the PiXL club
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Adapted by C Francis June 2021

Countesthorpe Academy

Transition Pack for A Level Chemistry

Get ready for A-level!

A guide to help you get ready for A-level Chemistry, including everything from topic guides to interesting reads and online learning courses.

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Please note: these resources are non-board specific. Please direct your students to the specifics of where this knowledge and skills most apply.

Year 11 into Year 12 Transition Work: Chemistry A level

The step up from GCSE to A level Chemistry is a large and we would like everyone to get off to a running start by doing a bit of preparation and revisiting of some key skills (chemistry and maths) from GCSE.

Please make sure that you have completed this booklet and hand it in to your chemistry teacher in your first lesson in September.

If you want to do a bit more revision before you start there is a study guide which helps to bridge the gap between GCSE and A level:

Head start to A level Chemistry by CGP retail price £4.95

Maths skills are much more evident in the new A level specification and 20% of questions will involve higher paper GCSE Maths skills. Another CGP guide which you might find useful is:

Essential Maths Skills for A level Chemistry retail price £7.50

Charges on ions

Task 1

Learn the formulas of the ions in the table below:

Positive ions		Negative ions	
Group 1 ions: Lithium, Li^+ Sodium, Na^+ potassium, K^+ Group 2 ions: magnesium, Mg^{2+} calcium Ca^{2+} barium Ba^{2+}	Group 3 ions: aluminium, Al^{3+} Other common ions: Silver, Ag^+ Zinc, Zn^{2+} Ammonium, NH_4^+ Hydrogen, H^+	Group 7 ions: fluoride, F^- chloride Cl^- bromide Br^- iodide I^- Group 6 ions: oxide, O^{2-} Sulphide, S^{2-}	Other common ions: Nitrate, NO_3^- Sulfate, SO_4^{2-} Carbonate, CO_3^{2-} Hydrogencarbonate, HCO_3^- Hydroxide, OH^- Hydride, H^- Phosphate, PO_4^{3-}

You will need to learn the formulas of all the above ions, as it essential that you can have them at your fingertips for writing equations throughout the course. Expect to have a quick test on these in week 1 or 2.

Task 2 Working out Formulas of ionic compounds

Use the charges on the ions to work out the formulas of the ionic compounds listed below:

1) silver 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 .....

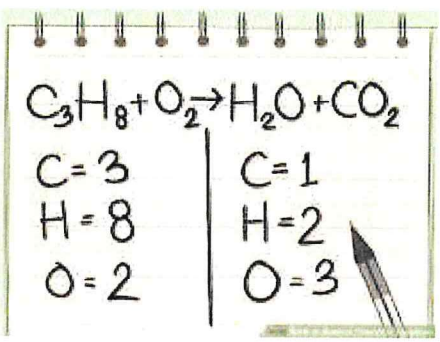
12) ammonium sulphate .....

13) gallium hydroxide .....

14) strontium selenide .....

15) radium sulfate .....

16) sodium nitride .....



Balancing 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	$2\ Mg + O_2 \rightarrow 2MgO$ $2\ H_2S + 3\ O_2 \rightarrow 2\ H_2O + 2\ SO_2$ $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
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 3

Learn the word equations (in the above table) for the general reactions. Expect to be tested on this in week 2 or 3.

Task 4

1) Balance the following equations.

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

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

$SO_2 + O_2 \rightarrow SO_3$ .....

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$ .....

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 + sulphuric acid → ammonium sulphate

Atomic Number, Mass Number and Isotopes

Task 5

Complete the following passages and the table:

Atomic number = number of .....

Mass number = number of ..... + number of .....

The number of protons, neutrons and electrons in an atom can be worked out using the atomic number and mass number.

Number of protons = ...

Number of neutrons = ...

Number of electrons = ...

Atoms of the same element have the same number of ..... . In fact, it is the number of ..... that determines what type of atom it is (e.g. all atoms with 6 protons are carbon atoms). Atoms of different elements have different numbers of ..... . **Isotopes** are atoms with the same number of ..... but a different number of ..... . This means they are atoms of the same ..... with the same ..... number but a different ..... number

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{23}_{11}Na$					
Li	3	7			
Ar		40	18		
K			19	20	
Al				14	13
$^{235}_{92}U$					
$^{238}_{92}U$					

Structure and Bonding

Key ideas from structure and bonding at GCSE will be revised and developed in term 1. Make sure you are confident with concepts from GCSE.

