- The relative masses of protons, neutrons and electrons are:
- Isotopes are atoms of the same element with the same number of protons but different number of neutrons.

Name of particle	Mass
Proton	1
Neutron	1
Electron	Very small

Relative atomic mass (Ar)

- It is a way of saying how heavy different atoms are in comparison to the isotope Carbon 12.
- The Ar of carbon 12 is exactly 12.
- When an element has more than 1 stable isotope, the relative atomic mass is an average value of the different isotopes.

Relative formula mass (Mr)

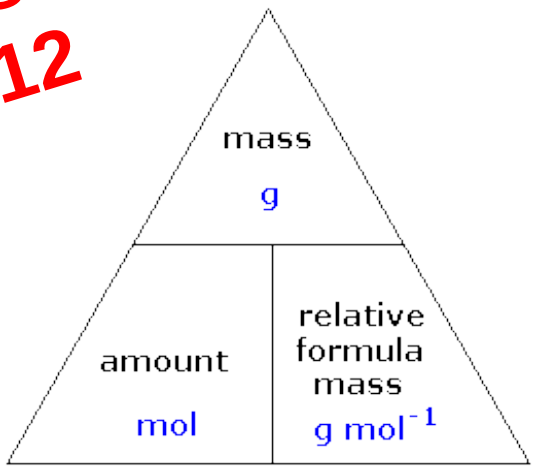
Relative formula mass calculations

Compound	Formula	Calculation	M_r
Water	H_2O	1 + 1 + 16 =	18
Sodium hydroxide	NaOH	23 + 16 + 1 =	40
Magnesium hydroxide	$Mg(OH)_2$	24 + 16 + 16 + 1 + 1 = (remember that there are two of each atom inside the brackets)	58

- A_r of H = 1
- A_r of O = 16
- A_r of Na = 23
- A_r of Mg = 24

Moles

- The relative formula mass of a substance in grams, is known was one mole of that substance.
- For example, the Ar of Iron is 56, so one mole of iron weighs 56g.
- The Mr of nitrogen gas (N2) is 28 (2*14), so one mole is 28g.
- You can convert between moles and grams by using this triangle:
- E.g how many moles are there in 42g of carbon?
- Moles = Mass / Mr = 42/12 = 3.5 moles



Analysing substances

- Elements and compounds can be detected and identified using instrumental methods.
- Benefits of instrumental methods are that it's rapid, sensitive and useful when detecting small amounts.
- Chemical analysis can be used to identify additives in food e.g paper chromatography

We can use this to work out how much water is made:

A_r of hydrogen = 1	Mass of 1 mole of H_2 = 2x1 = 2g
A_r of oxygen = 16	Mass of 1 mole of O_2 = 2 x 16 = 32g
M_r of water = (16+2) = 18	Mass of 1 mole of water = 18g

Putting in the numbers from our balanced equation:

2 moles of hydrogen = 2 x 2g = 4g
1 mole of oxygen = 1 x 32g = 32g
2 moles of water = 2 x 18g = 36g

Even though no atoms are lost or gained in a chemical reaction, it's not always possible to contain the calculated amount of product because:

- The reaction may not go to completion because it's reversible
- The reactants may react different to expected
- Some product may be lost when separated from the reaction mixture

Chemical Calculations

- Tell us how much of two chemicals to react together to get a final product
- Usually given one measurement

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
If we have 50g of $CaCO_3$, how much CaO can we make?

M_r of $CaCO_3$ = 40 + 12 + 16 + 16 + 16 = 100
M_r of CaO = 40 + 16 = 56

100g of $CaCO_3$ would yield 56g of CaO
50g of $CaCO_3$ would yield 28g of CaO
So we can make 28g of CaO
22g of CO_2 would also be produced (50 - 28 = 22)

Percentage yield

$$\text{Percentage yield} = \frac{\text{Amount of product produced}}{\text{Maximum amount of product possible}} \times 100$$

Reversible reactions

- In some reactions, the products can react to produce the original reactants. These are called reversible reactions, and are presented like:

$$A + B \rightleftharpoons C + D$$

For example:

$$\text{ammonium chloride} \rightleftharpoons \text{ammonia} + \text{hydrogen chloride}$$