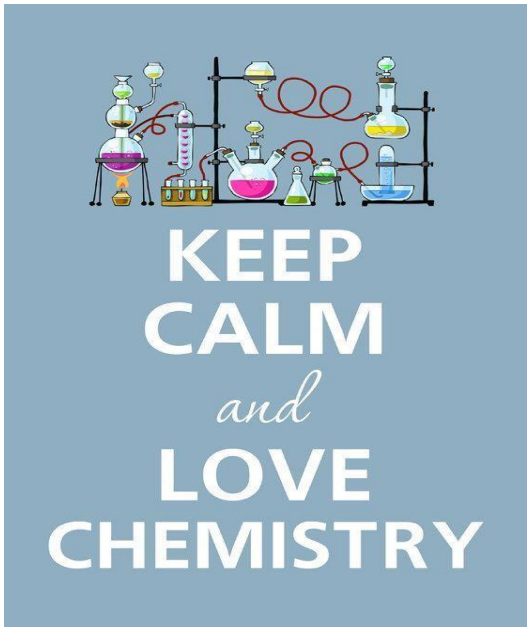
Queen Elizabeth High School

GCSE to A level transition booklet

Chemistry



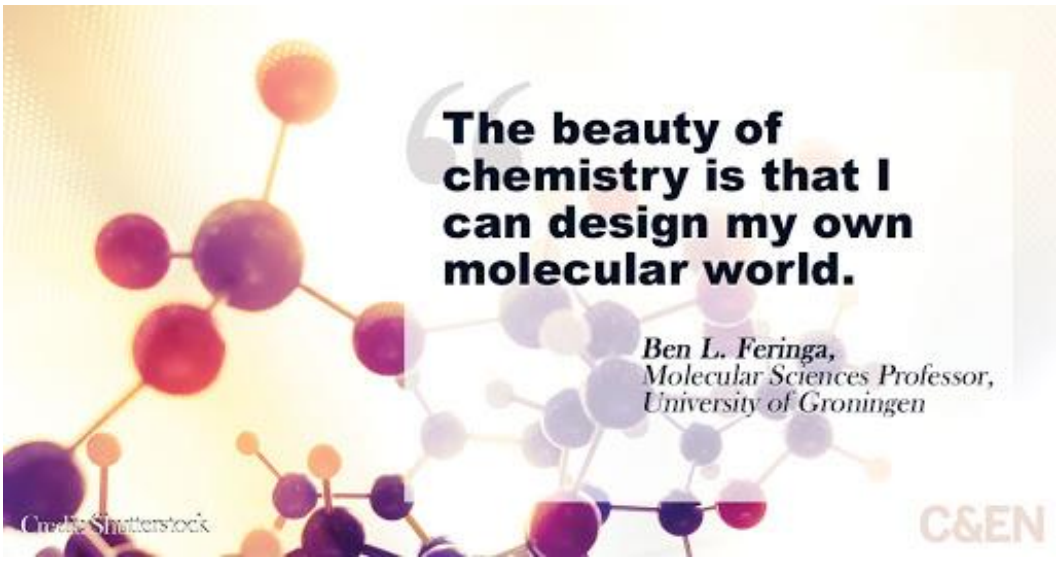
Name: _____

Welcome to A-level Chemistry.

This booklet is designed to help you prepare for the challenges ahead, to go over some of the things that you have done, to give you some application to your knowledge, to broaden your understanding of chemistry and dip your toes into the work you will do over the next two years.

This booklet contains:

a) Tasks linked to the topics you will cover in Year 12 to help you recap your GCSE knowledge.
b) Tasks to help you develop some of the skills you will need to succeed in A level Chemistry.
c) Tasks to see how your knowledge is extended.

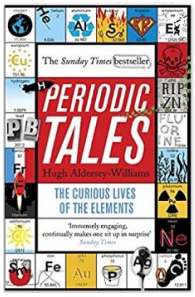


Contents

Books you might want to read?

