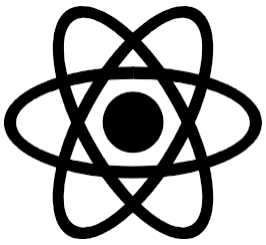
Bridging Course for Chemistry



Chemistry at Durham Johnston

Introduction

Well done on making the choice to study Chemistry with us at Durham Johnston. This booklet will give you a brief introduction to the AS and A-level courses together with some questions to get you started on your studies.

At Durham Johnston we follow the OCR Chemistry A specification. You will have 5 lessons of chemistry per week with 2 teachers.

It is possible to study Chemistry as either an AS or full A-level: the AS level includes the teaching of units 1-4, with the full A-level adding units 5 and 6 in the 2nd year. The modules are:

Unit	Content
1	Development of practical skills in chemistry
2	Foundations in chemistry
3	Periodic Table and energy
4	Core organic chemistry
5	Physical chemistry and transition elements
6	Organic chemistry and analysis

Exams

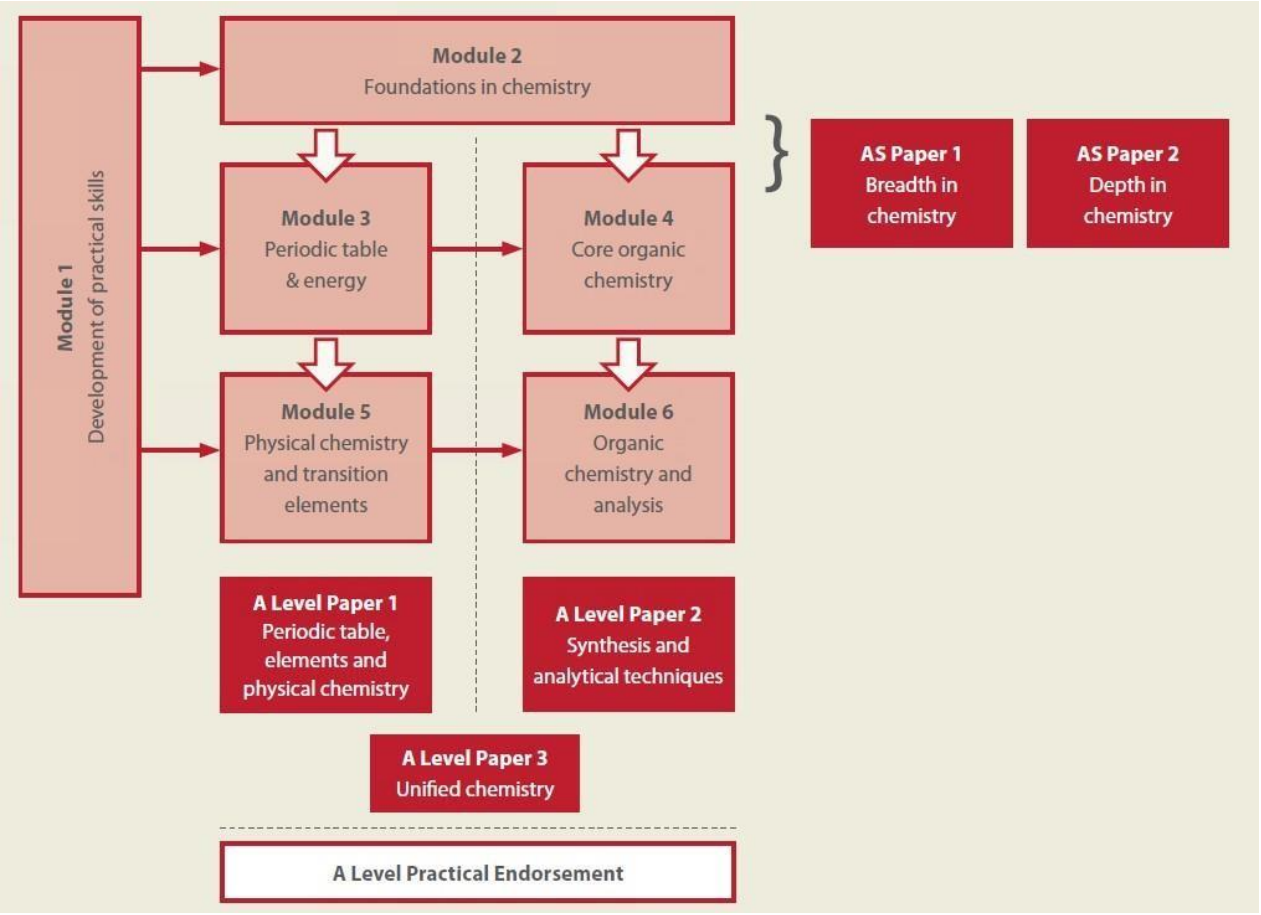
At AS level there are 2 exams with both papers assessing the content of modules 1-4.