Task 6

Make a summary of the different types of bonding and structure in the table below:

	Monatomic	Simple Molecular	Giant Covalent	Ionic	Metallic
Type of substances And examples	Group 0 elements e.g. He, Ar, Ne				
Type of bonding present	None				
Description of structure	Individual atoms with very weak forces between them				
Labelled Diagram to represent the structure					
Name of particles	Atoms				
Properties	Very low Boiling points Non-conductors Insoluble				

Task 7

Draw dot and cross diagrams to represent the covalent bonding in the following molecules:

a) CH_4

b) NH_3

c) HCl

d) O_2

e) CO_2

Task 8

a) Draw diagrams to show how a magnesium atom reacts with an oxygen atom to form magnesium oxide, MgO Your diagram should show the electron transfer process.

b) Draw diagrams to show how a calcium atom reacts with chlorine atoms to form magnesium oxide, $CaCl_2$. Your diagram should show the electron transfer process.

Essential Maths skills for A Level chemistry

Significant figures

A significant figure is any digit which you are confident is correct. A non-significant figure is any digit that you can't be sure about. It's important to recognise how many significant figures a value has been quoted to and how to round your own data to an appropriate number of significant figures.

Remember:

- Count the number of significant figures from the first non-zero digit.
- Zeros at the start of a number are not significant.
  So: 187.23 is given to 5 s.f.
  0.038 is given to 2 s.f.
  448 000 is given to 3 s.f.
- The rule for significant figures in calculations is to give your final answer to the same number of significant figures as the data value with the **fewest** significant figures used in the calculation.

Task 9

1. How many significant figures are each of these values given to?

   a) 221 985 Pa .....

   b) 15 200 g .....

   c) 39.00 K .....

   d) 0.00186 mol .....

2. Write each of the following to the number of significant figures shown:

a) 345789 4 sig figs .....

b) 297300 3 sig figs .....

c) 0.07896 3 sig figs ....

d) 6.0961 3 sig figs .....

e) 0.001563 3 sig figs .....

f) 0.010398 4 sig figs ....

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

a) 6125 x 384 .....

b) 25.00 x 0.01 0 .....

c) 13.5 + 0.18 .....

4. 0.175 moles of sodium chloride were dissolved in 1.2 dm^3 of water.

Use the formula concentration (mol dm^{-3}) = moles/volume (dm^3) to calculate the concentration of the solution, and quote your answer to the correct number of significant figures.

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Standard form

Standard form tidies up very big or very small numbers in calculations.

For example, there are 602 000 000 000 000 000 000 000 particles in 1 mole. This is much easier to write as 6.02×10^{23}

Or 0.0051 m^3 is easier to write as 5.1×10^{-3} m^3

Task 10

Write the following in standard form:

1. 0.000 035 $mol.dm^{-3}$ .....
2. 201500 Pa .....
3. 0.0167 moles .....
4. 6850000000 dm^3 .....
5. 0.000000382 g .....

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) $4.3 \times 10^{-4} / 7.00$ .....

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

d) $0.00156 + 2.4 \times 10^{3}$ ....

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

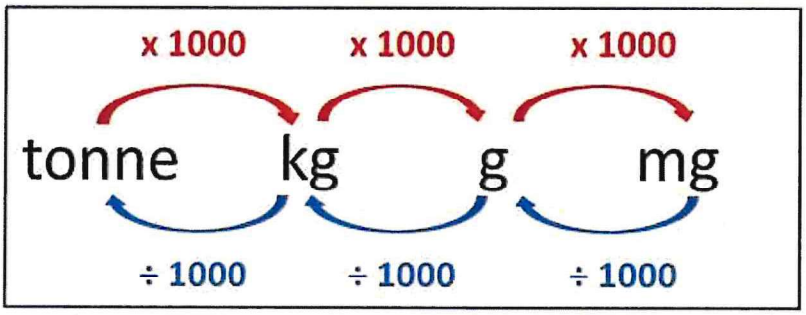
f) $8.00 \times 10^{-3} \times 0.100 \times 10^{-3}$ .....

Converting units

Converting MASS Units

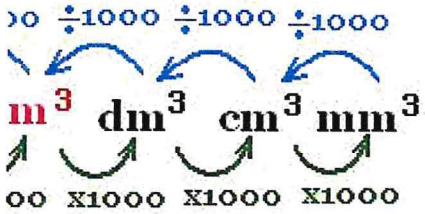
The Mass for weighing objects in Metric Units is similar to Capacity for Volumes.

In the Metric System, Mass is based on the Gram or "g" unit.



Mass conversions use 1000's, and usually create fairly large results.

1.6 tonne = ? kg Need to x 1000 1.6 x 1000 = **1600 kg** ✓



Task 11

Convert the following units :

1. 10 kg into g .....
2. 360 mg into g .....
3. 360 cm into m .....
4. 360 cm^3 into m^3 .....
5. 250 cm^3 into dm^3 .....
6. 2 dm^3 into mm^3 .....
7. 42357 g into mg .....
8. 4.1 kJ mol^{-1} to J mol^{-1} .....
9. During a titration, 31 cm^3 of an alkali is needed to neutralise 0.025 dm^3 of an acid.
   What is the total volume of the acid and alkali in cm^3? .....
10. What is the total mass, in grams, of 137 mg, 4g and 32kg?
    .....

