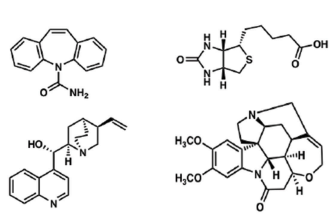


A Level Chemistry
Year 11 Transition Booklet

Dear Year 11,
Welcome to A Level Sciences. We hope that in choosing to study an A Level science, you have already looked into the requirements of the course and your suitability for it, as well as how it will combine with your other A Level subjects and how it could lead into your future university course, job or apprenticeship.

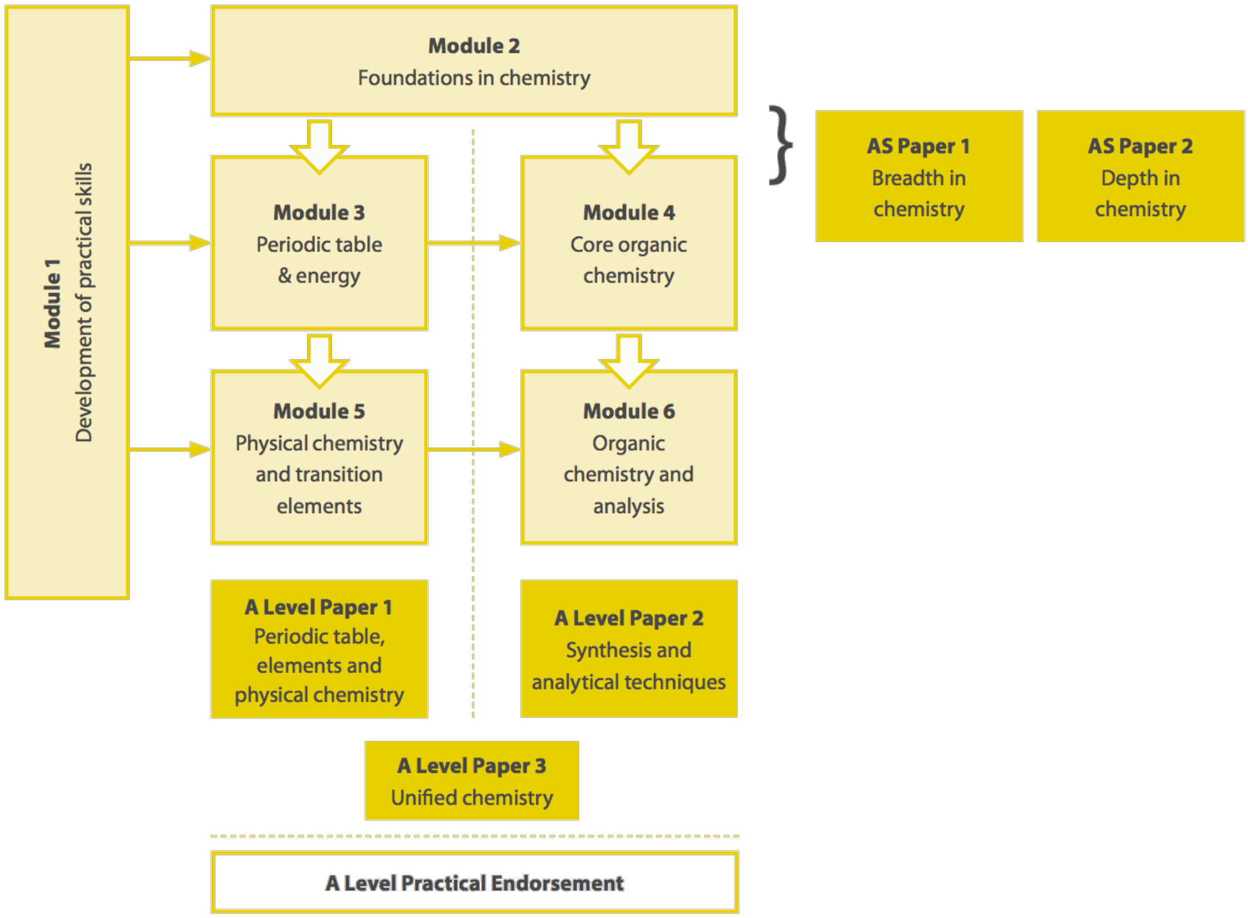
A Level Chemistry, Biology and Physics are demanding courses and we always advise that students thoroughly understand what is expected from them during the 2-year course and are prepared to supplement learning during lessons with thorough independent study at home or in school.