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

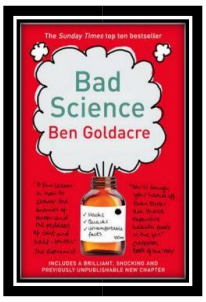
ISBN-10: 0141041455



The phenomenal *Sunday Times* bestseller *Periodic Tales* by Hugh Andersey-Williams, packed with fascinating stories and unexpected information about the building blocks of our universe.

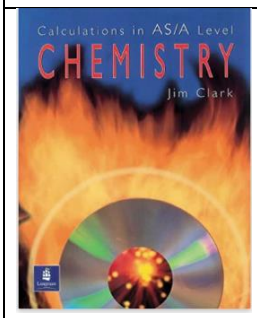
Bad Science (Paperback) Ben Goldacre

ISBN-10: 000728487X



Since 2003 Dr Ben Goldacre has been exposing dodgy medical data in his popular *Guardian* column. In this eye-opening book he takes on the MMR hoax and misleading cosmetics ads, acupuncture and homeopathy, vitamins and mankind's vexed relationship with all manner of 'toxins'. Along the way, the self-confessed 'Johnny Ball cum Witchfinder General' performs a successful detox on a Barbie doll, sees his dead cat become a certified nutritionist and probes the supposed medical qualifications of 'Dr' Gillian McKeith.

Full spleen and satire, Ben Goldacre takes us on a hilarious, invigorating and ultimately alarming journey through the bad science we are fed daily by hacks and quacks.

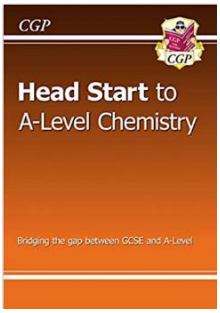


Calculations in AS/A Level Chemistry (Paperback) Jim Clark

ISBN-10: 0582411270

Calculations in AS and A Level Chemistry fills a gap in the market and provides excellent coverage of the calculations needed at A Level. Chapters are clearly laid out, with plenty of worked examples, and there are helpful notes throughout.

Head Start to A-level Chemistry (CGP A-Level Chemistry)



This fantastic Head Start book from CGP is the ideal way to bridge the gap between GCSE and A-Level Chemistry. It recaps all the crucial topics you'll need to remember from GCSE, with crystal-clear study notes and examples, plus practice questions to test your understanding. It also includes introductions to some of the key topics you'll meet at A-Level.

Videos to watch

I always loved Rough Science!

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://www.dailymotion.com/playlist/x2igjq_Rough-Science_rough-science-full-series/1#video=xxw6pr or https://www.youtube.com/watch?v=lUoDWAt259I

Chemistry in Films

Dantes Peak 1997: Volcano disaster movie.

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

https://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantes-peak

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 come of the cooler properties of mercury.
https://www.youtube.com/watch?v=t46lvTxHHTA

The most AMAZING chemical Reactions

Good demonstration reactions

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

SENCA
Log into SENECA and link yourself to the class - **t7394vijz5**

Chemistry: OCR A Level Preparation - Summer 2020, there is a GCSE preparation course and an A level Taster Course to do as well!

So what should I go over?

1 – Chemical equations

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

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

Here's a simulation to help with balancing if you find it hard:

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

Balance the following equations

1. .....C + ...O_2 ⟶ .....CO

2. .....Ba + ...H_2O ⟶ .....$Ba(OH)_2$ + ...H_2

3. .....C_2H_6 + ...O_2 ⟶ .....CO_2 + ...H_2O

4. .....HCl + ...$Mg(OH)_2$ ⟶ .....$MgCl_2$ + H_2O

5. .....N_2 + ...O_2 ⟶ .....NO

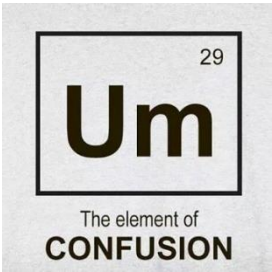
6. .....Fe_2O_3 + ...C ⟶ .....Fe + ...CO_2

