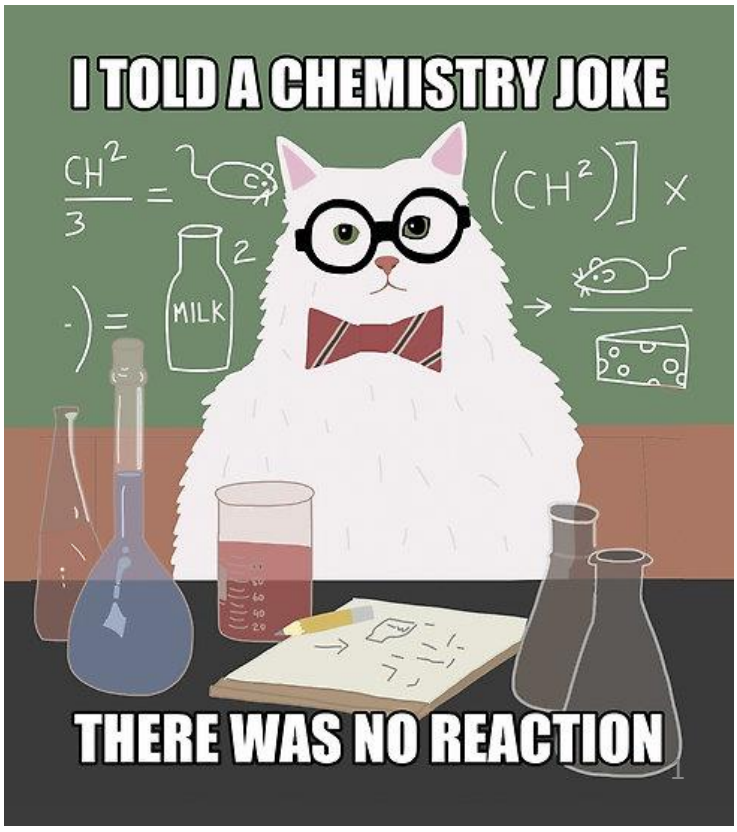
A level Chemistry Transition Work

We are very happy that you are considering to study Chemistry at A level.

Chemistry is a fantastic subject to study, and not just if you are thinking of a future career within Science. You will gain many valuable transferrable skills including problem solving, applying your ideas to new situations as well as becoming competent with practical work.

Over the summer, we are asking you to complete the work in this booklet. There are also a few topics that you will need to research. During the first week of lessons, you will be given a test to assess what you have covered over the summer.

Good luck!
Mrs Carter
Mrs Robertson



Can you see how the periodic table is slightly different from what you would have seen at GCSE?

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 H hydrogen 1.0	2											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		

Key
atomic number
Symbol
name
relative atomic mass

● 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

Formulae of ionic compounds

Practise writing out formulae by using the group numbers of the elements to find out the charge on the ions formed. Remember, *metals* form *positive ions* and *non-metals* form *negative ions*. Then, work out the number of each ion needed to make the charges add up to zero.

What is the formula for potassium oxide?
Potassium is in group 1 so forms an ion with a 1^+ charge, K^+.
Oxygen is in group 6 so forms an ion with a 2^- charge, O^{2-}.

To cancel the charges…

$2 \times K^+ = +2$ and $1 \times O^{2-} = -2$

The formula is $\mathbf{K_2O}$

What is the formula for calcium nitrate?
Calcium forms a Ca^{2+} ion
The nitrate ion has a 1^- charge, NO_3^-

$1 \times Ca^{2+} = +2$ and $2 \times NO_3^- = -2$

In this example, we need to use brackets as the nitrate ion is made up of more than one atom.