Component	Duration	Marks	Weighting
01 (Breadth in chemistry)	1h 30	70	50%
02 (Depth in chemistry)	1h 30	70	50%

At A-level there are 3 exams, split into discrete module content as follows:

Component	Duration	Marks	Weighting
01-Periodic table, elements and physical chemistry	2h 15	100	37%
02 – Synthesis and analytical techniques	2h 15	100	37%
03 – Unified chemistry	1h 30	70	26%

The diagram below shows how the content fits together for both the AS and A-level chemistry qualifications.

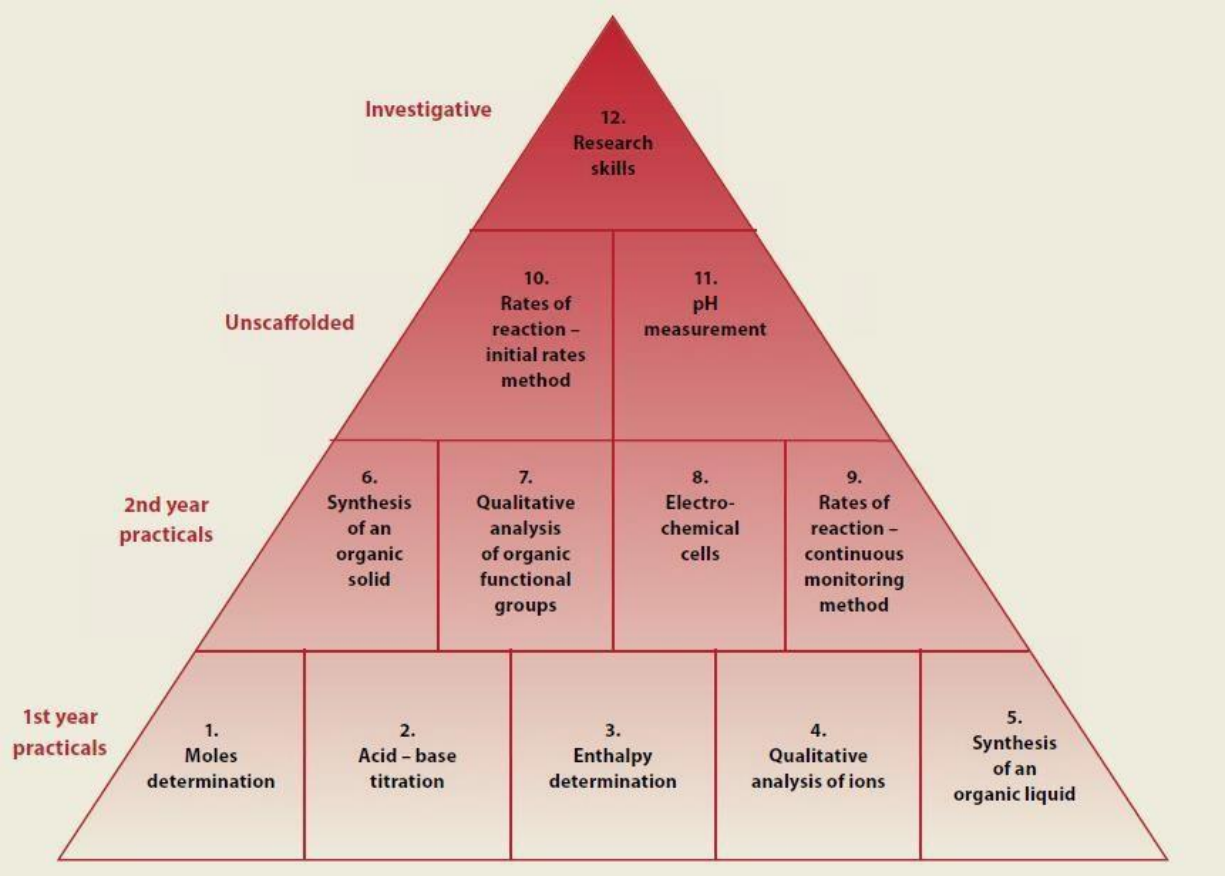


Practical

Chemistry is a practical subject and practical skills are taught throughout the course. There are no assessed practicals as part of the qualification, the

practical content is assessed within the written exam papers, and the practical endorsement part of the course will be reported as a pass alongside the examination result at A level if students have been successful across the 12 skill areas.

The pyramid below shows how the 12 skill areas are delivered through the course.



Want some more information?

The website for OCR can be found at: www.ocr.org.uk

Links to the chemistry specifications are below, the A-level specification includes the content for the AS specification too (it's units 1-4) only.

The AS chemistry specification can be found at: https://www.ocr.org.uk/qualifications/as-and-a-level/chemistry-a-h032-h432- from-2015/#as-level

The A-level chemistry specification can be found at:

https://www.ocr.org.uk/qualifications/as-and-a-level/chemistry-a-h032-h432- from-2015/

To start getting into the topics that will be covered at A-level, you could access free preparation materials on Seneca or revisit the GCSE content using the BBC bitesize material.

Important: If you have not done separate chemistry GCSE then you should work through the separate chemistry sections on BBC bitesize https://www.bbc.co.uk/bitesize/topics/zxsyh39 and https://www.bbc.co.uk/bitesize/topics/z398rwx as some of these ideas have not been covered at GCSE. Pay particular attention to 'hydrocarbons', 'alcohols and carboxylic acids', 'equilibria' and 'further chemistry calculations'. Remember to write anything down that you don't understand so that you can ask us.