7. .....CH_3CH_2OH + ...[O] ⟶ .....CH_3COOH + ...H_2O

8. .....HNO_3 + ...CuO ⟶ .....$Cu(NO_3)_2$ + H_2O

9. .....Al^{3+} + ...e^- ⟶ .....Al

10. .....$[Fe(H_2O)_6]^{3+}$ + ...CO_3^{2-} ⟶ .....$Fe(OH)_3(H_2O)_3$ + ...CO_2 + ...H_2O



2 – 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:

https://www.ocr.org.uk/Images/302736-units-h033-and-h433-data-sheet.pdf

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 + sulphur → magnesium sulphide

$$Mg + S \rightarrow MgS$$

We can see that one atom of magnesium will react with one atom of sulphur, 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 32.1g of sulphur then I would have 1 mole of sulphur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulphur, and will make 56.4g of magnesium sulphide.

At the website show below you will find some videos and activities.

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

Question

a) How many moles of water are in 50g?

b) How many moles of potassium are in 100g of potassium choride?

c) How many moles of water are in 300gg of hydrated magnesium sulphate(VI) ($MgSO_4.7H_2O$)? The dot followed by $7H_2O$ means that the molecule comes with 7 water molecules so these have to be counted in as part of the molecules mass.

d) What mass is 0.28 moles of ethanol (CH_3CH_2OH)?

e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium?

$2Mg + O_2 \rightarrow MgO$

3 – Solutions and concentrations (In Y12 topic Elements of life)

The dm^3 is a cubic decimetre, it is actually 1 litre or $1000cm^3$ but from this point on as an A level chemist you will use the dm^3 as your volume measurement.

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

Question

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?

4 – Titrations

One of the early key principles you will review is the titration and the associated calculation.

https://www.youtube.com/watch?v=RI14t0R1wMY

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 sulphuric acid with sodium hydroxide.

A $25.00cm^3$ sample of the unknown sulphuric acid was titrated with 0.100moldm^{-3} sodium hydroxide and required exactly $27.40cm^3$ for neutralisation. What is the concentration of the sulphuric 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 sulphuric 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

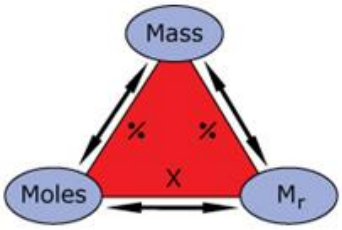
Step 5: Calculate concentration. concentration = moles/volume ←in dm^3 = 0.00137/0.025 = ***0.0548 moldm^{-3}***

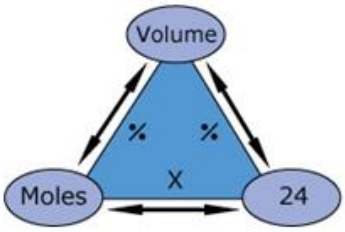
Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.

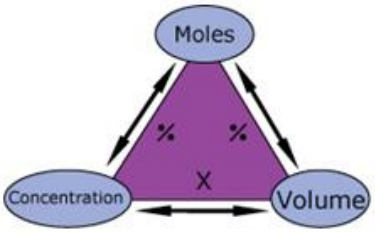
http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm

Use the steps on the last page to help you

Remember these formula triangles – including the volume one in the middle 24 dm^3 = 1 mole of any gas!







1. Use this formula to calculate the mass of each of the following

   (a) 2.50 mol of hydrogen, H_2g

   (b) 0.500 mol of sodium chloride, NaCl.

2. Use this formula to calculate the amount (in mol) of each substance listed below....

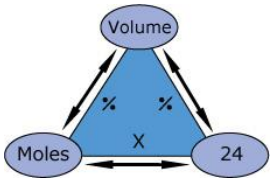
   a) 31.0 g of phosphorus molecules, P_4

   b) 50.0 g of calcium carbonate, $CaCO_3$.

3. Use this formula to calculate the molar mass of an 11g gas sample of compound X, which is 0.25mol.

   Molar mass: _____ $gmol^{-1}$

   Possible identity of the gas sample X: _____



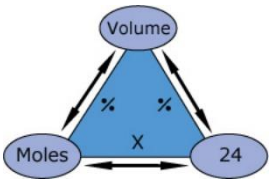
4. Use this formula to calculate the amount of gas (in mol) of....

