

S.L.O.P - Paper 1

Periodic table on back!

Unit 3 Quantitative Chemistry

Name:

Class:

Number of elements in a formula

Example: $FeBr_3$

The number of elements is the same as the number of symbols.
Each different symbol starts with a capital letter.

$FeBr_3$ So we have **two** different elements **Fe** = Iron, **Br** = Bromine

Task 1: How many different **elements** are in each chemical formula?

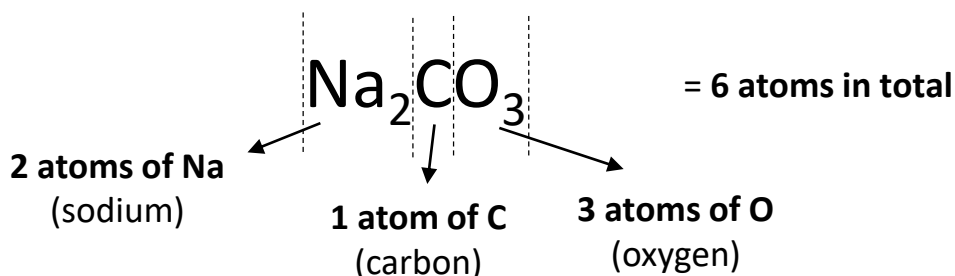
- a) Fe_2O_3 b) $CaCO_3$ c) H_2 d) $AgNO_3$ e) H_2SO_4

Number of atoms of each element in a formula

Example:

The small numbers on the bottom right of each symbol tell you how many atoms of that element you have. If there is no number to the right you have one atom of that element.

Na_2CO_3



Task 2: How many atoms of each element are in these formulae?

Also give the total number of atoms:

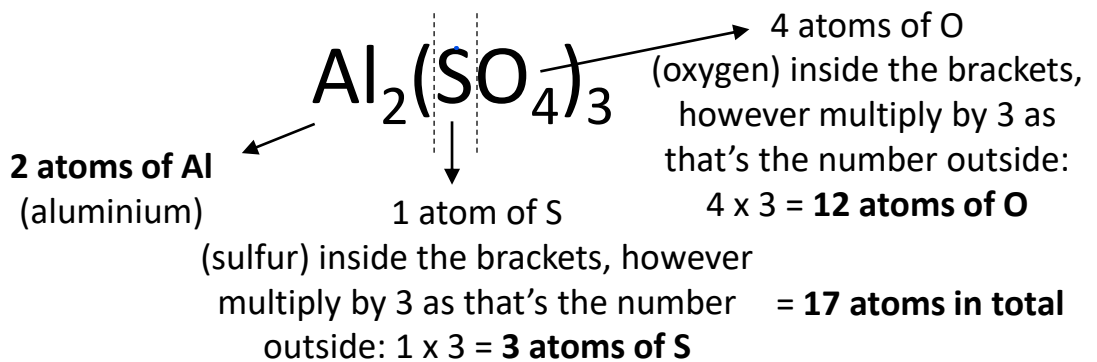
- a) $FeCl_3$ b) H_2SO_4 c) $AgNO_3$ d) K_2SO_4 e) CH_4 d) NH_3 e) SiO_2

Use of brackets in formulae

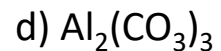
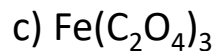
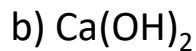
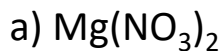
Example:



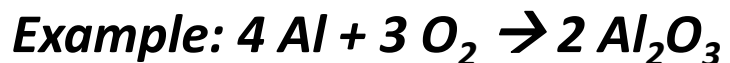
The number of atoms of each element inside the brackets is multiplied by the number on the bottom right outside the brackets.



Task 3: How many atoms of each element are in these formulae? Also give the total number of atoms:

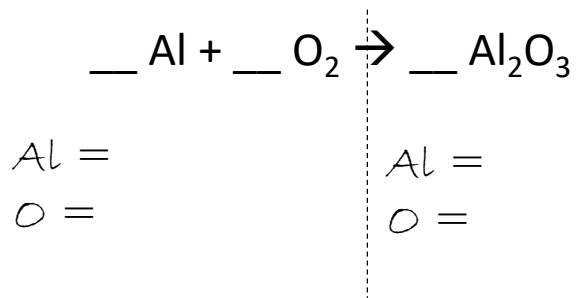


Balancing equations

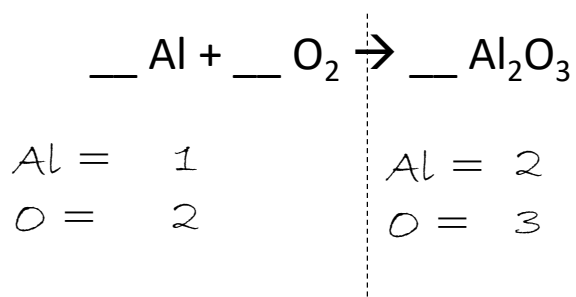


The number of atoms of each element either side of the arrow should be the same.

1. Draw a line down from the arrow in the unbalanced equation and list the symbols of all elements either side.



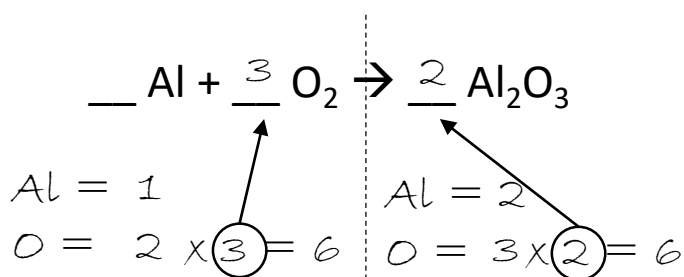
2. Count the number of atoms of each element currently in the equation.