Finally, Chemistry is not an easy subject at A-level so you will need to work hard. However, we are all here to support you and we offer regular drop-in sessions as well as more bespoke support when it is needed.

The following pages outline some GCSE content which you should review and prepare answers for when we begin the course. You should complete your work on A4 paper.

If you have any questions about the content, then please write them down and do remember to ask us when we return.

Enjoy the rest of the summer – we look forward to working with you soon. Good Luck!

1 - FORMULAE

If you are serious about doing A level Chemistry, you **MUST** be able to write a formula without a second thought. It is the single most essential skill for an A level chemist.

You have to know and be able to use the information on this page – you should not be looking it up. There is no data sheet with ion charges at A level.

If you can't write a formula in an instant, **DROP CHEMISTRY NOW** and choose something else.

Elements

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
He helium Ne neon Ar argon Kr krypton Xe xenon Rn radon	H_2 hydrogen N_2 nitrogen O_2 oxygen F_2 fluorine Cl_2 chlorine Br_2 bromine I_2 iodine P_4 phosphorus S_8 sulfur	There are no ionic elements!!	The formula is just the symbol, e.g. Mg magnesium Fe iron Na sodium Ni nickel	The formula is just the symbol C diamond C graphite C graphine Si silicon

Compounds

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
There are no monatomic compounds!!	Some common molecular compounds: CO_2 carbon dioxide CO carbon monoxide NO nitrogen monoxide NO_2 nitrogen dioxide SO_2 sulfur dioxide SO_3 sulfur trioxide NH_3 ammonia CH_4 methane H_2S hydrogen sulfide	These have to be worked out using ion charges – you have to know these at AS/A level! LEARN them ASAP. Note these acids: HCl hydrochloric acid H_2SO_4 sulfuric acid HNO_3 nitric acid H_3PO_4 phosphoric acid	There are no metallic compounds!!	SiO_2 silicon dioxide

