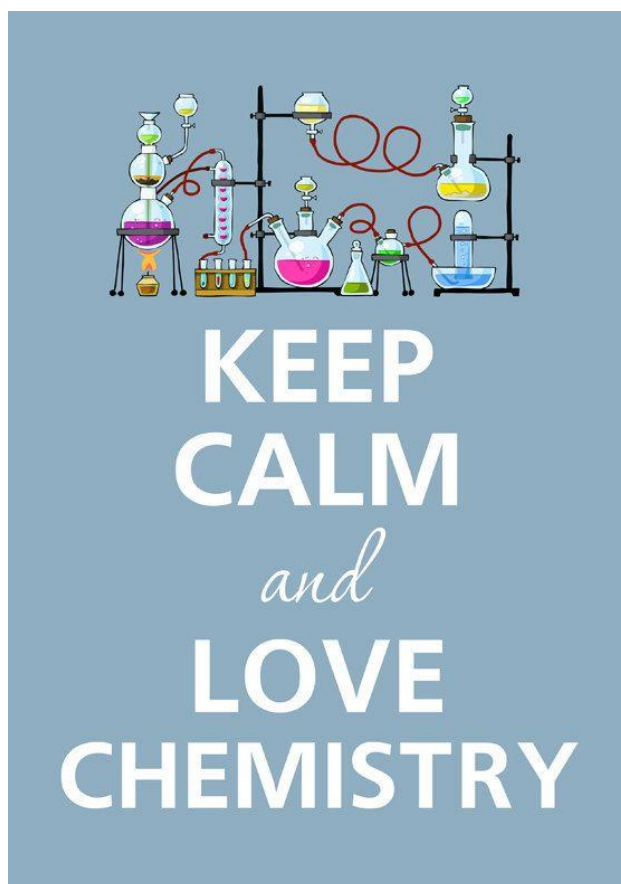


So you are considering A Level Chemistry at King Ecgbert School?



Chemistry A level Transition Work -Compulsory Booklet

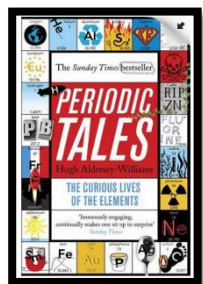
This pack contains a compulsory programme of activities and resources to prepare you to start your A level in Chemistry in September. Follow the instructions given on each page. Keep all of the work you are asked to complete in a safe place, you will be given instructions on how to submit it at a later date.

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Book Recommendations (Try and read one of the following books, you don't need to purchase these, several are available to borrow as ebooks from Sheffield or Derbyshire libraries with a library card. There are also cheap Kindle versions available if you do want your own copy)

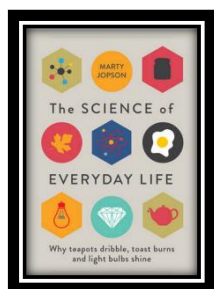
Periodic Tales: The Curious Lives of the Elements (**Paperback**) **Hugh Aldersey-Williams**



ISBN-10: 0141041455

This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

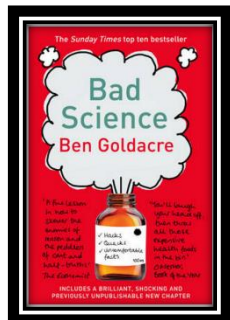
The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine (**Hardback**) **Marty Jopson**



ISBN-10: 1782434186

The title says it all really, lots of interesting stuff about the things around you home!

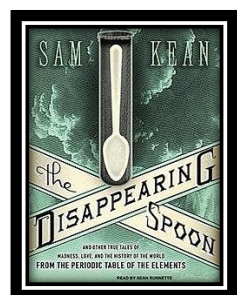
Bad Science (**Paperback**) **Ben Goldacre**



ISBN-10: 000728487X

Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound 'sciency'.