Using Formulae

Formulae are used often in chemistry, as they give a relationship between two or more quantities. It is an essential skill that you need to be able to **rearrange formulae**, **substitute** values, **converting to the correct units** if needs be.

You should be familiar with these formulae:

$$\text{Number of moles} = \frac{\text{mass of substance (in g)}}{\text{Relative molecular mass, Mr}}$$

$$\text{Concentration (mol dm}^{-3}\text{)} = \frac{\text{number of moles}}{\text{Volume of solution (dm}^3\text{)}}$$

You should always show your working: give the formula

input values

then calculate your answer.

Always give the **correct units** with your answer.

Task 12

Show your working for each of these calculations.

1. The Mr of CO_2 is 44. Calculate the number of moles in 125g of CO_2

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2. 5.0 moles of $CaCl_2$ is dissolved in 750 cm^3 of water. What is the concentration in $mol.dm^{-3}$?

   .....

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   .....

3. 2.0 g of NaOH were dissolved in 250 cm^3 of water in a flask.
   a) How many moles of NaOH are in this solution?
   b) What is the concentration of the solution in $mol.dm^{-3}$?

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Rearranging equations

Equations are used in chemistry in year 12 and 13. It is essential that you can rearrange equations before you begin A level chemistry.

Remember: Whatever you do to one side, you need to do to the other side of the equation.

For example, to rearrange $c = \frac{n}{V}$ (concentration = number of moles /volume) to find n:

Multiply both sides by v: $c \times v = \frac{n}{v} \times v$ ← the 'v's cancel out

So $c \times v = n$

Task 13

Rearrange these equations:

1. $c = \frac{n}{v}$ to find v .....
2. $mass = \frac{moles}{Mr}$ to find moles .....
3. $pV = nRT$ to find T .....
4. $Rate = k[NO]^2$ to find [NO] .....
5. $\Delta G = \Delta H - T\Delta S$ to find T .....

Pre-Knowledge Topics- All must be completed

You have come across most of these concepts to some degree at GCSE but it is really important you understand them as they are fundamental ideas in Chemistry. Take the time to make sure you can complete these tasks fully- use the links for help and guidance. You could always email myself or Miss Thompson if you get really stuck! Use the flipped learning sheet on the previous page to help you lay out your notes, we use it for pre-reading tasks at A level so you can get some practise at using it as you work through the tasks. If you can't print it out at home, you can just copy out the format onto your paper.

Chemistry topic 1 – Chemical equations

Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry.

There are loads of websites that give ways of balancing equations and lots of exercises in balancing.

Some of the equations to balance may involve strange chemical, don't worry about that, the key idea is to get balancing right.

http://bit.ly/pixlchem7

http://www.chemteam.info/Equations/Balance-Equation.html

This website has a download; it is safe to do so:

http://bit.ly/pixlchem8

https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Q5.1 Balance the following equations

a. $H_2 + O_2 \rightarrow H_2O$

b. $S_8 + O2 \rightarrow SO_3$

c. $HgO \rightarrow Hg + O_2$

d. $Zn + HCl \rightarrow ZnCl_2 + H_2$

e. $Na + H_2O \rightarrow NaOH + H_2$

f. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$

g. $Fe + O_2 \rightarrow Fe_2O_3$

h. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

i. $Fe_2O_3 + H_2 \rightarrow Fe + H_2O$

j. $Al + FeO \rightarrow Al_2O_3 + Fe$

Chemistry topic 3 – 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?

Chemistry topic 4 – Titrations

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.

Chemistry topic 2 – Measuring chemicals – the mole

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 → 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? $2Mg + O_2 \rightarrow MgO$

A 25.00cm^3 sample of the unknown sulfuric acid was titrated with 0.100$moldm^{-3}$ 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 0.25$moldm^{-3}$sodium sulfate solution would be needed to precipitate all of the barium from 12.5cm^3 of 0.15 $moldm^{-3}$ barium nitrate?

Chemistry topic 5 – Organic chemistry – functional groups

At GCSE you would have come across **hydrocarbons** such as alkanes (ethane etc) and alkenes (ethene etc). You may have come across molecules such as alcohols and carboxylic acids. At A level you will learn about a wide range of molecules that have had atoms added to the carbon chain. These are called functional groups, they give the molecule certain physical and chemical properties that can make them incredibly useful to us.

Here you are going to meet a selection of the functional groups, learn a little about their properties and how we give them logical names.

You will find a menu for organic compounds here:

http://bit.ly/pixlchem13

http://www.chemguide.co.uk/orgpropsmenu.html#top