The formula is $\mathbf{Ca(NO_3)_2}$

Writing formulae

Positive ions		Negative ions	
Name	Formula	Name	Formula
Hydrogen	H^+	Chloride	Cl^-
Sodium	Na^+	Bromide	Br^-
Silver	Ag^+	Fluoride	F^-
Potassium	K^+	Iodide	I^-
Lithium	Li^+	Hydroxide	OH^-
Ammonium	NH_4^+	Nitrate	NO_3^-
Barium	Ba^{2+}	Oxide	O^{2-}
Calcium	Ca^{2+}	Sulfide	S^{2-}
Copper(II)	Cu^{2+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}	Carbonate	CO_3^{2-}
Zinc	Zn^{2+}		
Lead	Pb^{2+}		
Iron(II)	Fe^{2+}		
Iron(III)	Fe^{3+}		
Aluminium	Al^{3+}		

Use the formulae of common ions to write formulae for the following…

Sodium bromide		Copper (II) oxide	
Potassium sulfate		Iron (III) fluoride	
Calcium fluoride		Aluminium oxide	
Zinc sulfide		Barium nitrate	
Iron (III) nitrate		Copper hydroxide	
Iron (II) oxide		Aluminium hydroxide	
Barium sulfate		Iron (III) sulfate	
Lead iodide		Aluminium carbonate	

You will not get these charges on ions in an exam – you will have to use the periodic table to work some of them out and learn the others!

Equations

It is really important that you become competent with writing equations for different reactions, and this includes word and symbol equations.

Below are some general equations that you need to be aware of.

Acid + metal → salt + hydrogen

Acid + alkali → salt + water

Acid + metal carbonate → salt + water + carbon dioxide

(and metal hydrogen carbonate)

Acid + metal oxide → salt + water

Acid + ammonia → ammonium salt

Element + oxygen → oxide

Element + halogen → halide

Displacement reactions (using the reactivity series)

Remember the names of the salts formed from these acids…

- Hydrochloric acid makes **chlorides**
- Sulfuric acid makes **sulfates**
- Nitric acid makes **nitrates**
- Phosphoric acid makes **phosphates**

Equations

Using the information on the previous page, complete the word equations and write symbol equations for the following.
Try to balance them if you can! The first one is done for you.

Reactants		Products
Magnesium + oxygen $2Mg + O_2$	→	Magnesium oxide $2MgO$
Calcium + hydrochloric acid	→	
Potassium + chlorine	→	
Zinc oxide + sulfuric acid	→	
Sodium hydroxide + sulfuric acid	→	
Ammonia + nitric acid	→	
Aluminium + iron (II) chloride (this is a displacement reaction!)	→	

Structure and Bonding

Being confident with bonding and the properties of different structures is a fundamental part of A level study. This follows on from what you have learnt at GCSE and includes:

- Ionic
- Simple molecular (covalent)
- Giant covalent
- Metallic

Draw dot and cross diagrams for the following substances and make predictions about their properties. TIF – can you explain the properties?

Substance	Type of bonding	Dot and cross diagram	Conducts electricity?	High or low melting point?
Hydrogen chloride, HCl				
Magnesium chloride, $MgCl_2$				
Ammonia. NH_3				
Aluminium oxide, Al_2O_3				

Atomic Structure

At GCSE, you will have covered atomic structure and should be able to work out the number of the sub-atomic particles in the first 20 elements.
At A level, you are expected to be familiar with the first 36 elements, and be expected to work out the number of sub-atomic particles in isotopes of their atoms and their ions.

For example; ^{23}Na is the isotope of sodium with a mass number of 23. It has 11 protons, 11 electrons and 12 neutrons.

$^{7}Li^{+}$ is an ion of the isotope of lithium with a mass number of 7. It has 3 protons, 2 electrons and 4 neutrons.

Use the Periodic table on **page 2** to fill in the table below.

Atom/Ion	Number of protons	Number of electrons	Number of neutrons
^{24}Mg			
^{35}Cl			
$^{16}O^{2-}$			
$^{32}S^{2-}$			
$^{27}Al^{3+}$			
$^{14}N^{3-}$			
$^{39}K^{+}$			
$^{52}Cr^{3+}$			

Using moles to calculate masses

What mass of $MgCl_2$ will be formed when 15.1g of Mg reacts with an excess of HCl?

Excess HCl means that all of the Mg will react.

To calculate this, you need a balanced equation.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

This tells us that 1 mole of Mg reacts with 2 moles of HCl, to form 1 mole of $MgCl_2$ and 1 mole of H_2.

This is called the **mole ratio**.