   (a) 3600cm^3 of hydrogen gas, H_2

   Amount of H_2 gas: _____ mol

   (b) 4dm^3 of hydrogen gas, CO_2

   mount of CO_2 gas: _____ mol



5. Use this formula to calculate the volume of gas....

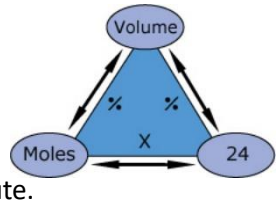
   (a) 6 mol of hydrogen gas, SO_2

   Volume of SO_2 gas: _____ dm^3

   (b) 0.25mol of oxygen gas, O_2

   Volume of CO_2 gas: _____ cm^3

6. Use this formula to calculate the volume produced in the following solutions....



(a) a solution with a concentration of 2 moldm^{-3} that contains 2 moles of solute.

Volume of solution: _____ dm^3

(b) a solution with a concentration of 0.25 moldm^{-3} that contains 0.005 moles of solute.

Volume of solution: _____ dm^3

7. Use this formula to calculate the concentration (in moldm^{-3}) for the following solutions....

(a) 0.5 moles of solid dissolved in 250cm^3 of solution

Concentration: _____ moldm^{-3}

(b) 0.00875 moles of solid dissolved in 25cm^3 solution

Concentration: _____ moldm^{-3}

8. Find the mass concentration, in gdm^{-3}, for the following solutions:

(a) 0.0042 moles of HNO_3 dissolved in 250cm^{-3} of solution

Mass concentration: _____ gdm^{-3}

(b) 0.5 moles of HCl dissolved in 4dm^3 of solution

Mass concentration: _____ gdm^{-3}

9. The following reaction can take place, shown in this equation: $\mathbf{NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}}$

(a) Balance the equation shown above

(b) What volume of CO_2 is formed by the decomposition of 5.04g of $NaHCO_3$?

Volume of CO_2: _____ dm^3

10. The following reaction can take place, shown in this equation:

$$\mathbf{MgCO_{3(s)} + HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}}$$

(a) Balance the equation shown above

(b) 2.529g of $MgCO_3$ reacts with an excess of HNO_3. What volume of CO_2 is formed?

(c) The final volume of the solution is 50.0cm^3. What is the concentration of $Mg(NO_3)_{2(aq)}$ formed?

11

Look at the equation for the reaction between potassium hydroxide and hydrochloric acid.

$$KOH + HCl \longrightarrow KCl + H_2O$$

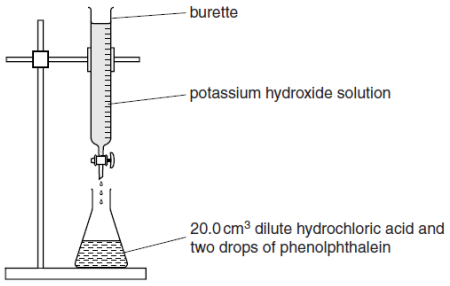
Calculate the **concentration** of potassium hydroxide in mol/dm^3.

These steps may help.

Work out the:

- number of moles in 20.0 cm^3 of 0.200 mol/dm^3 hydrochloric acid
- number of moles of potassium hydroxide neutralised
- average titre, in cm^3, using titration numbers **2**, **3** and **4**.

Look at the apparatus she uses.



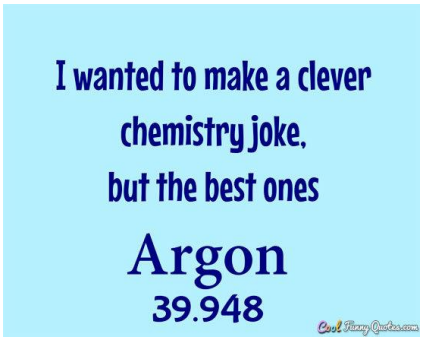
titration number	1	2	3	4
final burette reading in cm^3	26.9	27.6	27.0	28.2
initial burette reading in cm^3	0.5	2.5	2.0	3.3
titre (volume of alkali used) in cm^3	26.4	25.1	25.0	24.9

12

A solution of barium nitrate will react with a solution of sodium sulphate to produce a precipitate of barium sulphate.