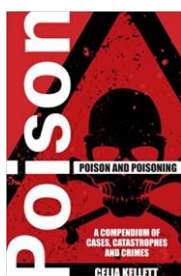
The Disappearing Spoon (**Paperback**) **Jim Clark**



ISBN-10: 0316388270

Why did Gandhi hate iodine (I, 53)? Why did the Japanese kill Godzilla with missiles made of cadmium (Cd, 48)? How did radium (Ra, 88) nearly ruin Marie Curie's reputation? And why did tellurium (Te, 52) lead to the most bizarre gold rush in history?

Poison and Poisoning **by Celia Kellett**



ISBN-10: 1906373965

In this fascinating guide to poisons, Celia Kellett provides information and entertainment in equal measure as she explains clearly what all the different poisons are and how they work, giving us all the gory detail of how, by accident or design, they have led to the demise of so many people

Videos to watch online (Watch at least 3 of these)

Rough science – the Open University – 34 episodes available

Real scientists are ‘stranded’ on an island and are given scientific problems to solve using only what they can find on the island.

Great fun if you like to see how science is used in solving problems.

There are six series in total

<http://bit.ly/pixlchemvid1a>

or

<https://www.youtube.com/watch?v=IUoDWAAt259I>

A thread of quicksilver – The Open University

A brilliant history of the most mysterious of elements – mercury. This program shows you how a single substance led to empires and war, as well as showing you some of the cooler properties of mercury.

<https://www.youtube.com/watch?v=t46lvTxHHTA>

10 weird and wonderful chemical reactions

10 good demonstration reactions, can you work out the chemistry of any... of them?

<https://www.youtube.com/watch?v=0Bt6RPP2ANI>

Chemistry in the Movies

Dantes Peak 1997: Volcano disaster movie.

Use the link to look at the Science of acids and how this links to the movie.

<http://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantes-peak>

<http://www.flickclip.com/flicks/dantespeak1.html>

<http://www.flickclip.com/flicks/dantespeak5.html>

Fantastic 4 2005 & 2015: Superhero movie

Michio Kaku explains the “real” science behind fantastic four

<https://www.wired.co.uk/article/fantastic-four-science-videos>

Places to go for help

1. The AQA website is a great place to start.

The AS and A-level [Chemistry webpages](#) are aimed at teachers, but you may find them useful too. Information includes:

- The [specification](#) – this explains exactly what you need to learn for your exams.
- [Practice exam papers.](#)
- Lists of [command words](#) and [subject specific vocabulary](#) – so you understand the words to use in exams.
- [Practical handbooks](#) explain the practical work you need to know.
- [Maths skills support.](#)
- [Web resources page](#) with many links to other resources to support study.

2. The Royal Society of Chemistry (RSC)

The RSC do everything from naming new elements and lobbying MPs, to improving funding for research sciences in the UK.

You'll find lots of handy resources on their [website](#).

3. The student room

Join the A-level Chemistry forums and share thoughts and ideas with other students if you're stuck with your homework. Just be very careful not to share any details about your assessments, there are serious consequences if you're caught cheating. Visit thestudentroom.co.uk

4. Textbooks

AQA [approved textbooks](#) are published by Collins, Hodder and Oxford University Press. **You will be provided with your own textbooks for a small deposit and will have access to online ones too, please do not feel you have to buy your own.**

5. Revision guides

These are great if you want a quick overview of the course when you're revising for your exams. Remember to use other tools as well, as these aren't detailed enough on their own. **We offer these for sale at a reduced cost at school, there is no need to purchase any in preparation for the course.**

6. YouTube

YouTube has thousands of Chemistry videos. Be careful to look at who produced the video and why, because some videos distort the facts. Check the author, date and comments – these help indicate whether the clip is reliable. @MaChemGuy is our recommended go to YouTuber, he has produced a playlist of videos to get you ready for A level Chemistry which are on our recommended list of activities they can be found here

<https://www.youtube.com/playlist?list=PLi6oabjl6coxUlfu8syK3K0iFXQljwDUM>

The University of Nottingham has a YouTube Channel with lots of interesting videos

<https://www.youtube.com/user/periodicvideos>

7. Current Articles

You will be set current articles, from a variety of sources, to read throughout your course, there are some in the recommended section of the transition work too.