Positive ions		Negative ions	
Group 1 ions: Li^+ lithium Na^+ sodium K^+ potassium Group 2 ions: Mg^{2+} magnesium Ca^{2+} calcium Ba^{2+} barium	Group 3 ions: Al^{3+} aluminium Other common ions Mg^{2+} silver(I) Zn^{2+} zinc(II) NH_4^+ ammonium H^+ hydrogen	Group 7 ions: F^- fluoride Cl^- chloride Br^- bromide I^- iodide Group 6 ions: O^{2-} oxide S^{2-} sulfide	Other common ions NO_3^- nitrate SO_4^{2-} sulfate CO_3^{2-} carbonate HCO_3^- hydrogencarbonate OH^- hydroxide H^- hydride PO_4^{3-} phosphate

TASK 1 – WRITING FORMULAS OF IONIC COMPOUNDS

1) silver(I) bromide ……..
2) sodium carbonate ……..
3) potassium oxide ……..
4) iron(III) oxide ……..
5) chromium(III) chloride ……..
6) calcium hydroxide ……..
7) aluminium nitrate ……..
8) sodium sulfate ……..
9) lead(II) oxide ……..
10) sodium phosphate ……
11) zinc hydrogencarbonate ……..
12) ammonium sulfate ……..
13) gallium hydroxide ……..
14) strontium selenide ……..
15) radium sulfate ……
16) sodium nitride ……

TASK 2 – WRITING FORMULAS 1

1) lead(IV) oxide ……..
2) copper ……..
3) sodium ……..
4) ammonium chloride ……..
5) ammonia ……..
6) sulfur ……..
7) sulfuric acid ……..
8) neon ……..
9) silica ……..
10) silicon ……..
11) barium hydroxide ……..
12) tin(IV) chloride ……..
13) silver(I) nitrate ……..
14) iodine ……..
15) nickel ……..
16) hydrogen sulfide ……..
17) titanium(IV) oxide ……..
18) lead ……..
19) strontium sulfate ……..
20) lithium ……..

TASK 3 – WRITING FORMULAS 2

1) silver(I) carbonate ……..
2) gold ……..
3) platinum(II) fluoride ……..
4) nitric acid ……..
5) ammonia ……..
6) silicon(IV) hydride ……..
7) phosphorus ……..
8) diamond ……..
9) vanadium(V) oxide ……..
10) cobalt(II) hydroxide ……..
11) barium hydroxide ……..
12) ammonia ……..
13) hydrochloric acid ……..
14) fluorine ……..
15) silicon ……..
16) calcium phosphate ……..
17) rubidium ……..
18) germanium(IV) oxide ……..
19) magnesium astatide ……..
20) nitrogen monoxide ……..

2 - EQUATIONS

From an early age you should have been able to balance chemical equations. However, at A level, you will often need to:

- work out the formulas yourselves
- work out what is made (so you need to know some basic general equations)
- for reactions involving ions in solution, write ionic equations

Some general reactions you should know:

General Reaction	**Examples**
substance + oxygen → oxides	$2\ Mg + O_2 \rightarrow 2\ MgO$ $2\ H_2S + 3\ O_2 \rightarrow 2\ H_2O + 2\ SO_2$ $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
metal + water → metal hydroxide + hydrogen	$2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$
metal + acid → salt + hydrogen	$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$
oxide + acid → salt + water	$MgO + 2\ HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$
hydroxide + acid → salt + water	$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
carbonate + acid → salt + water + carbon dioxide	$CuCO_3 + 2\ HCl \rightarrow CuCl_2 + H_2O + CO_2$
hydrogencarbonate + acid → salt + water + carbon dioxide	$KHCO_3 + HCl \rightarrow KCl + H_2O + CO_2$
ammonia + acid → ammonium salt	$NH_3 + HCl \rightarrow NH_4Cl$
metal carbonate → metal oxide + carbon dioxide (on heating)	$CaCO_3 \rightarrow CaO + CO_2$

TASK 4 – WRITING BALANCED EQUATIONS

1) Balance the following equations.

   a) $Mg + HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

   b) $CuCl_2 + NaOH \rightarrow Cu(OH)_2 + NaCl$

   c) $SO_2 + O_2 \rightarrow SO_3$

   d) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

2) Give balanced equations for the following reactions.