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

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

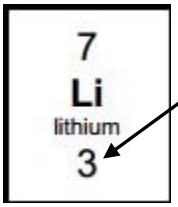


5 – Electronic structure, how electrons are arranged around the nucleus (In Y12 Topic Elements of life)

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the ***atom***.

You will have used the rule of electrons shell filling, where:

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).



Atomic number =3, electrons = 3, arrangement 2 in the first shell and 1 in the second or

Li = 2,1

At **A level** you will learn that the electron structure is more complex than this.

An electron SHELL is really and ENERGY LEVEL rather than a position in space. Electrons do not really orbit aa nucleus like planets round a solar system.

The 'shells' can be broken down into 'orbitals' which are which are given letters:'s' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here:

http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top

You will be taught this is in your first topic, Elements of Life.

Please move on if you don't want to practice these. THIS IS NEW.

If you want to practice then now that you know electrons are in principle energy levels (1,2,3,4,5 etc) which are divided up into sublevels called orbitals labelled as s, p and d orbitals.

Try these problems, write your answer in the format:

$1s^2$, $2s^2$, $2p^6$ etc.

Question

Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As

Extension question, can you write out the electron arrangement of the following ***ions***:

a) K^+ b) O^{2-} c) Zn^{2+} d) V^{5+} e) Co^{2+}

6 – Oxidation and reduction (In Y12 topic Elements from the Sea)

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

At A level, we use a term OXIDATION NUMBER, which helps us understand when something has been oxidised or reduced. If the number gets smaller, then it is reduced; bigger and it is oxidised.

The OXIDATION NUMBER is the charge an element has if it was an ion!

You know that the metals in group 1 react to form ions that are +1, i.e. Na^+ and that group 7, the halogens, form -1 ions, i.e. Br -.

We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1.

All atoms that are involved in a reaction can be given an oxidation number.

An element, Na or O_2 is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is **reduction**, if, in a reaction the element becomes **more** negative it has been reduced, if it becomes more positive it has been oxidised.

You can read about the rules for assigning oxidation numbers here:
http://www.dummies.com/how-to/content/rules-for-assigning-oxidation-numbers-to-elements.html

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

Metals have a + oxidation state when they react.
Oxygen is 'king' it always has an oxidation state of -2 Hydrogen has an oxidation state of +1 (except metal hydrides)
The charges in a molecule must cancel.

Examples: what is the oxidation number of Nitrogen in Sodium nitrate, $NaNO_3$?

	Na +1	3x O^{2-}
Total charge	+1	-6 but overall $NaNO_3$ has no charge so +1 -6 +(N) = 0 so N must be +5
	N = +5	

What is the oxidation number of sulphur in a sulphate ion, SO_4^{2-}

	4xO^{2-}
	-8 overall ionic charge is 2- so -9 + (S) = -2, so S must be +6
	S = +6

Question

Work out the oxidation state of the **underlined** atom in the following:

a) $Mg\underline{C}O_3$ b) $\underline{S}O_3$ c) $Na\underline{Cl}O_3$ d) $\underline{Mn}O_2$ e) $\underline{Fe}_2O_3$ f) $\underline{V}_2O_5$

g) $K\underline{Mn}O_4$ h) $\underline{Cr}_2O_7^{2-}$ i) $\underline{Cl}_2O_4$

7 – Organic chemistry (in Y12 Topic Developing Fuels)

You know what molecules look like that are called alkanes, alkenes, alcohols, carboxylic acids and esters. These different molecules behave different due to the different FUNCTIONAL GROUPS in them.

.

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

And how to name organic compounds here:

http://www.chemguide.co.uk/basicorg/conventions/names.html#top

Using the two links see if you can answer the following questions:

Questions

1 Draw a) heptane b) but-1-ene c) 2methylbutane

d) propanoic acid e) propyl ethanoate f) ethyl propaoate

2 What is made when propene reacts with Cl_2?

3) What two different molecules can be made when propene reacts with HCl?

4) Alcohols - How could you make ethanol from ethene?

