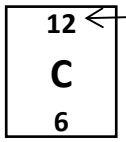
# C4: Quantitative Chemistry 1

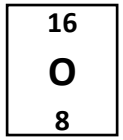
**Relative formula mass ($M_r$):**




Add together the $A_r$ of each atom in a substance to give the $M_r$.

Carbon monoxide, CO, would be:

12 + 16 = 28




$CO_2$ would be:

12 + (16x2) = 44

There are two oxygen atoms.

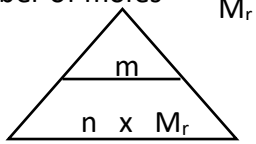
**% mass of an element in a compound**

$$\text{Percentage mass of an element in a compound} = \frac{A_r \times \text{number of atoms of that element}}{M_r \text{ of the compound}} \times 100$$

eg. the % pass of iron in iron chloride, $Fe_2O_3$ is: $\frac{56 \times 2}{(56 \times 2) + (16 \times 3)} \times 100 = 70\%$

**Learn the moles formula:**

$$\text{Number of moles} = \frac{\text{mass}}{M_r}$$




**Moles in equation:** $2H_2 + O_2 \rightarrow 2H_2O$

2 moles of hydrogen react with one mole of oxygen to produce two moles of water.

**Working out balanced equations:**

**8.1g of zinc oxide reacts with 0.6g of carbon to form 2.2g of carbon dioxide and 6.5g of zinc**

1. Work out the Mr for each substance

ZnO = 81 $CO_2$ = 44 C = 12 Zn = 65

2. Calculate the number of moles

$ZnO = \frac{8.1}{81} = 0.1$ mol $CO_2 = \frac{2.2}{44} = 0.05$ mol

$C = \frac{0.6}{12} = 0.05$ mol $Zn = \frac{6.5}{65} = 0.1$ mol

3. Divide each one by the smallest number of moles

0.05 is the smallest, so divide all of them by this. The answers are all whole numbers.

$ZnO = \frac{0.1}{0.05} = 2$ $CO_2 = \frac{0.05}{0.05} = 1$

$C = \frac{0.05}{0.05} = 1$ $Zn = \frac{0.1}{0.05} = 2$

4. Use these numbers to write the balanced equation

$2ZnO + C \rightarrow CO_2 + 2Zn$

Eg. ZnO was 2 (from step 3) so put this number in front of ZnO
C was 1 but you don't write a 1 in front of a substance, just leave it blank.

**Moles:**

A mole is an amount of a substance. **One mole** of a substance contains **$6.02 \times 10^{23}$** particles (**Avogadro constant**). The mass of that number of particles is equal to the relative atomic mass and therefore its mass in grams.

For example, one mole of carbon ($A_r = 12$) contains $6.02 \times 10^{23}$ atoms and weighs 12g.
One mole of $CO_2$ ($M_r = 44$) contains $3.02 \times 10^{23}$ particles and weighs 44g.

**Conservation of mass:**

Mass is always conserved in a reaction meaning no atoms are destroyed or created. Sometimes it appears that mass does change:

Reason 1: one of the **reactants was a gas** in the air and the products are all solids or liquids. This means you did not weigh the gas at the start but you are weighing the products. **It will appear as though the mass goes up.**

Reason 2: one of the **products is a gas** but the reactants are solids and liquids. The gas may be given off so it does not get weighed. **It will appear that the mass goes down.**