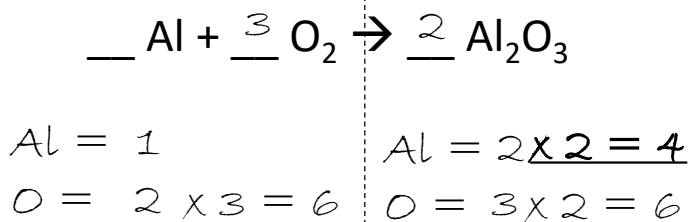
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Balancing equations continued...

3. Work on one element (row) at a time, finding a number that both numbers fit into. e.g oxygen's original 2 and 3 both fit into 6. Put the number you multiplied by into the correct gap in the equation. If at the end it didn't need multiplying, just put a 1 in the gap or leave it blank.



4. Note how when I multiplied Al_2O_3 by 2 to get 6 oxygens, I also multiplied the Al_2 bit of it by 2. Track these changes as you go!

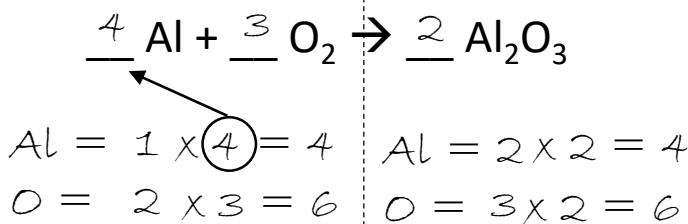


5. Now we can check that the numbers of atoms of each element are the same.

$$\text{Al} = 4 \quad \text{Al} = 4$$

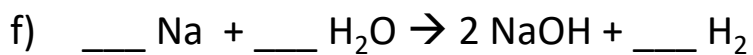
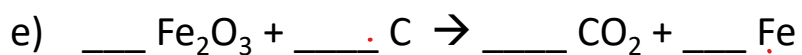
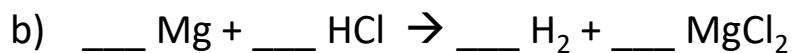
$$\text{O} = 6 \quad \text{O} = 6$$

The equation is balanced.



Now apply what you've learned to the questions on the next page.

Task 4: Balance these equations:



Calculating Relative Formula Mass (M_r)

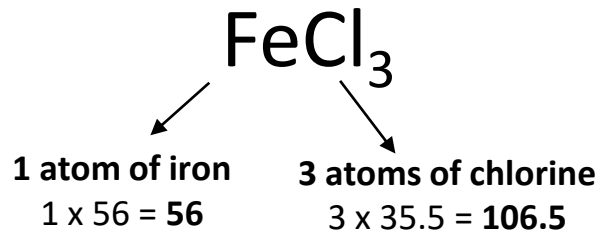
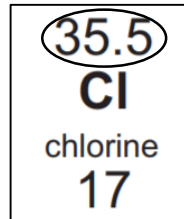
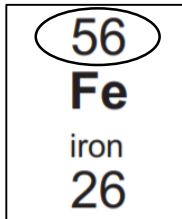
Example:



Look for the elements' symbols on the periodic table, you need to use the mass numbers (They're the massive ones!).

Note: Sometimes they give you the mass numbers of each element in the Q.

You need to add up the masses of each atom of each element.

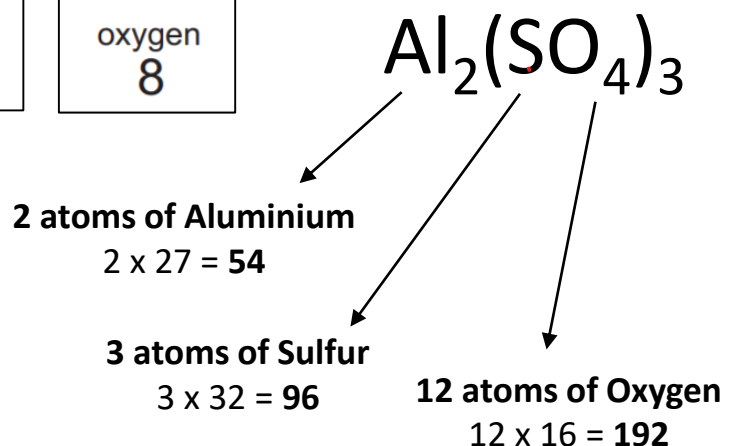
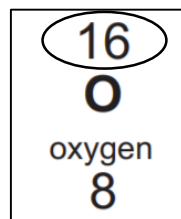
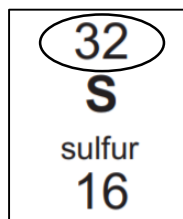
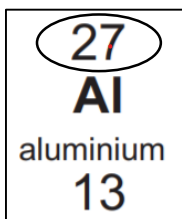


$$56 + 106.5 = M_r = 162.5 \text{ g/mol}$$

Don't forget the unit of "grams per mole" (g/mol).

This example has brackets, remember what we looked at earlier, multiple the number inside the brackets by the number on the outside to get the full number of atoms of that element.