5) How does ethanol react with sodium, in what ways is this

a) similar to the reaction with water, b) different to the reaction with water?

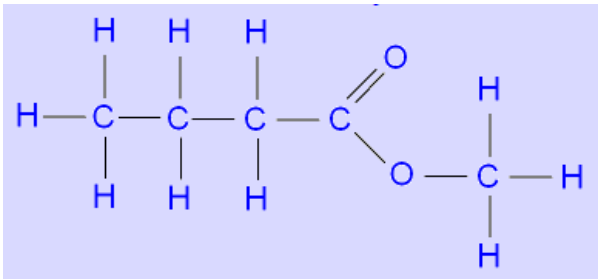
6) NEW MOLECULES - Aldehydes and ketones

Look up and draw the structures of

a) propanal b) propanone

How are these two functional groups different?

7) How would you go about making methyl butanoate?



8 Acids, bases, pH

At GCSE you will know that an acid can dissolve in water to produce H^+ ions, at A level you will need a greater understanding of what an acid or a base is.

Read the following page on Theory of acids and bases:

http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html#top

Read the following pages on Weak acids and bases

http://www.chemguide.co.uk/physical/acidbaseeqia/acids.html#top

Questions

1) Write your own new definition of an acid and a base.
2) Show how sulphuric acid acts as an acid.
3) Show how ammonia acts as a base.
4) Explain the idea of strong and weak acids and why this is different to concentrated or dilute acids.
5) Explain why ethanoic acid is a weaker acid than HCl.
6) EXTRA – why is fluoroethanoic acid and stronger acid that ethanoic acid?
7) If a solution of acid which has a pH = 2 is diluted $1cm^3$ into $100cm^3$ volume, what is the new pH?
8) If the pH = 2 solution is diluted into $50cm^3$, what is the pH (trickier?)

Things to Research!

Use your online searching abilities to see if you can find out as much about the topic as you can.

Remember you are a prospective A level student of chemistry so go 'one step beyond' your understanding.

Try using Cornell Notes to make a 1-page summary for each one you research. Or a short presentation.

Task 1: The chemistry of fireworks (explosions for some reason are not in the specification!)

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 some plastic, like polyacetylene can conduct electricity

Organic materials are always insulators, aren't they? Have you thought why?

Task 3: Why is copper sulphate blue? (cover this in Developing Metals, Year 13)

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

Task 4: Aspirin (cover this in What's in a Medicine? Year 12)

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

Task 5: The hole in the ozone layer (cover this in Ozone, Year 12)

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 6: ITO and the future of touch screen devices (rare earth metals – we don't cover)

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?

Transition Test

Circle the correct answers in this section

(Camscanner (app for phone) written answers, and send to smawson@qehs.net as a pdf document)

1 Which row shows the atomic structure of an atom of the ^{19}F isotope?

	Protons	neutrons	electrons
A	**9**	**9**	**10**
B	**9**	**10**	**9**
C	**10**	**9**	**10**
D	**10**	**10**	**9**

[1]

2 Which row shows the numbers of neutrons and electrons in an $^{56}Fe^{3+}$ ion?

	Neutrons	electrons
A	**26**	**27**
B	**29.8**	**56**
C	**30**	**23**
D	**33**	**20**

[1]

3 What is the total number of electrons in a nitrate ion, NO_3^-?

A 32 **B** 33

C 47 **D** 64

[1]

4 Calcium hydroxide contains Ca^{2+} and OH^- ions.

What is the formula of calcium hydroxide?

A CaOH **B** $CaOH_2$

C Ca_2OH **D** $Ca(OH)_2$

[1]

5 The mass of an object measured on a 4 decimal place balance is 7.0855 g

What is this mass to 3 significant figures?

A 7.09 g **B** 7.19 g

C 7.085 g **D** 7.086 g

[1]

6 Rearrange $PV = nRT$ to make n the subject.

A $n = \frac{RV}{PT}$ **B** $n = \frac{PV}{RT}$

C $n = \frac{RT}{PV}$ **D** $n = \frac{1}{RTPV}$

[1]

7 Lithium reacts with oxygen to form lithium oxide, Li_2O

Which equation is correct for this reaction?

