Calculating relative formula mass

- Look *carefully* at the compound.
  - CO_2
- Find out what elements you have and how many there are of each.
  - C = Carbon O = Oxygen (x2)
- Use the periodic table to check the mass number (relative atomic mass)
  - Carbon has a mass number of 12; Oxygen has a mass number of 16.
- Add up the mass numbers (remember to multiply if there is more than 1 element)
  - **12** + (**16** x 2) = **44**

Finding the relative formula mass:

Find the M_r of the following:

Fe_2O_3 $(2 \times \mathbf{56}) + (3 \times \mathbf{16}) = \mathbf{160}$

$CuCO_3$ $\mathbf{63.5} + \mathbf{12} + (3 \times \mathbf{16}) = \mathbf{123.5}$

H_2SO_4 $(2 \times \mathbf{1}) + 32 + (4 \times \mathbf{16}) = \mathbf{98}$

Calculating Percentage Mass

Percentage mass = Ar of the element / Mr of the compound x 100

e.g. Find the percentage of calcium in calcium carbonate, $CaCO_3$

- **Step 1: Work out the M_r of the compound**

  M_r of $CaCO_3$ = 40 + 12 + (3 x 16) = 100

- **Step 2: Work out the A_r of all the atoms of the element you are interested in**

  There is only 1 Ca atom so 1 x 40 = 40

- **Step 3: Divide the A_r /M_r x 100**

  40/100 x 100 = 40%

Calculating Percentage Mass

Find the percentage of iron in iron(III) oxide, Fe_2O_3

Step 1: Work out the M_r of the compound

- M_r of Fe_2O_3 =

Step 2: Work out the A_r of all the atoms of the element you are interested in

- There are ___ atoms of Fe so the total A_r =

Step 3: Divide the A_r /M_r x 100

Calculating Percentage Mass

Find the percentage of iron in iron(III) oxide, Fe_2O_3

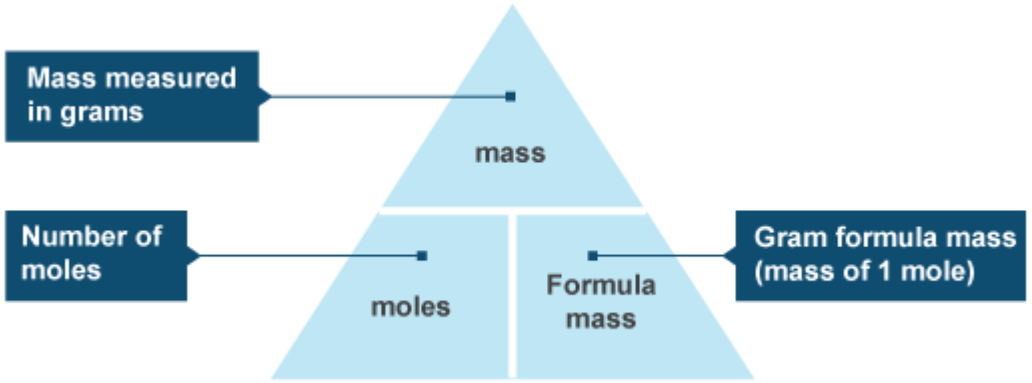
- **Step 1: Work out the M_r of the compound**
  - M_r of Fe_2O_3 = **(2 x 56) + (3 x 16) = 160**
- **Step 2: Work out the A_r of all the atoms of the element you are interested in**
  - There are **2** atoms of Fe so the total A_r = **2 x 56 = 112**
- **Step 3: Divide the A_r /M_r x 100**
  - **(112 / 160) x 100 = 70%**

Calculate the minimum mass of zinc that needs to be added to 0.500 g of iodine so that the iodine fully reacts.

The equation for the reaction is:

$$Zn + I_2 \longrightarrow ZnI_2$$

Relative atomic masses (M_r): Zn = 65 I = 127



1. Highlight all the key information

   Shown in yellow

2. Decide which equation you will need to use

   No. of moles = mass / M_r

3. Use the equation to find the number of moles of I_2 used

   No. of moles of I_2 = 0.500g / (2 x 127) g/mol = 0.001968…

4. Now you can use the mole ratio to find the number of moles of Zn

   1:1 ratio so will be the same no. of moles of Zn

5. Rearrange the equation to find the mass of Zn

   Mass = no. of moles x M_r = 0.001968… x 65 = 0.128 g

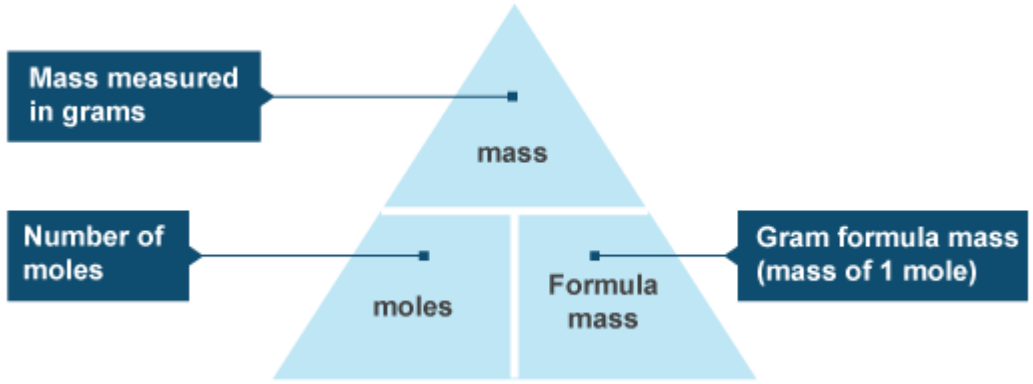
A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:

$$CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$$

Relative atomic masses, A_r: H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.