Example:

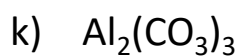
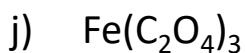
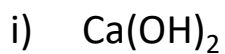
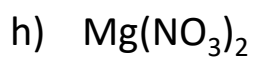
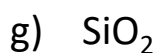
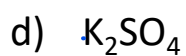
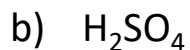


$$54 + 96 + 192 = M_r = 342 \text{ g/mol}$$

Now apply what you've learned to the questions on the next page.

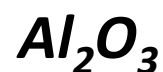
Task 5: Calculate the Relative Formula Mass (M_r) of each substance:

Note: Use your copy of the periodic table to find the relative atomic mass:



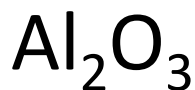
Calculating Elemental Percentage

Example:



Sometimes you will be asked a question like this:
"What is the percentage by mass in Al_2O_3 , of aluminium?"

Step 1: Calculate M_r



2 atoms of Aluminium

$$2 \times 27 = 54$$

3 atoms of Oxygen

$$3 \times 16 = 48$$

$$54 + 48 = M_r = 102 \text{ g/mol}$$

Step 2: Divide the total mass of the particular element by the M_r then $\times 100$

Aluminium made up 54 out of the total of 102 so:

$$\frac{54}{102} \times 100 = 52.9 \%$$

Task 6: Calculate the percentage by mass for the specified element, round to 1 d.p:

a) FeCl_3 %Fe?

b) H_2SO_4 %O?

c) Ca(OH)_2 %H?

d) $\text{Al}_2(\text{CO}_3)_3$ %C?

The Mole

Chemical amounts are measured in **moles**, the symbol for the unit mole is **mol**.

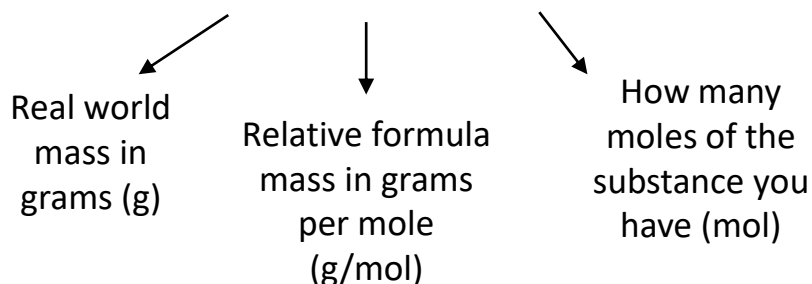
The mass of one mole of a substance is equal to its relative formula mass (M_r) in grams

e.g. 1 mol of FeCl_3 ($M_r = 162.5 \text{ g/mol}$) = 162.5 g

This is why the units of relative formula mass are “grams per mole” – It’s how many grams 1 mole would weigh! So two moles of a substance would be twice its M_r

e.g. 2 mol of FeCl_3 ($M_r = 162.5 \text{ g/mol}$) = 325g

This gives us the equation: **Mass = $M_r \times \text{mol}$**



This can be rearranged to give:

$$\text{mol} = \frac{\text{mass}}{M_r} \qquad M_r = \frac{\text{mass}}{\text{mol}}$$

The mass in this equation needs to be in grams, but modern papers are giving you masses in:

- nanograms (ng) $n \times 10^{-9}$
- micrograms (μg) $n \times 10^{-6}$
- milligrams (mg) $n \times 10^{-3}$
- kilograms (kg) $n \times 10^3$
- tonnes (T/Mg) (megagrams) $n \times 10^6$.

Whatever number they give you (if not in grams), just multiply by the correct power as above and slot into the equation → remembering these is easier than remembering conversions!

The Mole examples.....

Example 1:

What is the mass of 3.5 moles of Methane (CH₄)?, M_r = 16 g/mol

$$\text{Mass} = M_r \times \text{mol}$$

$$\text{Mass} = 16 \times 3.5 = 56 \text{ g}$$

Example 2:

How many moles are in 348 g of aluminium oxide (Al₂O₃)? M_r = 102 g/mol

$$\text{Mol} = \text{mass} / M_r$$

$$\text{Mol} = 348 / 102 = 3.41 \text{ mol}$$

Example 3:

What is the M_r of two moles of a compound that weighs 204 g?

$$M_r = \text{mass} / \text{mol}$$

$$M_r = 204 / 2 = 102 \text{ g/mol}$$

Therefore it must be aluminium oxide...

Example 4:

How many moles are in 5 kg of carbon dioxide (CO₂)? M_r = 44 g/mol

$$\text{Mol} = \text{mass} / M_r$$

$$\text{Mol} = 5 \times 10^3 / 44 = 113.6 \text{ mol}$$

Example 5:

How many moles in 600 mg of paracetamol? (C₈H₉NO₂) M_r = 151 g/mol

$$\text{Mol} = \text{mass} / M_r$$

$$\text{Mol} = 600 \times 10^{-3} / 151 = 3.97 \times 10^{-3} \text{ mol}$$

Make sure you know the powers of ten that each prefix stands for, this will save you time in your biology, physics and chemistry papers!