A $Li + O_2 \rightarrow Li_2O$

B $Li + O_2 \rightarrow LiO_2$

C $2Li + O_2 \rightarrow Li_2O_2$

D $4Li + O_2 \rightarrow 2Li_2O$

[1]

8 Balance the equation below.

___K_3PO_4 + ___$Ca(NO_3)_2 \rightarrow$ ___KNO_3 + ___$Ca_3(PO_4)_2$

[2]

9 What is the relative formula mass of NH_4NO_3?

A 42.0

B 56.0

C 66.0

D 80.0

[1]

10 How many moles of CO_2 are there in 22 g of CO_2?

A 0.25

B 0.5

C 2

D 4

[1]

Tick the boxes next to the correct answers in this section

11 Sodium carbonate contains sodium ions and carbonate ions.

Which statement(s) is/are correct?

The formula of sodium carbonate is $NaCO_3$.	☐
The relative formula mass of sodium carbonate is 106.	☐
A carbonate ion has the formula CO_3^{2-}.	☐
A sodium ion contains one electron in its outer shell.	☐

[1]

12 A sample of copper contains two isotopes, ^{63}Cu and ^{65}Cu.
The relative atomic mass of copper is 63.5.

Which statement(s) is/are correct? Tick **two** boxes

^{65}Cu has two more neutrons than ^{63}Cu	☐
^{65}Cu has two more protons than ^{63}Cu	☐
^{63}Cu and ^{65}Cu contain the same number of electrons	☐
^{65}Cu has two more electrons than ^{63}Cu	☐

[1]

14 Which statement describes the structure of an atom?

a sphere of positive charge with electrons embedded in it	☐
a nucleus containing protons and neutrons, orbited by electrons	☐
a solid sphere that cannot be divided into smaller parts	☐
protons and electrons concentrated in a nucleus, surrounded by orbiting neutrons	☐

[1]

15 Which force holds an atom's nucleus together?

electrostatic force	☐
electromagnetic force	☐
strong nuclear force	☐
weak intermolecular interactions	☐

[1]

16 What type of error is caused by results varying around the true value in an unpredictable way?

measurement error	☐
systematic error	☐
random error	☐
zero error	☐

[1]

Answer the questions in the spaces provided in this section

17 Describe what it means when results are described as:

accurate: .....

.....

precise: .....

..... **[2]**

18 This question is about atoms, isotopes and ions.

(a) **(i)** Complete the table below to show the properties of the particles.

Particle	Relative mass	Relative charge
proton		
neutron		
electron		

[3]

(ii) Complete the table for an atom and an ion of two **different** elements.

Element	Mass number	Protons	Neutrons	Charge	Electron configuration
……	……	**11**	**13**	**0**	……
……	**34**	……	……	**2–**	**2.8.8**

[2]

(b) State the similarities and differences between isotopes of the **same** element.

Similarities.....

Differences.....

. **[2]**

(c) An isotope of an element **X** contains 56 protons and 56 neutrons.

Identify element **X** and write down the mass number and atomic number
of this isotope of **X**.

element **X** = ...

Atomic number: .....

Mass number: ..... **[3]**

18 Describe the function of a mass spectrometer.

....

.... **[2]**

Chemistry Analysis Transition Project:

Aims:

At A Level you won't just need to learn more chemistry, you will need to be able to solve more complex chemical problems without the structure provided by GCSE exam questions. The aim of this project is to allow you to use your GCSE knowledge, but applied in an A Level manner. You will have to plan and problem solve independently and justify your choices of methods and equipment. This is a relatively new skill, so we know you may need to email to ask for support, but think carefully about your questions!

Direct your questions to Mr Mawson by emailing smawson@qehs.net.

Background:

Antacids are common over the counter medications designed to treat heartburn or indigestion which is a result of excess stomach acid. The active ingredient is typically a

Group 1 or 2 metal oxide or group 1 or 2 metal carbonate.

When taken, these react with excess hydrochloric acid in the stomach forming harmless products, and prevent the discomfort when excess acid causes irritation of the gullet.