This transition pack is designed to give you an insight into the course, a taster of some of the work you will do and also our expectations of what should already know and be able to do from GCSE.

To be able to begin studying any of the A Level Sciences in September, as well as meeting the entry requirements, you will need to bring this completed booklet to your first lesson. A Level Scientists must prove that they are critical thinkers, problem solvers and, above all, hard workers.

If you are struggling to complete any of the tasks or have any questions about an A Level Science, please contact the course leader:
Biology – Miss Fellows – katie.fellows@oatforge.co.uk
Chemistry – Miss Toner - anna.toner@oatforge.co.uk
Physics – Mr Iliffe – michael.iliffe@oatforge.co.uk

OCR A Level Chemistry Course Outline



Year 12- Modules 1 – 4
Year 13 – Modules 5- 6

Practical Endorsement → a set of practical activities which are assessed by your teacher and form part of your final written examination

Task 1 – Glossary

Create a key term glossary by finding the correct **scientific** definitions.

Key term	Definition
Activation energy	
Atomic number	
Alkane	
Alkene	
Avogadro's constant	
Concentration (of a solution)	
Covalent bonding	
Cracking	
Empirical formula	
Endothermic	
Exothermic	
Functional group	
Fractional distillation	
Giant covalent lattice	
Greenhouse effect	
Hydrocarbon	
Ion	
Ionic bonding	
Ionic lattice	
Isotope	
Mass number	
Metallic bonding	
Mole	
Relative atomic mass	
Relative formula mass	

Task 2 – Pre-knowledge topics

Atomic Structure

1. Calculate the number of protons, neutrons and electrons in:
- Sodium
- Boron
- Barium
- Astatine
- Iodine

2a. State one difference and one similarity between isotopes of the same element.

b. Three isotopes of carbon are; carbon-12, carbon-13, and carbon-14. State the numbers of protons, neutrons and electrons for each isotope.

3a. Draw diagrams to show the electron arrangement of potassium, sodium and oxygen
b. Write the electron arrangement out for an atom with 10 electrons and 17 electrons

Measuring Chemicals and Calculations

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:
http://bit.ly/pixlpertab

https://secondaryscience4all.files.wordpress.com/2014/08/filestore_aqa_org_uk_subjects_aqa-2420-w-trb-ptds_pdf.png

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.
The ***mole*** is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, we weigh out chemicals.
For example: magnesium + sulfur → magnesium sulfide

$$Mg + S \rightarrow MgS$$

We can see that one atom of magnesium will react with one atom of sulfur, if we had to weigh out the atoms we need to know how heavy each atom is.
From the periodic table: Mg = 24.3 and S = 32.1
If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium, if we counted how many atoms were present in this mass it would be a huge number (6.02×10^{23}!!!!), if I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms.
So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide.
Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems.
You will find the first 6 tutorials of most use here, and problem sets 1 to 3.
http://bit.ly/pixlchem9

http://www.chemteam.info/Mole/Mole.html

Q6.1 Answer the following questions on moles.

a) How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?
b) How many moles of potassium in 73.56g of potassium chlorate (V) ($KClO_3$)?
c) How many moles of water are in 249.6g of hydrated copper sulfate(VI) ($CuSO_4.5H_2O$)? For this one, you need to be aware the dot followed by $5H_2O$ means that the molecule comes with 5 water molecules so these have to be counted in as part of the molecules mass.
d) What is the mass of 0.125 moles of tin sulfate ($SnSO_4$)?
e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium? $2Mg + O_2 \rightarrow MgO$

Solutions and concentrations

In chemistry a lot of the reactions we carry out involve mixing solutions rather than solids, gases or liquids.

You will have used bottles of acids in science that have labels saying 'Hydrochloric acid 1M', this is a solution of hydrochloric acid where 1 mole of HCl, hydrogen chloride (a gas) has been dissolved in $1dm^3$ of water.