Task 7: Using the mole equation:

- a) Write the mole equation in its basic form:
- b) Write the mole equation rearranged to make mol the subject:
- c) Write the mole equation rearranged the make M_r the subject:
- d) Calculate the number of moles in:**
- i) 50g of Calcium M_r (Ca) = 40g/mol
- ii) 100 μg of Zinc M_r (Zn) = 65g/mol
- iii) 300 tonnes of Iron chloride, M_r (FeCl₃) = 162.5 g/mol
- e) Calculate the mass of:**
- i) 0.5 moles of Cobalt, M_r (Co) = 59 g/mol
- ii) 0.75 moles of Methane, M_r (CH₄) = 16 g/mol
- iii) 12 moles of Zinc chloride, M_r (ZnCl₂) = 136 g/mol

Task 8: Moles challenge – For levels 5 and higher:

How many moles of each substance are there? You will first need to calculate M_r in order to use the equation $\text{mol} = \text{mass} / M_r$

- a) 150g of Bromine – Br_2

- b) 540g of calcium chloride – CaCl_2

- c) 460g of Iron (II) hydroxide – $\text{Fe}(\text{OH})_2$

What is the mass of each substance? You will first need to calculate M_r in order to calculate mass using the equation $\text{mass} = M_r \times \text{mol}$

- d) 3 moles of Vanadium, V

- e) 0.75 moles of Lead oxide Pb_2O

- f) 4 moles of Aluminium chloride AlCl_3

Calculate the M_r of the unknowns and attempt to identify them by writing a formula that matches the M_r (there are multiple solutions for each).

- g) *4 moles of X, has a mass of 68 g, what is the M_r of X and suggest its identify by writing a formula that matches the M_r you calculated.*

- h) *5.4 moles of Y has a mass of 162g, Calculate the M_r of Y and suggest its identity by writing a formula that matches the M_r you calculated.*

Avogadro's Constant

The real world masses of atoms doesn't match our metric system. However the mass = $M_r \times \text{mol}$ equation makes it so that 1 mole of a substance weights exactly its M_r in grams.

This is because the mole is based on a number called Avogadro's constant which translates the mass of atoms to the scale of our metric system.

Avogadro found that one mole of a substance will weigh its relative formula mass (M_r) in grams, if one mole of a substance contains:

6.02×10^{23} atoms, ions or molecules.

This number is called Avogadro's constant.

Using Avogadro's Constant

Avogadro's constant can be used to work out the mass of a single atom, ion or molecule, for example:

If the relative formula mass of a molecule of chlorine Cl_2 is 71 g/mol (that's 71g for every 1 mole), and in 1 mole there is 6.02×10^{23} atoms, ions or molecules then one molecule of chlorine weighs exactly:

$$\frac{71 \text{ g/mol}}{6.02 \times 10^{23} \text{ molecules / mol}} = 1.18 \times 10^{-22} \text{ g}$$

Simply divide the M_r by Avogadro's constant to get the exact mass of one atom, ion or molecule.

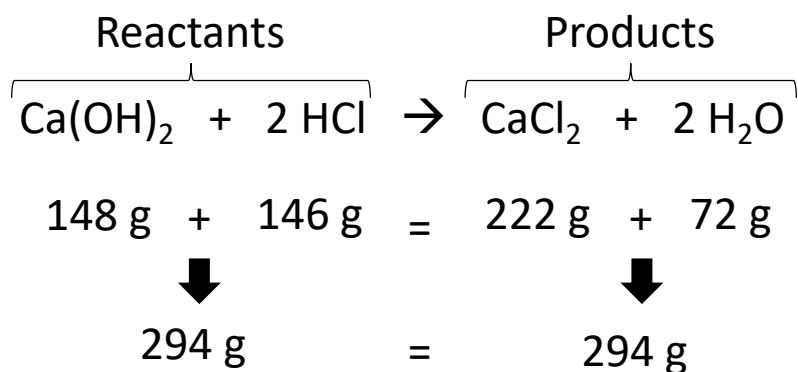
Task 9: Using Avogadro's constant:

- a) What is the value of Avogadro's constant?
- b) One mole of any substance weighs exactly the same as its relative formula mass M_r in _____.
- c) One mole of a substance contains 6.02×10^{23} _____, _____ or _____.
- d) What is the mass of one atom of sodium (Na)?, where $M_r/A_r = 23 \text{ g/mol}$?
- e) What is the mass of one molecule of methane (CH_4)?, where $M_r = 16 \text{ g/mol}$?
- f) What is the mass of one molecule of sulfur dioxide (SO_2)?, where $M_r = 64 \text{ g/mol}$?
- g) How many moles are in 12.04×10^{23} atoms, ions or molecules?

The Law of Conservation of Mass

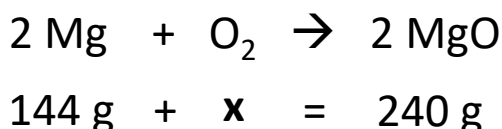
The mass of all reactants will be equal to the mass of all products.

For example, when 148 g calcium hydroxide reacts with 146 g hydrochloric acid, 222 g of calcium chloride and 72 g of water are produced, we can show that the mass of reactants is equal to the mass of products:



We can use this rule to work out the mass of an unknown when all other masses are given, for example:

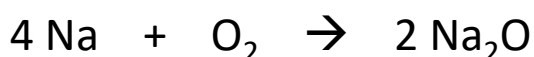
When 144g of magnesium reacts with oxygen, 240g of magnesium oxide is produced. What mass of oxygen reacted?



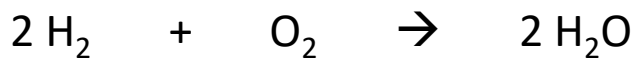
Therefore: $240 - 144 = \mathbf{x} = 96\text{g}$ of oxygen.