   a) sodium + oxygen → sodium oxide

   b) aluminium + chlorine → aluminium chloride

   c) calcium + hydrochloric acid → calcium chloride + hydrogen

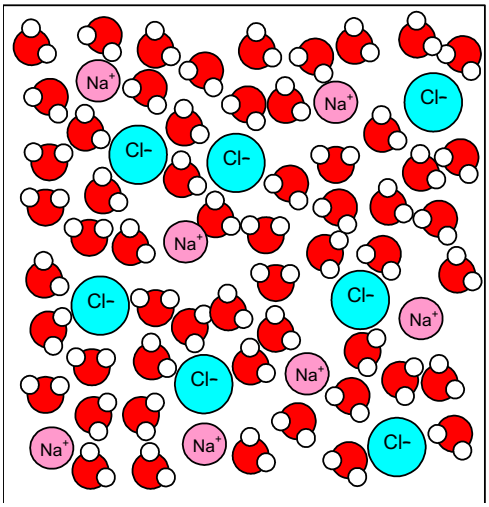
   d) ammonia + sulfuric acid → ammonium sulfate

TASK 5 – WRITING BALANCED EQUATIONS 2

Write balance equations for the following reactions:

1) burning aluminium
2) burning hexane (C_6H_{14})
3) burning ethanethiol (CH_3CH_2SH)
4) reaction of lithium with water
5) reaction of calcium carbonate with nitric acid
6) thermal decomposition of lithium carbonate
7) reaction of ammonia with nitric acid
8) reaction of potassium oxide with sulfuric acid
9) reaction of calcium hydroxide with hydrochloric acid
10) reaction of zinc with phosphoric acid
11) reaction of sodium hydrogencarbonate with sulfuric acid
12) reaction of potassium hydroxide with sulfuric acid

Ionic equations



When an ionic substance dissolves in water, the positive and negative ions separate and become hydrated (they interact with water molecules rather than each other). For example, a solution of sodium chloride could also be described as a mixture of hydrated sodium ions and hydrated chloride ions in water.

In reactions involving ionic compounds dissolved in water, some of the ions may not be involved in the reaction. These are called ***spectator ions***. For such reactions, we can write an ***ionic equation*** that only shows the species that are involved in the reaction.

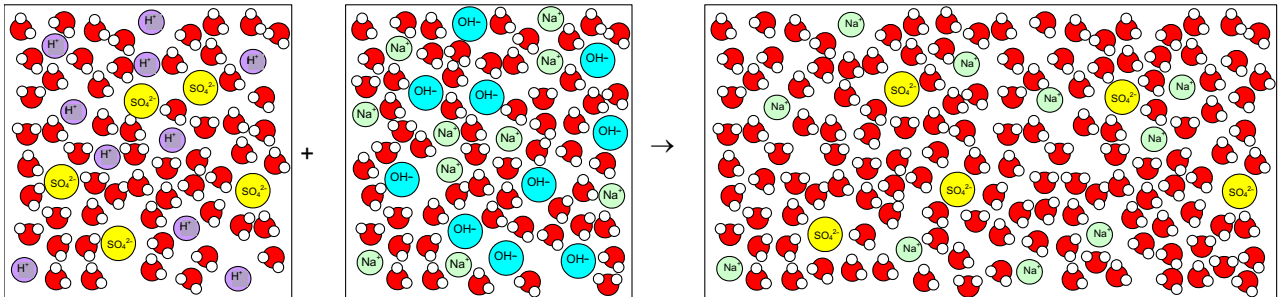
Simple examples are equations for which ionic equations can be written include:

Reactions of acids:

Common ionic equations are:	acid + hydroxide	$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
	acid + carbonate	$2\ H^+(aq) + CO_3^{2-}(aq) \rightarrow\ H_2O(l)\ +\ CO_2(g)$
	acid + hydrogencarbonate	$H^+(aq) + HCO_3^-(aq) \rightarrow\ H_2O(l)\ +\ CO_2(g)$
	acid + ammonia	$H^+(aq) + NH_3(aq) \rightarrow\ NH_4^+(aq)$