8. Online Resources

You may find these websites/ Youtube sites useful; the school has no links to these websites and we do not regularly check the content.

<http://www.a-levelchemistry.co.uk/1st-year-and-as-level.html>

<http://www.chemguide.co.uk/>

<https://chemrevise.org/revision-guides/>

www.youtube.com/user/MaChemGuy

Useful information and activities

There are now a number of activities for you to complete throughout this resource, look out for text in red which indicates instructions.

Greek letters

Greek letters are used often in science. They can be used as symbols for numbers (such as $\pi = 3.14\dots$), as prefixes for units to make them smaller (eg $\mu\text{m} = 0.000\,000\,001\text{ m}$) or as symbols for particular quantities (such as λ which is used for wavelength).

The Greek alphabet is shown below.

A	α	alpha
B	β	beta
Γ	γ	gamma
Δ	δ	delta
E	ϵ	epsilon
Z	ζ	zeta
H	η	eta
Θ	θ	theta
I	ι	iota
K	κ	kappa
Λ	λ	lambda
M	μ	mu

N	ν	nu
Ξ	ξ	ksi
O	\omicron	omicron
Π	π	pi
P	ρ	rho
Σ	ς or σ	sigma
T	τ	tau
Y	υ	upsilon
Φ	ϕ	phi
X	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Activity 1

A lot of English words are derived from Greek ones, but it's difficult to see as the alphabet is so different.

Many of the Greek letters are pronounced like the start of their name. For example, omega is pronounced "o", sigma is pronounced "s" and lambda is pronounced "l".

See if you can work out what the following Greek words mean by comparing the phonetic spelling with similar English words.

Πυθαγόρας
Ωκεανος
μόνος
Τηλε
Τρωγλοδύτης

Name of a mathematician
Atlantic, Pacific or Arctic...
Single
Far or distant
Cave dweller

SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or °C). Sometimes there are different units available for the same type of measurement, for example ounces, pounds, kilograms and tonnes are all used as units for mass. To reduce confusion and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes. These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China. The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^9	1 000 000 000	
Mega	M	10^6	1 000 000	
kilo	k	10^3	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 2

Which SI unit and prefix would you use for the following quantities?

1. The mass of water in a test tube.
2. The time taken for a solution to change colour.
3. The radius of a gold atom.
4. The volume of water in a burette.
5. The amount of substance in a beaker of sugar.
6. The temperature of the blue flame from a Bunsen burner.

Sometimes, there are units that are used that are not combinations of SI units and prefixes. These are often multiples of units that are helpful to use. For example, one litre is 0.001 m^3 .

Activity 3

Rewrite the following in SI units.

1. 5 minutes
2. 2 days
3. 5.5 tonnes

Activity 4

Rewrite the following quantities.

1. 0.00122 metres in millimetres
2. 104 micrograms in grams
3. 1.1202 kilometres in metres
4. 70 decilitres in millilitres
5. 70 decilitres in litres
6. 10 cm^3 in litres

Important vocabulary for practical work

Activity 5

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different technique or set of equipment is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

Precise language

It is essential to use precise language when you write reports and when you answer examination questions. You must always demonstrate that you understand a topic by using the correct and appropriate terms.

For example, you should take care when discussing bonding to refer to the correct particles and interactions between them.

Also, when discussing the interaction between particles in an ionic solid, you would demonstrate a lack of understanding if you referred to the particles as atoms or molecules instead of ions or the interaction between these ions as intermolecular forces rather than electrostatic forces. In this case, use of the incorrect terms would result in the loss of all the marks available for that part of a question.

Take care also to use the word 'chloride' and not 'chlorine' when referring to the ions in a compound such as sodium chloride. The word 'chlorine' should only be used for atoms or molecules of the element.

The periodic table

The periodic table of elements is shown on the back page of this booklet. The A-level course will build on what you've learned in your GCSE studies.