Task 10: Applying the Law of Conservation of Mass:

a) Show that when 230 g of sodium reacts with 80g of oxygen to produce 310 g of sodium oxide, that this reaction obeys the law of conservation of mass:



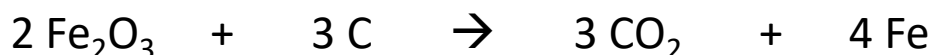
b) When an unknown mass of hydrogen reacts with 288g of oxygen, 324g of water is produced. What mass of hydrogen reacted?



c) 112g of methane reacted with 448g of oxygen, 252g of water was produced, what mass of carbon dioxide was produced?



d) 1600 tonnes of iron oxide reacted with an unknown mass of carbon to produce 660 tonnes of carbon dioxide and 1120 tonnes of iron. What mass of carbon reacted?



Conservation of mass, when a product is a gas:

To understand this next section you first need to understand state symbols: (s) = solid, (l) = liquid, (g) = gas, (aq) = Aqueous solution.

If you carried out a reaction on a balance, sometimes the mass of the reaction flask and its contents will change as the reaction proceeds. This appears to break the law of conservation of mass.

Take for example the reaction of any metal carbonate with acid:

$$\text{CaCO}_3 (\text{s}) + 2 \text{HCl} (\text{aq}) \rightarrow \text{CaCl}_2 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$$

Solid calcium carbonate and **aqueous** hydrochloric acid solution will stay in flask so will be weighed.

The **aqueous** calcium chloride solution and **liquid** water will stay in the flask so will be weighed, however the **carbon dioxide** is a **gas** so **will escape** and will not be weighed.

Example Q:

Why does the reaction flask and its contents appear to decrease in mass for this reaction?



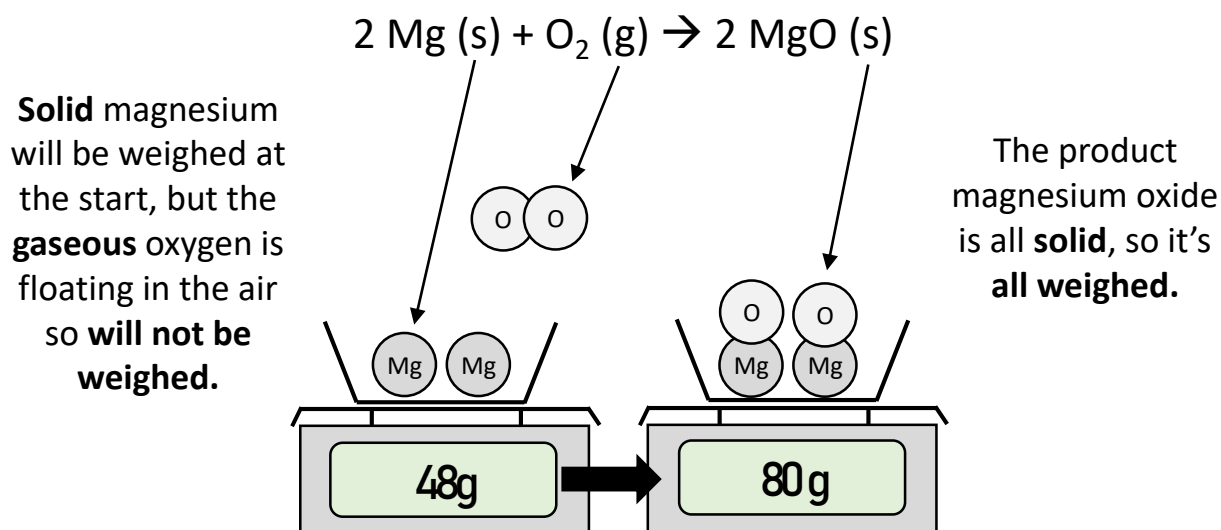
1. Identify and **name the gas** using the state symbols:
Carbon dioxide is a product.....
2. State that **it's a gas**:
and it's a gas.....
3. Say **it escapes**:
so it escapes

So technically the reaction still obeys the law of conservation of mass, it just looks like it hasn't because the NAMED GAS escaped.

Conservation of mass, when a reactant is a gas:

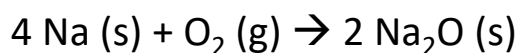
If a reactant is a gas, the mass may appear to increase.

Take for example the reaction of any metal with oxygen:



Example Q:

Why does the reaction crucible and its contents appear to increase in mass for this reaction?



1. Identify and **name the gas** using the state symbols:

Oxygen is a reactant

2. State that **it's a gas**:

and it's a gas.....

3. Say **it** is not weighed as a reactant but is at the end when it's part of the solid product.

It's not weighed at the start when it's a gas, but after it reacts it becomes part of the solid product so is weighed.

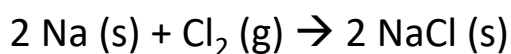
So technically the reaction still obeys the law of conservation of mass, it just looks like it hasn't because the mass of the gas was incorporated into the product.

Task 11: When a reactant or product is a gas

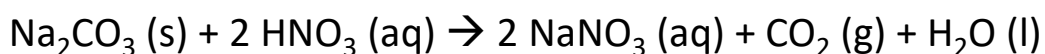
- a) Why does the reaction crucible and its contents appear to decrease in mass?



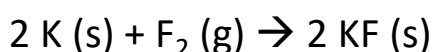
- b) Why does this reaction crucible and its contents appear to increase in mass?