The dm^3 is a cubic decimetre, it is actually 1 litre, but from this point on as an A level chemist you will use the dm^3 as your volume measurement.

http://bit.ly/pixlchem10

http://www.docbrown.info/page04/4_73calcs11msc.htm

Q7.1

a) What is the concentration (in mol dm^{-3}) of 9.53g of magnesium chloride ($MgCl_2$) dissolved in $100cm^3$ of water?
b) What is the concentration (in mol dm^{-3}) of 13.248g of lead nitrate ($Pb(NO_3)_2$) dissolved in $2dm^3$ of water?
c) If I add $100cm^3$ of 1.00 mol dm^3 HCl to $1.9dm^3$ of water, what is the molarity of the new solution?
d) What mass of silver is present in $100cm^3$ of $1moldm^{-3}$ silver nitrate ($AgNO_3$)?
e) The Dead Sea, between Jordan and Israel, contains 0.0526 $moldm^{-3}$ of Bromide ions (Br^-), what mass of bromine is in $1dm^3$ of Dead Sea water?

***Titrations** (only triple students will have come across this, but you can still attempt if you did trilogy!)*

One key skill in A level chemistry is the ability to carry out accurate titrations, you may well have carried out a titration at GCSE, at A level you will have to carry them out very precisely **and** be able to describe in detail how to carry out a titration - there will be questions on the exam paper about how to carry out practical procedures.
You can read about how to carry out a titration here, the next page in the series (page 5) describes how to work out the concentration of the unknown.
http://bit.ly/pixlchem11

http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/further_analysis/analysing_substances/revision/4/
Remember for any titration calculation you need to have a balanced symbol equation; this will tell you the ratio in which the chemicals react.
E.g. a titration of an unknown sample of sulfuric acid with sodium hydroxide.
A 25.00cm^3 sample of the unknown sulfuric acid was titrated with 0.100moldm^{-3} sodium hydroxide and required exactly 27.40cm^3 for neutralisation. What is the concentration of the sulfuric acid?
Step 1: the equation $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$
Step 2; the ratios 2 : 1
Step 3: how many moles of sodium hydroxide 27.40cm^3 = 0.0274dm^3
number of moles = c x v = 0.100 x 0.0274 = 0.00274 moles
step 4: Using the ratio, how many moles of sulfuric acid
for every 2 NaOH there are 1 H_2SO_4 so, we must have 0.00274/2
=0.00137 moles of H_2SO_4
Step 5: Calculate concentration. concentration = moles/volume ← in dm^3 = 0.00137/0.025 = ***0.0548 moldm^{-3}***
Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.
http://bit.ly/pixlchem12

http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm

Use the steps on the last page to help you

Q8.1 A solution of barium nitrate will react with a solution of sodium sulfate to produce a precipitate of barium sulfate.

$Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaNO_3(aq)$

What volume of 0.25moldm^{-3}sodium sulfate solution would be needed to precipitate all of the barium from 12.5cm^3 of 0.15 moldm^{-3} barium nitrate?

Bonding

Ionic Bonding

Ionic bonding occurs when positive and negatively charged ions are attracted together to form ionic compounds. For example;

$$Na^+ + Cl^- \rightarrow NaCl$$

Positively charged sodium ions react with negatively charged chlorine ions to produce the compound sodium chloride.

Ions are formed when atoms (from a periodic table) either gain or lose electrons to form a full outer shell of electrons on the atom's outermost shell. For example, an atom of potassium has an electron configuration of (2,8,8,1) meaning potassium has 1 electron in its outer shell. To form a full outer shell it is easier to lose 1 electron rather than gain 7 and so because electrons are negatively charged and one electron is lost, when an atom of potassium loses that 1 electron it forms a positive ion:

$$K \rightarrow K^+ + e^-$$

The same can be seen with a non-metal for example bromine. Bromine has 7 electrons in its outer shell which we know because it is in group 7 on the periodic table with an electron configuration of (2,8,18,7). It is easier for bromine to gain one electron rather than lose 3 to become an ion and so because it is gaining one negatively charged electron, it becomes a negatively charged ion with a full outer shell of electrons:

$$Br + e^- \rightarrow Br^-$$

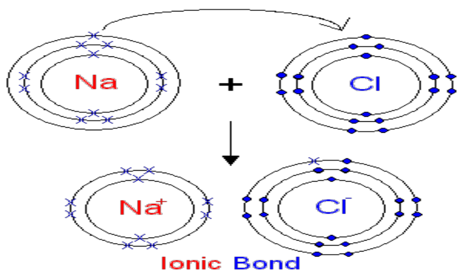
Overall,

Positive ions are formed when atoms LOSE electrons

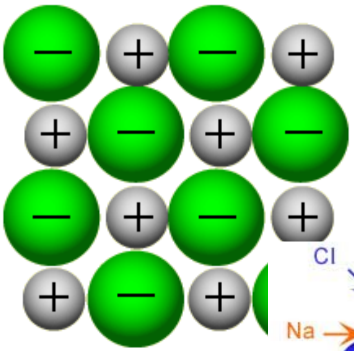
Negative ions are formed when atoms GAIN electrons.