Activity 6

On the periodic table on the following page:

- Draw a line showing the metals and non-metals.
- Colour the transition metals blue.
- Colour the halogens yellow.
- Colour the alkali metals red.
- Colour the noble gases green.
- Draw a blue arrow showing the direction of periods.
- Draw a red arrow showing the direction of groups.
- Draw a blue ring around the symbols for all gases.
- Draw a red ring around the symbols for all liquids.

1	2	Key										3	4	5	6	7	0
		relative atomic mass symbol name atomic (proton) number										(18)					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
6.9 Li lithium 3	9.0 Be beryllium 4	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	40.1 Ca calcium 20	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	98.0 Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	98.0 Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La * lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	209.0 Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac † actinium 89	[267] Rf rutherfordium 104	[268] Db dubnium 105	[271] Sg seaborgium 106	[272] Bh bohrium 107	[270] Hs hassium 108	[276] Mt meitnerium 109	[281] Ds darmstadtium 110	[280] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						
* 58 – 71 Lanthanides		140.1 Ce cerium 58	144.2 Nd neodymium 60	149.9 Pr praseodymium 59	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.1 Yb ytterbium 70	175.0 Lu lutetium 71			
† 90 – 103 Actinides		232.0 Th thorium 90	238.0 U uranium 92	231.0 Pa protactinium 91	244 Pu plutonium 94	243 Am americium 95	247 Cm curium 96	247 Bk berkelium 97	251 Cf californium 98	252 Es einsteinium 99	257 Fm fermium 100	258 Md mendelevium 101	259 No nobelium 102	262 Lr lawrencium 103			

Activity 7

Use the periodic table to find the following:

1. The atomic number of: osmium, sodium, lead, chlorine.
2. The relative atomic mass of: helium, barium, europium, oxygen.
3. The number of protons in: mercury, iodine, calcium.
4. The symbol for: gold, lead, copper, iron.
5. The name of: Sr, Na, Ag, Hg.
6. THInK can be written using a combination of the symbols for Thorium, Indium and Potassium (ThInK). Which combinations of element symbols could be used to make the following words?

AMERICA, FUN, PIRATE, LIFESPAN, FRACTION, EROSION, DYNAMO

Activity 8: research activity

Use your online searching abilities to see if you can find out as much about the topic as you can. Remember if you are a prospective A level chemist, you should aim to push your knowledge.

Choose 2 of the following tasks and make a 1-page summary for each one you research using Cornell notes:

<http://coe.jmu.edu/learningtoolbox/cornellnotes.html>

Task 1: The chemistry of fireworks

What are the component parts of fireworks? What chemical compounds cause fireworks to explode? What chemical compounds are responsible for the colour of fireworks?

Task 2: Why is copper sulfate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

Task 3: Aspirin

What was the history of the discovery of aspirin, how do we manufacture aspirin in a modern chemical process?

Task 4: The hole in the ozone layer

Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?

Task 5: ITO and the future of touch screen devices

ITO – indium tin oxide is the main component of touch screen in phones and tablets. The element indium is a rare element and we are rapidly running out of it. Chemists are desperately trying to find a more readily available replacement for it. What advances have chemists made in finding a replacement for it?

Relative atomic mass (A_r)

If there are several isotopes of an element, the relative atomic mass will take into account the proportion of atoms in a sample of each isotope. For example, chlorine gas is made up of 75% of chlorine-35 $^{35}_{17}\text{Cl}$ and 25% of chlorine-37 $^{37}_{17}\text{Cl}$. The relative atomic mass of chlorine is therefore the mean atomic mass of the atoms in a sample, and is calculated by:

$$A_r = \left(\frac{75.0}{100} \times 35 \right) + \left(\frac{25.0}{100} \times 37 \right) = 26.25 + 9.25 = 35.5$$

Activity 9

Use the example above to help you work out the answers to the following questions