- c) How will the mass of the reaction flask and its contents appear to change in this reaction and why?



- d) How will the mass of the reaction crucible and its contents appear to change in this reaction and why?

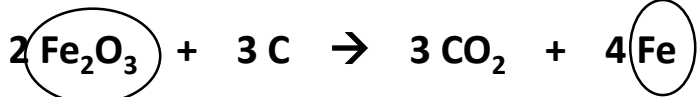


Example question continued:

3. Continued: I've had to work out the M_r : $Fe_2O_3 = (56 \times 2) + (16 \times 3) = 160 \text{ g/mol}$

M_r : Fe = 56

IGNORE THE BIG NUMBERS!



Mass: 500g

Mass:

M_r : 160 g/mol

M_r : 56 g/mol

Mol:

Mol:

4. Now use the equation $mass = M_r \times mol$ rearranged for mol for the one you have two bits of info on.

Moles Fe_2O_3

$$mol = mass / M_r$$

$$mol = 500 / 160 = 3.125 \text{ mol}$$

Put this mol value in the correct column/row...

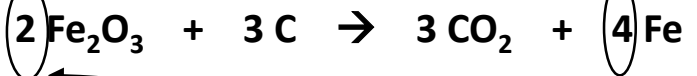
5. Now you can use those BIG numbers: The mol values in your bottom row will follow the same ratio.

Step 1: Divide you mole value by the big number in its column.

Step 2: Multiply it by the big number in the column that you're looking for a mole value for.

divide

multiply



Mass: 500g

Mass:

M_r : 160 g/mol

M_r : 56 g/mol

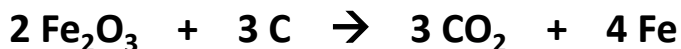
Mol: 3.125 mol

Mol:

$$\text{Step 1} \quad \text{Step 2} \\ (3.125 / 2) \times 4 = 6.25 \text{ mol}$$

Example Question continued:

6. Now use
Mass = $M_r \times \text{mol}$ to
calculate the mass
of the one you're
looking for.



Mass: 500g

Mass:

M_r : 160 g/mol

M_r : 56 g/mol

Mol: 3.125 mol

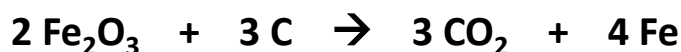
Mol: 6.25 mol

Mass Fe

Mass = $M_r \times \text{mol}$

Mass = $56 \times 6.25 = 350\text{g}$

Put this mass value in the correct
column/row...



Mass: 500g

Mass: 350 g

M_r : 160 g/mol

M_r : 56 g/mol

Mol: 3.125 mol

Mol: 6.25 mol

Tips:

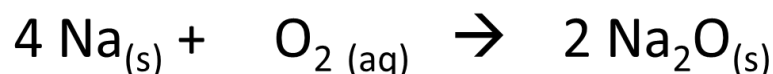
1. The big numbers only apply as the ratio to the mol row, don't use the big numbers when calculating M_r !
2. Write Mass, M_r and Mol in the right order underneath the equation as this will prompt you to remember the mass = $M_r \times \text{mol}$ equation. If you don't have space re-write the equation so you have space underneath.
3. Divide moles by BIG number in its own column, then multiply this answer by BIG number in target column.

Task 12: Calculating the mass of a product or reactant. If you show your working it makes it easier for a teacher/examiner to either diagnose your work and give you help, or to give you marks even if you made a mistake!

- a) A student has 80 g of magnesium (Mg), what mass of magnesium chloride (MgCl₂) will they produce? SHOW ALL STAGES OF WORKING.



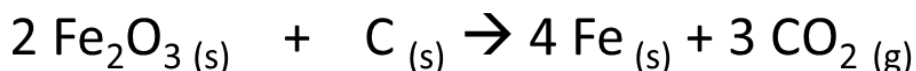
- b) A student has 200 g of Sodium (Na), what mass of sodium oxide (Na₂O) will they produce? SHOW ALL STAGES OF WORKING.



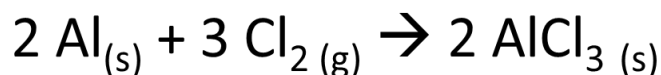
c) A fire produced 170 g of carbon monoxide via incomplete combustion, how many grams of oxygen are needed to convert it fully to CO₂?
SHOW ALL STAGES OF WORKING.



d) What mass of carbon is required to react with 1000 g of iron oxide?
SHOW ALL STAGES OF WORKING.



e) What mass of aluminium is required to produce 500 g of aluminium chloride? SHOW ALL STAGES OF WORKING.



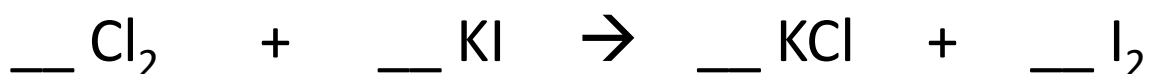
Balancing equations using moles

You can use mole values to balance an equation. The mole values will follow the same ratio as the balancing numbers in the equation.

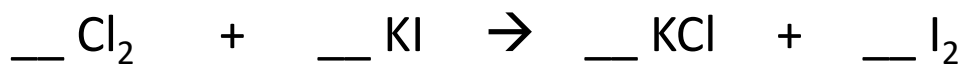
Example Question:

In a reaction 142 g of chlorine reacts with 620 g of potassium iodide to produce 298 g of potassium chloride and 508 g of iodine. Use these values to show how you could balance the equation.