When you get a question like this, you must always find the number of moles of whatever you can!

In this case, it's the ***moles of Mg***.

Moles of Mg = mass/RFM = 15.1/24 = 0.629

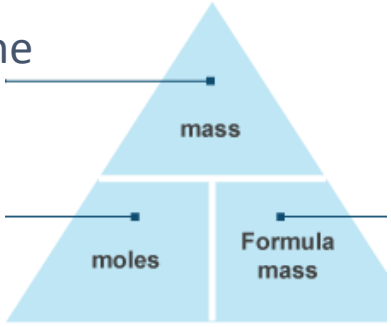
The mole ratio of Mg to $MgCl_2$ is 1:1

If we had **1 mole of Mg**, we would make **1 mole of $MgCl_2$**

But we have **0.629 moles of Mg**, so this means we make **0.629 moles of $MgCl_2$**

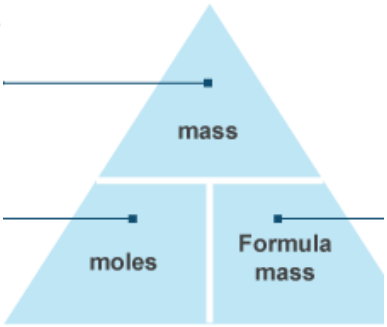
To find out the mass of $MgCl_2$, we multiply the moles by the RFM

Mass $MgCl_2$ = 0.629 x 95 = 59.8g



Using moles to calculate masses

What mass of O_2 will be formed when 25.5g of H_2O_2 decomposes?



$2H_2O_2 \rightarrow 2H_2O + O_2$

Moles of H_2O_2 = mass/RFM = 25.5/34 = 0.75

The mole ratio of H_2O_2 to O_2 is 2:1

If we had **2 moles of H_2O_2**, we would make **1 mole of O_2**

But we have **0.75 moles of H_2O_2**, so this means we make **0.75/2 moles of O_2 = 0.375**

To find out the mass of O_2, we multiply the moles by the RFM

Mass O_2 = 0.375 x 32 = 12 g

Try these questions ☺

(1) Calculate the number of moles in the following:

a) 1.82g of KOH ***(2)***

b) 14.85 of $Cu(NO_3)_2$ ***(2)***

c) 4.12g of magnesium hydroxide ***(3)***

(2) Calculate the mass in grams of the following:

a) 0.50 moles of CO_2 ***(2)***

b) 2.13 moles of H_2SO_4 ***(2)***

c) 1.25 moles of aluminium oxide ***(3)***

(3) A student makes some sodium chloride by reacting sodium carbonate with hydrochloric acid.

a) Balance the equation for this reaction:

$$Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$ ***(1)***

The student reacts 12.16g of sodium carbonate with an excess of hydrochloric acid.

b) Calculate the moles of sodium carbonate that he used. ***(2)***

c) Calculate the mass of sodium chloride that would be formed. ***(2)***

d) Suggest another chemical that would react with hydrochloric acid to form sodium chloride. ***(1)***

(4)Titanium is a transition metal used as pins and plates to support badly broken bones. Titanium is extracted from an ore that contains the mineral titanium oxide. This oxide is converted into titanium chloride. Titanium chloride is heated with sodium to form titanium metal. This reaction takes place in an atmosphere of a noble gas, such as argon.

$$4Na(s) + TiCl_4(l) \rightarrow Ti(s) + 4NaCl(s)$$

Calculate the mass of titanium that can be extracted from 570 kg of titanium chloride.

Relative atomic masses: Cl 35.5; Ti 48.

Mass of titanium = _____ kg

(Total 3 marks)

Research!

Find out the answers to the following!

1) Water is a simple covalent substance, yet has a relatively high melting and boiling point. Find out why. Some diagrams may be useful in your explanation.

2) Two new examples of organic compounds you will encounter this year are **aldehydes** and **ketones**. Find out the names and structures of the first 4 members of each homologous series and explain why an aldehyde and a ketone with the same number of carbon atoms are structural isomers of each other.

3) What is the trend in the melting and boiling points as you go down group 0? (from Helium to Radon). Explain why this pattern is observed.