1. What is the relative atomic mass of Bromine, if the two isotopes, ^{79}Br and ^{81}Br , exist in equal amounts?
2. Neon has three isotopes. ^{20}Ne accounts for 90.9%, ^{21}Ne accounts for 0.3% and the last 8.8% of a sample is ^{22}Ne . What is the relative atomic mass of neon?
3. Magnesium has the following isotope abundances: ^{24}Mg : 79.0%; ^{25}Mg : 10.0% and ^{26}Mg : 11.0%. What is the relative atomic mass of magnesium?
4. Boron has two isotopes, ^{10}B and ^{11}B . The relative atomic mass of boron is 10.8. What are the percentage abundances of the two isotopes?
5. Copper's isotopes are ^{63}Cu and ^{65}Cu . If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Relative formula mass (M_r)

Carbon dioxide, CO_2 has 1 carbon atom ($A_r = 12.0$) and two oxygen atoms ($A_r = 16.0$). The relative formula mass is therefore

$$M_r = (12.0 \times 1) + (16.0 \times 2) = 44.0$$

Magnesium hydroxide $\text{Mg}(\text{OH})_2$ has one magnesium ion ($A_r = 24.3$) and two hydroxide ions, each with one oxygen ($A_r = 16.0$) and one hydrogen ($A_r = 1.0$).

The relative formula mass is therefore:

$$(24.3 \times 1) + (2 \times (16.0 + 1.0)) = 58.3$$

Activity 10

Use one of the periodic tables in this booklet to calculate the relative formula mass of the following compounds your answers should all be to 1dp:

1. Magnesium oxide MgO
2. Sodium hydroxide NaOH
3. Copper sulfate CuSO_4
4. Ammonium chloride NH_4Cl
5. Ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$

Common ions

Positive ions (cations)		Negative ions (anions)	
Name	Symbol	Name	Symbol
Hydrogen	H ⁺	Hydroxide	OH ⁻
Sodium	Na ⁺	Chloride	Cl ⁻
Lithium	Li ⁺	Bromide	Br ⁻
Silver	Ag ⁺	Oxide	O ²⁻
Magnesium	Mg ²⁺	Hydrogencarbonate	HCO ₃ ⁻
Calcium	Ca ²⁺	Nitrate	NO ₃ ⁻
Zinc	Zn ²⁺	Sulfate	SO ₄ ²⁻
Aluminium	Al ³⁺	Carbonate	CO ₃ ²⁻
Ammonium	NH ₄ ⁺	Phosphate	PO ₄ ³⁻

Some elements have more than one charge. For example, iron can form ions with a charge of +2 or +3. Compounds containing these are named Iron(II) and Iron(III) respectively. Other common elements with more than one charge include:

Chromium(II) and chromium(III)

Copper(I) and copper(II)

Lead(II) and lead(IV)

Activity 11

On the periodic table on the following page, colour elements that form one atom ions (eg Na⁺ or O²⁻) according to the following key:

Charge	Colour
+1	red
+2	yellow
+3	green
-1	blue
-2	brown

Ionic compounds must have an overall neutral charge. The ratio of cations to anions must mean that there is as many positives as negatives. For example:

NaCl	
Na ⁺	Cl ⁻
+1	-1

MgO	
Mg ²⁺	O ²⁻
+2	-2

MgCl ₂	
	Cl ⁻
Mg ²⁺	Cl ⁻
+2	-2

Activity 12

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Iron(II) sulfate
8. Iron(III) sulfate

Diatomic molecules

A number of atoms exist in pairs as diatomic (two atom) molecules. The common ones that you should remember are:

Hydrogen H₂, Oxygen O₂, Fluorine F₂, Chlorine Cl₂, Bromine Br₂, Nitrogen N₂ and Iodine I₂

Common compounds

There are several common compounds from your GCSE studies that have names that do not help to work out their formulas. For example, water is H_2O .

Activity 13: Research activity

Use the internet or your knowledge to state the formulas of the following compounds?

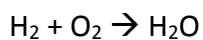
1. Methane
2. Ammonia
3. Hydrochloric acid
4. Sulfuric acid
5. Sodium hydroxide
6. Potassium manganate(VII)
7. Hydrogen peroxide

Balancing equations

Chemical reactions never create or destroy atoms. They are only rearranged or joined in different ways.