$M_r \text{ Cl}_2 = 71 \text{ g/mol}$, $M_r \text{ KI} = 155 \text{ g/mol}$, $M_r \text{ KCl} = 74.5 \text{ g/mol}$, $M_r \text{ I}_2 = 254 \text{ g/mol}$



1. Write mass, M_r and mol down in a column underneath everything, then fill with known values from the question.

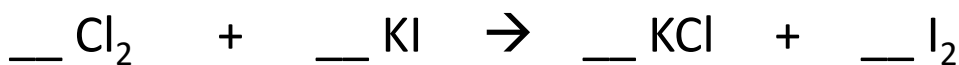


Mass: 142 g Mass: 620 g Mass: 298 g Mass: 508 g

M_r : 71 g/mol M_r : 155 g/mol M_r : 74.5 g/mol M_r : 254 g/mol

Mol: Mol: Mol: Mol:

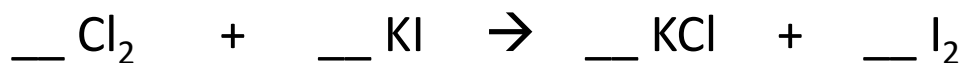
2. Calculate moles for each using $\text{mol} = \text{mass}/M_r$.



Mass: 142 g Mass: 620 g Mass: 298 g Mass: 508 g
 \div \div \div \div
 M_r : 71 g/mol M_r : 155 g/mol M_r : 74.5 g/mol M_r : 254 g/mol

Mol: 2 mol Mol: 4 mol Mol: 4 mol Mol: 2 mol

3. Divide each mole value by whichever mole value in the row is smallest to get the simplest whole number ratio.



Mass: 142 g Mass: 620 g Mass: 298 g Mass: 508 g

M_r : 71 g/mol M_r : 155 g/mol M_r : 74.5 g/mol M_r : 254 g/mol

Mol: 2 mol \div 2 mol Mol: 4 mol \div 2 mol Mol: 4 mol \div 2 mol Mol: 2 mol \div 2 mol

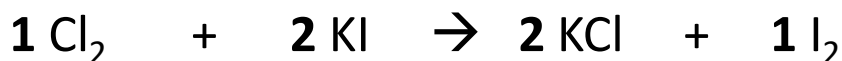
1

2

2

1

4. These are the balancing numbers for the equation.



Task 13: Use the values to balance the equations:

- a) 120 g of nitrogen monoxide (M_r 30 g/mol), decomposes to produce 56 g of nitrogen (M_r 28 g/mol) and 64 g of oxygen (M_r 32 g/mol). Use these values to show how you can balance the equation.



b) 378 g of nitric acid (M_r 63 g/mol) reacts with 120 g of calcium (M_r 40 g/mol) to produce 492 g of calcium nitrate (M_r 164 g/mol) and 6 g of hydrogen (M_r 2 g/mol). Use these values to show how you can balance the equation.



c) 88 g of propane (M_r 44 g/mol) reacts with 320 g of oxygen (M_r 32 g/mol) to produce 264 g of carbon dioxide (M_r 44 g/mol) and an unknown mass of water (M_r 18 g/mol)

1. Use basic law of conservation of mass to work out the mass of water formed.

2. Use these values to show how you can balance the equation.



Concentrations in g/dm³

Concentrations of solutions in chemistry are measured in “grams per cubic decimetre” written as g/dm³. A cubic decimetre or dm³ is 1000 cm³. You need to be able to convert cm³ into cubic decimetres, and vice versa.

Example 1:

A solution has a volume of 75 cm³, what is this volume in cubic decimetres?

$$\text{Volume in dm}^3 = \frac{75 \text{ cm}^3}{1000 \text{ cm}^3/\text{dm}^3} = 0.075 \text{ dm}^3$$

Example 2:

A solution has a volume of 2.3 dm³, what is this volume in cubic centimetres?

$$\text{Volume in cm}^3 = 2.3 \text{ dm}^3 \times 1000 \text{ cm}^3/\text{dm}^3 = 2300 \text{ cm}^3$$

Concentrations in chemistry are measured in g/dm³, that's the number of grams dissolved in one cubic decimetre. Therefore a more concentrated solution will have a higher number of grams dissolved in every cubic decimetre, so will have a larger number of g/dm³.

To calculate concentration all you need to do is divide the number of grams by the number of cubic decimetres.

Example 3:

A student dissolved 10g of chlorine in 200 cm³, calculate the concentration in g/dm³.

1. Convert cm³ to dm³

$$\text{Volume in dm}^3 = \frac{200 \text{ cm}^3}{1000 \text{ cm}^3/\text{dm}^3} = 0.2 \text{ dm}^3$$

2. Divide mass in g by volume in dm³.

$$\text{Concentration in g/dm}^3 = \frac{10 \text{ g}}{0.2 \text{ dm}^3} = 50 \text{ g/dm}^3$$

So: Concentration (g/dm³) = $\frac{\text{Mass (g)}}{\text{Volume (dm}^3\text{)}}$

Task 14: Concentrations of solutions

- a) Write the equation for concentration in g/dm^3 :
- b) Write this equation rearranged for mass in g as the subject:
- c) Write this equation rearranged for volume in dm^3 as the subject:
- d) How many cubic centimetres are in a cubic decimetre?
- e) Convert the following volumes to cubic decimetres:
i) 700 cm^3
ii) 25 cm^3
iii) 2500 cm^3
- f) Convert the following volumes to cubic decimetres:
i) 2.8 dm^3
ii) 0.010 dm^3
iii) 0.5 dm^3
- g) What is the concentration of the solution formed when 5 g of iodine are dissolved in 1500 cm^3 ?
- h) What is the concentration in g/dm^3 of a solution formed when 60 g of copper sulfate is dissolved in 700 cm^3 ?