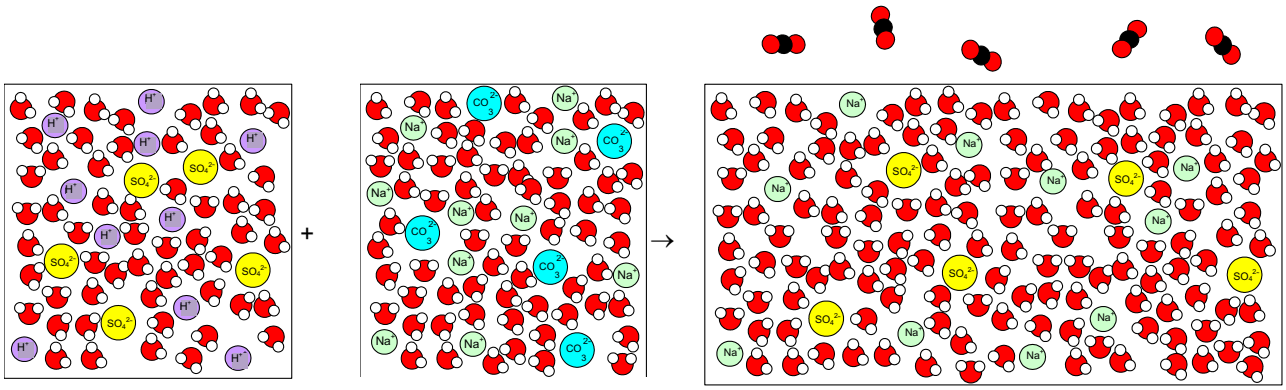
We can even use these ionic equations to work out the ratio in which acids react without writing any equation.

For example, in the reaction of $H_2SO_4(aq)$ with $NaOH(aq)$ we know that one lot of H_2SO_4 contains two lots of H^+ ions. As H^+ ions react with OH^- ions in the ratio 1:1 [$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$] we know that we need two lots of NaOH to provide two lots of OH^- ions to react with the two lots of H^+ ions. Therefore, one lot of H_2SO_4 reacts with two lots of NaOH, i.e. the reacting ratio of H_2SO_4 : NaOH = 1:2



H_2SO_4 (aq) contains H^+(aq) + NaOH (aq) contains OH^-(aq) → $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

the Na^+(aq) and SO_4^{2-}(aq) ions are not involved

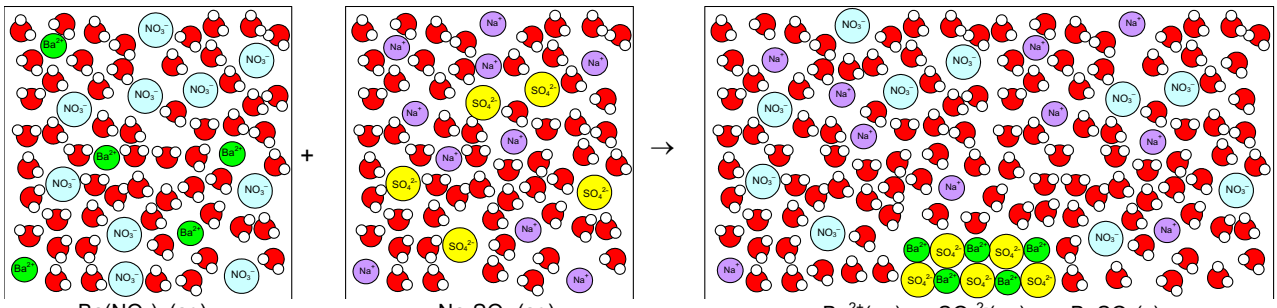


H_2SO_4 (aq) contains H^+(aq) + Na_2CO_3 (aq) contains CO_3^{2-}(aq) → $2\ H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$