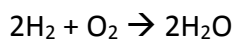
When hydrogen and oxygen react to make water: hydrogen + oxygen

→ water



There are two hydrogen atoms on both sides of this equation, but two oxygen atoms on the left and only one on the right. This is not balanced.

This can be balanced by writing:



The reactants and products in this reaction are known and you can't change them. The compounds can't be changed and neither can the subscripts because that would change the compounds. So, to balance the equation, a number must be added in front of the compound or element in the equation. This is a coefficient. Coefficients show how many atoms or molecules there are.

Activity 14

Write balanced symbol equations for the following reactions. You'll need to use the information on the previous pages to work out the formulas of the compounds. Remember some of the elements may be diatomic molecules.

1. Aluminium + oxygen \rightarrow aluminium oxide
2. Methane + oxygen \rightarrow carbon dioxide + water
3. Aluminium + bromine \rightarrow aluminium bromide
4. Calcium carbonate + hydrochloric acid \rightarrow calcium chloride + water + carbon dioxide
5. Aluminium sulfate + calcium hydroxide \rightarrow aluminium hydroxide + calcium sulfate

Harder:

6. Silver nitrate + potassium phosphate \rightarrow silver phosphate + potassium nitrate

More challenging:

7. Potassium manganate(VII) + hydrochloric acid \rightarrow
potassium chloride + manganese(II) chloride + water + chlorine

Moles

A mole is the amount of a substance that contains 6.02×10^{23} particles.

The mass of 1 mole of any substance is the relative formula mass (M_r) in grams.

Examples:

One mole of carbon contains 6.02×10^{23} particles and has a mass of 12.0 g

Two moles of copper contains 12.04×10^{23} particles, and has a mass of 127 g 1 mole of water contains 6.02×10^{23} particles and has a mass of 18 g

The amount in moles of a substance can be found by using the formula:

$$\text{Amount in moles of a substance} = \frac{\text{mass of substance}}{\text{relative formula mass}}$$

Activity 15

Fill in the table.

Substance	Mass of substance	Amount/moles	Number of particles
Helium			18.12×10^{23}
Chlorine	14.2		
Methane		4	
Sulfuric acid	4.905		

Empirical formula (Those of you who have done the AQA exam board will not have seen this before, we will cover it again in more detail)

If you measure the mass of each reactant used in a reaction, you can work out the ratio of atoms of each reactant in the product. This is known as the empirical formula. This may give you the actual chemical formula, as the actual formula may be a multiple of this. For example, hydrogen peroxide is H_2O_2 but would have the empirical formula HO .

Use the following to find an empirical formula:

1. Write down reacting masses
2. Find the amount in moles of each element
3. Find the ratio of moles of each element

Example:

A compound contains 2.232 g of iron, 1.284 g of sulfur and 1.920 g of oxygen. What is the empirical formula?

Element	Iron	Sulfur	Oxygen
mass/relative atomic mass	2.232/55.8	1.284/32.1	1.920/16.0
Amount in moles	0.040	0.040	0.120
Divide by smallest value	0.040/0.040	0.040/0.040	0.120/0.040
Ratio	1	1	3

So the empirical formula is FeSO_3 .

If the question gives the percentage of each element instead of the mass, replace mass with the percentage of an element present and follow the same process.

Activity 16

Work out the following empirical formulas:

1. The smell of a pineapple is caused by ethyl butanoate. A sample is known to contain only 0.180 g of carbon, 0.030 g of hydrogen and 0.080 g of oxygen. What is the empirical formula of ethyl butanoate?
2. Find the empirical formula of a compound containing 0.0578 g of titanium, 0.288 g of carbon, 0.012 g of hydrogen and 0.384 g of oxygen.
3. 300 g of a substance are analysed and found to contain only carbon, hydrogen and oxygen. The sample contains 145.9 g of carbon and 24.32 g of hydrogen. What is the empirical formula of the compound?
4. Another 300 g sample is known to contain only carbon, hydrogen and oxygen. The percentage of carbon is found to be exactly the same as the percentage of oxygen. The percentage of hydrogen is known to be 5.99%. What is the empirical formula of the compound?