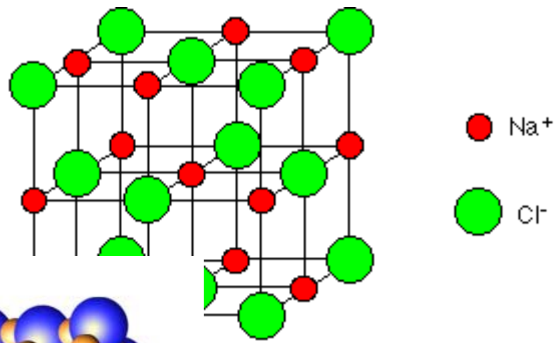
Elements in groups 1, 2, 6 and 7 form ionic compounds.

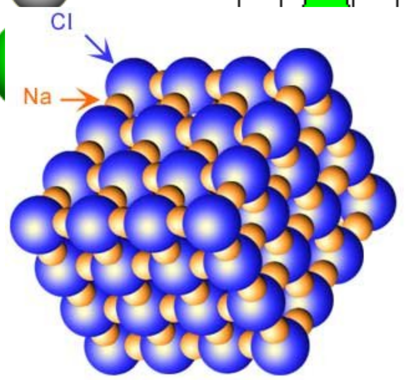
An example of ionic bonding can be seen here with sodium chloride. Sodium from group 1 reacts with chlorine from group 7. Chlorine requires 1 electron to form a full outer shell and so sodium donates its outer electron so that both atoms form ions and have a full outer shell.



When an ionic compound is formed it has certain properties. They are **solids** at **room temperature** and form part of a **giant ionic lattice** (or crystal which it is also known as at AS level) where the positively charged ions are attracted to the negatively charged ions with **electrostatic forces of attraction**.







Sodium Chloride Crystal Structure

<u>Properties</u>

Electrical conductivity:

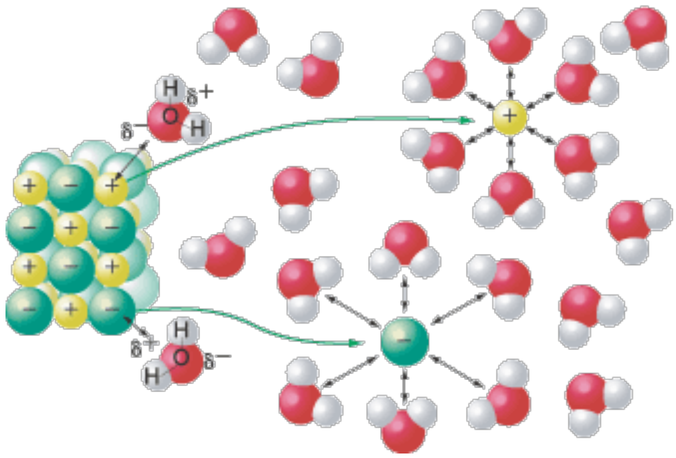
Ionic compounds do NOT conduct electricity when in their solid state. However, when molten or in aqueous solution they conduct electricity because the ions are free to move and carry a carry as opposed to being in a fixed position when solid and cannot carry a current.

Melting point

In order to melt a solid, the forces between the molecules have to be overcome so lots of energy is required to break them. This means that ionic compounds have high forces of attraction.

Solubility

In many cases, ionic compounds are soluble in water. This is because water is POLAR molecule. This means that the molecule is both slightly positively and negatively charged. The oxygen part of the molecule is slightly negatively charged and attracted to the positive ions in the ionic compound. And the hydrogen part is slightly positive and attracted to the negative ions in the ionic compound. This means that energy required to break up the compound is made up with lots of weak bonds between the water molecules and the ions in solution. The *crystal does not dissolve instantly*, but rather is *broken up slowly*.



As can be seen on the left, an ionic compound is being broken up with water molecules. The oxygen atoms are attracted to the positive ions in the compound and the hydrogen atoms are attracted to the negatively charged ions in the ionic compound eg Br^- in KBr (potassium bromide).