- i) A solution of copper sulfate has a concentration of 1.5 g/dm^3 , what mass of copper sulfate is dissolved in 50 cm^3 ?**
- j) A 0.5 g/dm^3 solution of sodium hydroxide is in a 1 dm^3 flask. If you were to take 40 cm^3 of this solution, what mass of sodium hydroxide would be dissolved in the 40 cm^3 ?**
- k) A student made a 0.25 g/dm^3 solution using 50 g of iron sulfate, what volume in dm^3 did they make it up to?**

Notes:

Answers

Task 1

- a) 2
- b) 3
- c) 1
- d) 3
- e) 3

Task 2

- a) Fe = 1, Cl = 3, Total = 4
- b) H = 2, S = 1, O = 4, Total = 7
- c) Ag = 1, N = 1, O = 3, Total = 5
- d) K = 2, S = 1, O = 4, Total = 7
- e) C = 1, H = 4, Total = 5
- f) N = 1, H = 3, Total = 4
- g) Si = 1, O = 2, Total = 3

Task 3

- a) Mg = 1, N = 2, O = 6, Total = 9
- b) Ca = 1, O = 2, H = 2, Total = 5
- c) Fe = 1, C = 6, O = 12, Total = 19
- d) Al = 2, C = 3, O = 9, Total = 14

Task 4

- a) 2 : 3 : 2
- b) 1 : 2 : 1 : 1
- c) 1 : 1 : 2
- d) 1 : 2 : 2
- e) 2 : 3 : 3 : 4
- f) 2 : 2 : 2 : 1

Task 5

- a) 162.5 g/mol
- b) 98 g/mol
- c) 170 g/mol
- d) 174 g/mol
- e) 16 g/mol
- f) 17 g/mol
- g) 60 g/mol
- h) 148 g/mol
- i) 74 g/mol
- j) 320 g/mol
- k) 234 g/mol

Task 6

- a) 34.5 %
- b) 65.3 %
- c) 2.8%
- d) 15.4 %

Task 7

- a) Mass = $M_r \times \text{mol}$
- b) Mol = mass / M_r
- c) M_r = mass / mol
- d) i) 1.25 mol
ii) 1.54×10^{-6} mol
iii) 1.85×10^6 mol

Task 7 Continued....

- e) i) 29.5 g
ii) 12 g
iii) 1632 g

Task 8

- a) 0.94 mol
- b) 4.9 mol
- c) 5.1 mol
- d) 153 g
- e) 322.5 g
- f) 534 g
- g) 17 g/mol therefore NH_3 or OH^- (accept other correct)
- h) 30 g/mol therefore NO (accept other correct)

Task 9

- a) 6.02×10^{23}
- b) Grams
- c) Atoms, ions or molecules
- d) 3.82×10^{-23} g
- e) 2.66×10^{-23} g
- f) 1.06×10^{-23} g
- g) 2

Task 10

- a) $230 + 80 = 310$, so reactant mass equals product mass.
- b) 36 g
- c) 308 g
- d) 180 tonnes

Task 11

- a) Carbon dioxide is a product and is a gas, so it escapes and is not weighed at the end of the reaction.
- b) Chlorine is a reactant and is a gas, so is not weighed at the start but is weighed when it becomes part of the solid product.
- c) Will appear to decrease in mass as carbon dioxide is a product and is a gas, so it escapes and is not weighed at the end of the reaction.
- d) Will appear to increase in mass as fluorine is a reactant and a gas, so is not weighed at the start but is weighed when it becomes part of the solid product.

Task 12

- a) 316.6r g
- b) 269.6r g
- c) 97.1 g
- d) 37.8 g
- e) 101.1 g

Task 13

- a) 4 mol : 2 mol : 2 mol
2 : 1 : 1
- b) 6 mol : 3 mol : 3 mol : 3 mol
2 : 1 : 1 : 1
- c) 1. Water = 144g
2.
2 mol : 10 mol : 6 mol : 8 mol
1 : 5 : 3 : 4

Task 14

- a) Concentration = mass / volume
- b) Mass = concentration x volume
- c) Volume = mass / concentration
- d) 1000 cm^3
- e) i) 0.7 dm^3
ii) 0.025 dm^3
iii) 2.5 dm^3
- f) i) 2800 cm^3
ii) 10 cm^3
iii) 500 cm^3
- g) $3.3r \text{ g/dm}^3$
- h) 85.7 g/dm^3
- i) 0.075 g
- j) 0.02 g/dm^3
- k) 200 dm^3

This is a working document so if you spot any errors in the text or mark scheme please email:

Ltull@greenswardacademy.org

Revision 1.1
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The Periodic Table of Elements

1	2	3	4	5	6	7	0										
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18								
19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109	110 Ds darmstadtium 110	111 Rg roentgenium 111	112 Cn copernicium 112	113 Nh nihonium 113	114 Fl flerovium 114	115 Mc moscovium 115	116 Lv livermorium 116	117 Ts tennessine 117	118 Og oganeson 118

1	H	hydrogen	1
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Key

relative atomic mass
atomic symbol
 name
 atomic (proton) number