1. Highlight all the key information

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2. Decide which equation you will need to use

   No. of moles = mass / M_r

3. Use the equation to find the number of moles of $CuCl_2$ used

   No. of moles of $CuCl_2$ = 11.0g / (63.5 + 2(35.5)) = 11.0 / 134.5 = 0.08178…

4. Now you can use the mole ratio to find the number of moles of Zn

   No. of moles of $CuCl_2$ = no. of moles of $CuCO_3$ = 0.08178…

5. Rearrange the equation to find the mass of $CuCO_3$

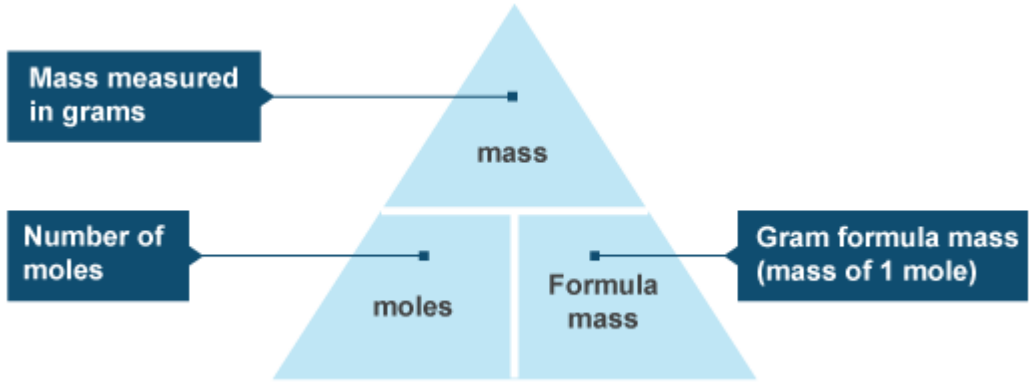
   Mass of $CuCO_3$ = no. of moles x M_r = 0.08178… x (65 + 12 + 3(16) = 10.1 g

Iron oxide (Fe_2O_3) can be reduced with carbon to form iron (Fe) and carbon dioxide, as shown by the equation below.

$$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$$

Calculate the mass of iron oxide needed to form 32.0 g of iron.

Relative atomic masses, A_r: Fe = 56; O = 16



1. Highlight all the key information

Shown in yellow

2. Decide which equation you will need to use

No. of moles = mass / M_r

3. Use the equation to find the number of moles of Fe used

No. of moles of Fe = 32.0g / 56 = 0.5714...

4. Now you can use the mole ratio to find the number of moles of Fe_2O_3

Mole ratio is 2:4, simplified to 1:2 so there are ½ the number of moles of Fe_2O_3 = 0.5 x 0.5714...

5. Rearrange the equation to find the mass of Fe_2O_3

Mass of Fe_2O_3 = no. of moles x M_r = 0.2857... x (2(56) + 3(16)) = 0.2857... x 160 = 45.7g

A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

The table below shows the student's results.

Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:

$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other.

1. Highlight all the key information
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2. Decide which equation you will need to use
   No. of moles = concentration x volume
3. Calculate the volume of sodium hydroxide (NaOH) from the concordant results
   Average volume from concordant titres = (22.10 + 22.15 + 22.15) / 3 = 22.13 cm^3
4. Use the equation to find the number of moles of NaOH used
   No. of moles of NaOH = 0.105 mol/dm_3 x (22.13/1000) dm^3 = 0.002324 mol
5. Now you can use the mole ratio to find the number of moles of H_2SO_4
   Mole ratio is 2:1, so there are ½ the number of moles of H_2SO_4 = 0.001162 mol
6. Rearrange the equation to find the concentration of H_2SO_4
   Conc of H_2SO_4 = no. of moles / vol = 0.001162 / (25/1000) = 0.0465 mol/dm^3

A student titrated 25cm^3 citric acid with sodium hydroxide solution.

The equation for the reaction is:

$C_6H_8O_7 + 3\ NaOH \longrightarrow C_6H_5O_7Na_3 + 3\ H_2O$

The concentration of the sodium hydroxide was 0.102 mol / dm^3

Concordant results are those within 0.10 cm^3 of each other.

Calculate the concentration of the citric acid in mol / dm^3

Use only the concordant results from the table in your calculation.

You must show your working.

Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
13.50	12.10	11.10	12.15	12.15

1. Highlight all the key information
   Shown in yellow
2. Decide which equation you will need to use
   No. of moles = concentration x volume
3. Calculate the volume of sodium hydroxide (NaOH) from the concordant results
   Average volume from concordant titres = (12.10 + 12.15 + 12.15) / 3 = 12.13 cm^3
4. Use the equation to find the number of moles of NaOH used
   No. of moles of NaOH = 0.102 mol/dm$_3$ x (12.13/1000) dm^3 = 0.0012376 mol
5. Now you can use the mole ratio to find the number of moles of $C_6H_8O_7$
   Mole ratio is 3:1, so there are 1/3 the number of moles of $C_6H_8O_7$ = 0.0004125333.... mol
6. Rearrange the equation to find the concentration of $C_6H_8O_7$
   Conc of $C_6H_8O_7$ = no. of moles / vol = 0.0004125... / (25/1000) = 0.0165 mol/dm^3