In addition to the active ingredient, the tablets contain a chemical filler to hold the tablet into a recognisable and easier to digest shape and sometimes contain flavourings such as mint. For the purposes of this task, you can assume that none of these additions react with the acid in the stomach.

The Task:

You have been given an indigestion tablet of unknown brand. The mass of each tablet is around 2.0g. You need to identify the active ingredient of the tablet and determine the percentage by mass of the tablet which is the active ingredient. You will have access to a range of typical laboratory equipment and reagents which are listed on page 3 of this document. Be aware, there are multiple ways to perform this analysis, and you may be asked to consider if the method you have chosen will yield the most accurate results.

You will need to prepare a report detailing how you plan to record your results, how you will ensure that your results are sufficiently accurate and how you have determined the active ingredient and percentage purity by mass of the tablet. You will also be asked to research some techniques that will be introduced at A level which could aid your analysis.

When you have completed your experimental design, you will need to email the method to Mr Mawson who will reply giving you a set of experimental results to use for the purposes of your calculations and analysis.

The table on the following page details what you should consider in each step. Your work can be handwritten or word processed.

Stage of Report	**What we are looking for.**
Plan	• A suitable plan to identify the active ingredient in the tablet. **<u>This must assume that this ingredient is unknown</u>.** • A suitable plan to determine the percentage by mass of the tablet which is that active ingredient. **<u>For this stage, you can assume the active ingredient is calcium carbonate (so experimental data can be sent to you).</u>** • Plans written in detail, with clear, exacting step by step bullet points. • Calculations to justify the choice of measuring equipment and volumes of solutions used. • Justification of equipment choices and methods that will yield the most accurate and reliable results. • Equations to represent any reactions that will take place in the experiment. • A table of results to record your measurements. **Remember to send your plan to Mr Mawson at the end of this stage so he can provide you with experimental results.**
Analysis	• A summary of your **<u>qualitative</u>** analysis to identify the active ingredient. • **<u>Calculation</u>** using **<u>results provided</u>** to identify the percentage by mass of the tablet that is the active ingredient.
Evaluation	• Calculation demonstrating the **<u>maximum percentage error</u>** on the percentage purity by mass calculation. • Discussion of where the **<u>largest sources of error</u>** came from, and how you could modify the experiment to reduce these errors.
Research	• Use the internet to research how **<u>mass spectrometry</u>** could be used to confirm the identity of the active ingredient. Explain how this technique works and how it would be used in this experiment. • Use the internet to research **<u>Gas Chromatography</u>**. Discuss is this would be an appropriate technique to support the analysis of this medicine.

List of Available Equipment for Experimental Design.

Note, you may not require all this equipment!

- Top Pan Balances (0-100g in 0.01g intervals and 0-60g in 0.001g intervals)
- Conical Flasks (100cm^3 and 250cm^3)
- Measuring Cylinders (capacity in cm^3/intervals in cm^3) 10/0.1, 50/0.5, 100/1, 250/1
- Plastic Weighing Boats
- Thermometers (-10 to 110°c in 0.5°c intervals)
- Beakers (100cm^3 and 250cm^3)
- Graduated Flask (250cm^3)
- Gas Syringe with delivery tube and bungs for conical flasks (150cm^3 in 1cm^3 intervals)
- Burette with stand (50cm^3 in 0.1cm^3 intervals)
- Graduated Pipette and filler (25cm^3)
- Dropping Pipette
- Clamp Stands.
- Heat Proof Mat
- Bunsen Burner
- Tripod
- Gauze
- Evaporating Basin
- Nichrome Wire
- Platinum Wire
- White Tile
- Safety Goggles
- Nitrile Gloves
- Distilled Water
- 1.0mol dm^{-3} Sodium Hydroxide
- 1.0mol dm^{-3} Hydrochloric Acid
- Concentrated Hydrochloric Acid
- Universal Indicator
- Methyl Orange Indicator
- Phenolphthalein Indicator.
- Stop Watch
- Mortar and Pestle
- Glass Rod
- Filter Paper
- Funnel
- Silver Nitrate solution in dropper bottle.
- Barium Chloride solution in dropper bottle.