Similarly, atoms in group 2 which have 2 electrons in their outer shells find it easier to lose 2 electrons to gain a full outer shell and atoms in group 6 have 6 electrons in their outer shell and therefore must react by gaining 2 electrons. Elements from group 2 can react with elements from group 6 to form ionic compounds.
Reactions for ionic bonding are not limited at reactions between groups 1 and 7 and groups 2 and 6; it is possible for example that an element from group 2 may react with 2 atoms of an element from group 7 to form a compound. For example calcium chloride:

$$Ca \rightarrow Ca^{2+} + 2e^-$$

$Cl + e^- \rightarrow Cl^-$ (multiply by 2 to ensure the electrons are balanced)

Overall equation; $Ca^{2+} + 2Cl^- \rightarrow CaCl_2$

Ionic bonding strength
The strength of the bonds between ions are not the same in all ionic structures.

In general,
The *bigger the charges* on the ions, the *stronger the attraction*
For example, the bonds in the compound potassium bromide ($K^+ + Br^-$) are weaker than the bonds in the compound magnesium sulphide ($Mg^{2+} + S^{2-}$).

Activity 1:
1) Draw a dot and cross diagram as shown above with sodium chloride to show how a magnesium atom (forms a 2+ ion) reacts with an oxygen atom (forms a 2- ion).
2) Write the ionic equation for the reaction between strontium and iodine. Ensure you look at which groups each of the elements

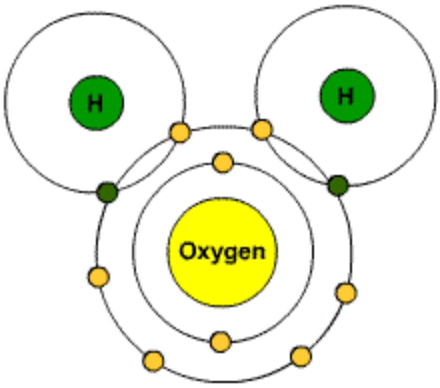
are in on the periodic table to understand what ions would be formed.

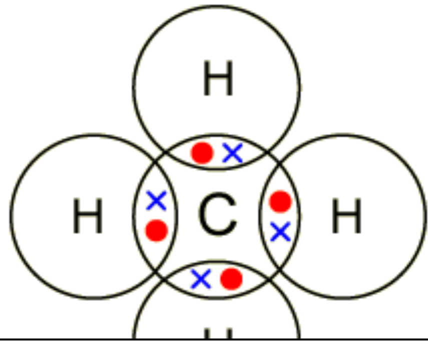
3) Which would have stronger forces of attraction, bonds in the compound sodium iodide or bonds in the compound barium oxide? Explain how you know.
4) Are ionic compounds soluble in water? Explain how you know.

Covalent Bonding

Ionic bonding is good for a reaction between a metal with 1 or 2 electrons in its outer shell and a non-metal which requires 1 or 2 electrons to have a full outer shell. However, when this is not the case with all atoms, covalent bonding may occur.

Covalent bonding, unlike ionic bonding, can exist in isolation in single molecules. In covalent bonding, two atoms can share a pair of electrons as shown below:





On the left, you can see that hydrogen requires 1 electron to complete its outer shell and so shares one of oxygen's electrons. Oxygen requires 2 electrons to have a full outer shell and so requires two hydrogens so that it can share 1 electron with both of the hydrogen atoms to get a full outer shell.

On the right, carbon is bonded to 4 hydrogen atoms. Carbon requires 4 electrons to have a completed outer shell of electrons whilst hydrogen requires 1 electron to complete its outer shell. Therefore, carbon shares electrons with 4 hydrogen atoms so it can share the 4 electrons it requires for that full energy level (shell) and each hydrogen atom requires just one of the carbon electrons to complete its outer energy level (shell).

The electron pair creates a bond between the two atoms because it attracts the nucleus of each atom and therefore resists the separation of the two atoms.

Activity 2:

1) Draw dot and cross diagrams to represent the shared pairs of electrons in each of the following;
   (i) Hydrogen (H_2)
   (ii) Ammonia (NH_3)
   (iii) Ethane (C_2H_6)
   (iv) Carbon dioxide

Task 3 - Research activities

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

You can make a 1-page summary for each one you research, using note form. (A link to Cornell note taking is below- this is a useful technique when starting an A Level course.)
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?

Reading List

Suggested textbooks:
A Level Chemistry for OCR A (Oxford University Press)
OR
A Level Chemistry (OCR A) (CGP)