the Na^+(aq) and SO_4^{2-}(aq) ions are not involved

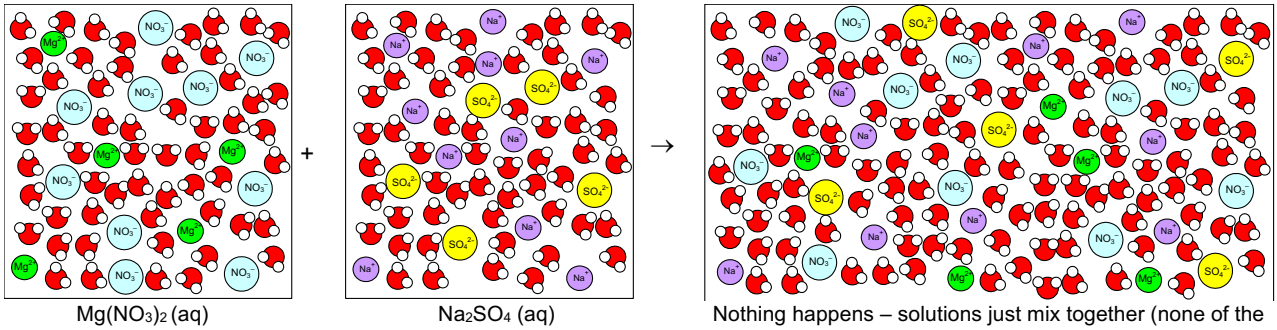
Precipitation reactions

Some salts are insoluble in water. If solutions containing those ions are mixed, the insoluble salt forms as a solid as the solutions are mixed. This solid is known as a precipitate, and the reaction as precipitation.



$Ba(NO_3)_2$ (aq) contains Ba^{2+}(aq) + Na_2SO_4 (aq) contains SO_4^{2-}(aq) → $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

Most salts are soluble in water. Often when solutions of two salts are mixed, no such precipitation reaction will take place and the ions will remain dissolved in water.



$Mg(NO_3)_2$ (aq) + Na_2SO_4 (aq) → Nothing happens – solutions just mix together (none of the combinations of ions give an insoluble compound)

TASK 6 – IONIC EQUATIONS

1) Use your knowledge of ionic equations to give the molar ratio in which the following acids react with bases. Complete the table to show your answers.

Acid	Formula of acid	Base	Formula of base	Molar ratio of acid:base
hydrochloric acid		lithium hydroxide		
sulfuric acid		sodium hydrogencarbonate		
nitric acid		ammonia		
sulfuric acid		potassium carbonate		
nitric acid		strontium hydroxide		

2) Write ionic equations for each of the following reactions.

a) reaction of hydrochloric acid (aq) with potassium hydroxide (aq)

b) precipitation of silver(I) iodide from reaction between silver(I) nitrate (aq) and potassium iodide (aq)

c) reaction of potassium carbonate (aq) with nitric acid (aq)

d) precipitation of calcium hydroxide from reaction between sodium hydroxide (aq) and calcium chloride (aq)

e) reaction of ammonia (aq) with hydrochloric acid (aq)

f) reaction of sodium hydrogencarbonate (aq) with sulfuric acid (aq)

g) precipitation of calcium sulfate from reaction between calcium chloride (aq) and sulfuric acid (aq)

h) precipitation of lead(II) chloride from reaction between lead(II) nitrate (aq) and sodium chloride (aq)

i) reaction of barium hydroxide (aq) with nitric acid (aq)

3 – SIGNIFICANT FIGURES & STANDARD FORM

Standard Form

- Standard form is very useful for writing very large or small numbers.
- They are written in the form A x 10^n where A is a number between 1 and 10.
- n represents the number of places the decimal point is moved (for +n values the decimal point has been moved to the left, for –n values the decimal point has been moved to the right).

Number	3435	1029000	0.025	23.2	0.0000278
Standard form	3.435×10^3	1.029×10^6	2.5×10^{-2}	2.32×10^1	2.78×10^{-5}

- To find the value of n:
  - for numbers greater than 1, n = number of places between first number and decimal place
  - for numbers less than 1, n = number of places from the decimal place to the first number (including that number)

Significant figures

Full number	1 sig fig	2 sig fig	3 sig fig	4 sig fig	5 sig fig
9.378652	9	9.4	9.38	9.379	9.3787
4204274	4000000	4200000	4200000	4204000	4204300
0.903521	0.9	0.90	0.904	0.9035	0.90352
0.00239482	0.002	0.0024	0.00239	0.002395	0.0023948

Significant figures for calculations involving multiplication / division

- Your final answer should be given to the same number of significant figures as the least number of significant figures in the data used.

  e.g. Calculate the average speed of a car that travels 1557 m in 95 seconds.

  average speed = $\frac{1557}{95}$ = 16 m s^{-1} (answer given to 2 sig fig as lowest sig figs in data is 2 sig fig for time)

  e.g. Calculate the average speed of a car that travels 1557 m in 95.0 seconds.

  average speed = $\frac{1557}{95}$ = 16.4 m s^{-1} (answer given to 3 sig fig as lowest sig figs in data is 3 sig fig for time)

Significant figures for calculations involving addition/subtraction ONLY

- Here the number of significant figures is irrelevant – it is about the place value of the data. For example

  e.g. Calculate the total energy released when 263 kJ and 1282 kJ of energy are released.

