10/0.10 = **1**	0.20/0.10 = **2**
EMPIRICAL FORMULA	**MnO_2**	

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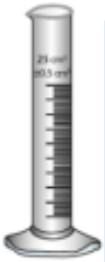

CHEMICAL MEASUREMENTS

- Whenever a measurement is made, there is always some **UNCERTAINTY** about the result obtained.
- A measuring cylinder has an **uncertainty of ±0.5 cm³.** 15 cm³ should be written as 15.0 cm³±0.5 cm³.

- **TRUE MEASUREMENT:** between 14.5 cm³ and 15.5 cm³.
- **RANGE** = highest measurement – lowest measurement
- **MEAN** = sum of the measurements divided by the number of measurements

- **PERCENTAGE UNCERTAINTY = range of measurements / mean x 100**

NUMERACY IN SCIENCE

1. Equation
2. Identify variables
3. Substitute
4. Rearrange
5. Answer
6. Units

CONCENTRATION

- Most chemical reactions take place in solutions.
- Concentration can be measured in **grams per dm³** (g/dm³).

- **Concentration (g/dm³) = mass (g) / volume (dm³)**

- **1 dm^3 = 1000cm^3 (1 litre)**

- E.G. What is the concentration in g/dm³ of **2.4g** sodium chloride dissolved in **0.5dm^3** of water?
- Concentration = mass / volume
- Concentration = 2.4g / 0.5dm^3 = **4.8 g/dm^3**

CONCENTRATION

- The **concentration increases** as the number of solute **particles** in a **fixed volume increases.**