  Energy released = 263 + 1282 = 1545 kJ (answer is to nearest unit as both values are to nearest unit)

  e.g. Calculate the total mass of calcium carbonate when 0.154 g and 0.01234 g are mixed.

  Mass = 0.154 + 0.01234 = 0.166 g (answer is to nearest 0.001 g as least precise number is to nearest 0.001 g)

TASK 7 – SIGNIFICANT FIGURES & STANDARD FORM

1) Write the following numbers to the quoted number of significant figures.

a) 345789 4 sig figs …… d) 6.0961 3 sig figs ……

b) 297300 3 sig figs …… e) 0.001563 3 sig figs ……

c) 0.07896 3 sig figs …… f) 0.010398 4 sig figs ……

2) Complete the following sums and give the answers to the appropriate number of significant figures.

a) 6125 x 384 …… d) 7550 ÷ 25 ……

b) 25.00 x 0.010 …… e) 0.000152 x 13.00 ……

c) 13.5 + 0.18 …… f) 0.0125 x 0.025 ……

3) Write the following numbers in non standard form.

a) 1.5×10^{-3} …….. d) 5.34×10^{2} ……

b) 4.6×10^{-4} ……..... e) 1.03×10^{6} ……

c) 3.575×10^{5} ……..... f) 8.35×10^{-3} ……

4) Write the following numbers in standard form.

a) 0.000167 …….. d) 34500 ……

b) 0.0524 ……..... e) 0.62 ……

c) 0.000000015 ……..... f) 87000000 ……

5) Complete the following calculations and give the answers to the appropriate number of significant figures.

a) $6.125 \times 10^{-3} \times 3.5$ ……..

b) $4.3 \times 10^{-4} \div 7.00$ ……..

c) $4.0 \times 10^{8} + 35000$ …….....

d) $0.00156 + 2.4 \times 10^{3}$ …….

e) $6.10 \times 10^{-2} - 3.4 \times 10^{-5}$ …….

f) $8.00 \times 10^{-3} \times 0.100 \times 10^{-3}$ …….

4 – RELATIVE MASS

- Most elements are made of up atoms of different isotopes (e.g. chlorine contains both ^{35}Cl and ^{37}Cl atoms)
- The relative atomic mass (A_r) of an element is an average of the mass of the isotopes taking into account the relative abundance of each isotope.

Relative atomic mass, A_r	Average mass of an atom of an element relative to $\frac{1}{12}$th the mass of ^{12}C atom
Relative formula mass, M_r	*If referring specifically to a molecule (relative molecular mass)* Average mass of a molecule of a substance relative to $\frac{1}{12}$th the mass of ^{12}C atom
	More generally for any substance Sum of the relative atomic masses of all the atoms in the formula of a substance

TASK 8 – RELATIVE FORMULA MASS

Calculate the M_r of each of these substances.

1 F_2 ……

2 Fe ……

3 H_2SO_4 ……

4 Al_2O_3 ……

5 $Mg(OH)_2$ ……

6 $Al(NO_3)_3$ ……

7 $(NH_4)_2SO_4$ ……

8 $CuCO_3$ ……

9 $AgNO_3$ ……

10 NH_4NO_3 ……

11 $CuSO_4.5H_2O$ ……

12 magnesium ……

13 oxygen ……

14 sodium bromide ……

15 calcium fluoride ……

16 potassium sulfate ……

17 chlorine ……

18 iron(III) sulfate ……

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	**18**
1 **H** hydrogen 1.0	**2**	**Key** atomic number **Symbol** name relative atomic mass										**13**	**14**	**15**	**16**	**17**	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium 144.9	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.2	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
89 **Ac** actinium	90 **Th** thorium 232.0	91 **Pa** protactinium	92 **U** uranium 238.1	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium