ALTON
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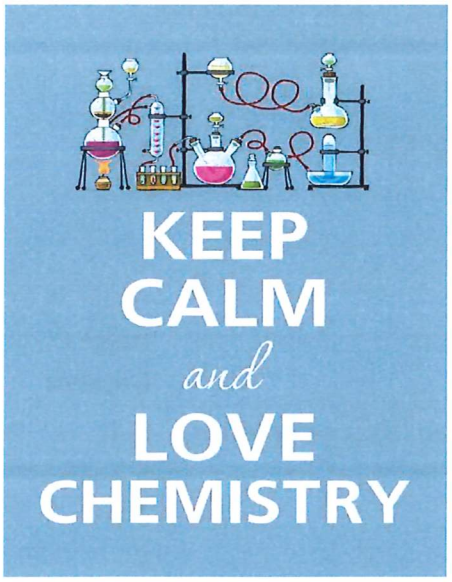
GCSE to A level Transition workbook

Chemistry



Lots of hints & tips & how to lay out your work so it is logical, with steps clearly indicated

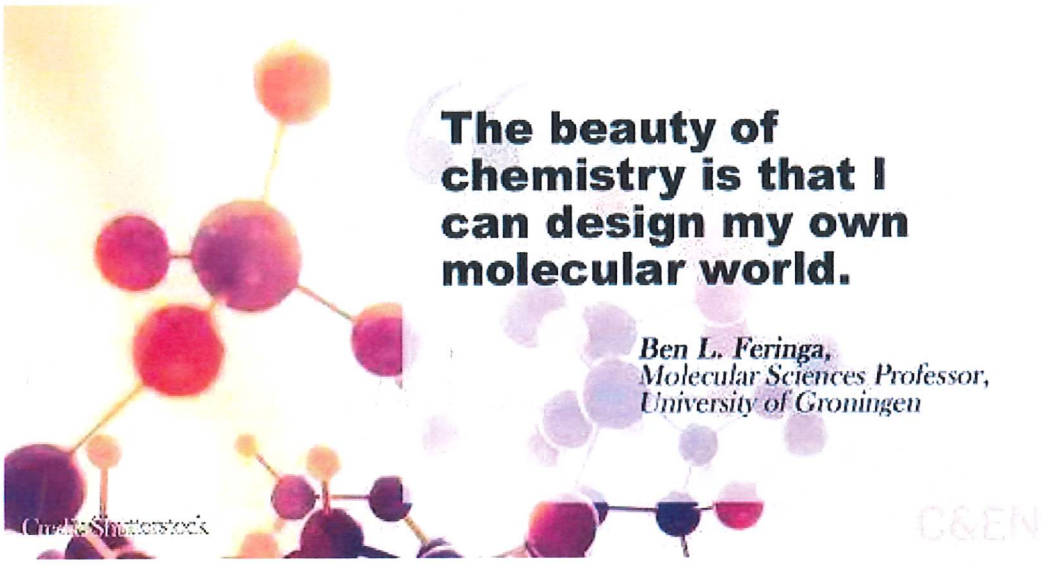
Name: Anne Serrs

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.

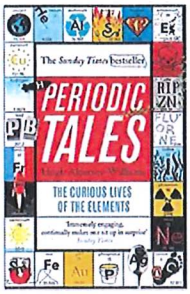


Contents

Books you might want to read or purchase?

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

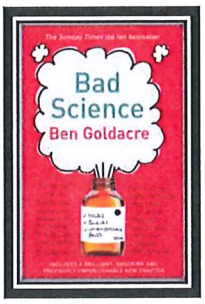
ISBN-10: 0141041455



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.

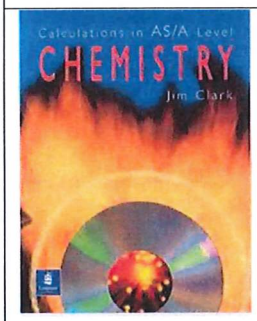
Bad Science (Paperback) Ben Goldacre

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.

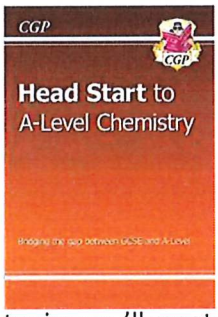


Calculations in AS/A Level Chemistry (Paperback) Jim Clark

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.
VERY USEFUL

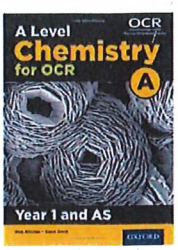
Head Start to A-level Chemistry (CGP A-Level OCR A Chemistry)



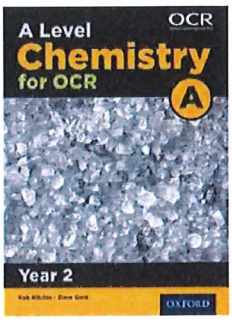
This fantastic Head Start book from CGP is the ideal way to bridge the gap between GCSE and A-Level Chemistry. It recaps all the crucial topics you'll need to remember from GCSE, with crystal-clear study notes and examples, plus practice questions to test your understanding. It also includes introductions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

A Level Chemistry for OCR our first year text book https://www.amazon.co.uk/Level-Chemistry-Year-Student-Book/dp/0198351968

ISBN-10: **0198351968**
VERY USEFUL



A Level Chemistry for OCR A: Year 2 Paperback – 10 Sept. 2015
by Dave Gent (Author), Rob Ritchie (Series Editor)
VERY USEFUL



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 - **mt1oxlhte8**

Chemistry: OCR A Level Preparation work - Summer 2025

https://app.senecalearning.com/dashboard/class/mt1oxlhte8/assignments/assignment/a84b88c7-ce35-4241-ae9d-71d3970d9eae

https://app.senecalearning.com/dashboard/class/mt1oxlhte8/assignments/assignment/66294254-6427-4481-90e5-feee3fb8094e

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:

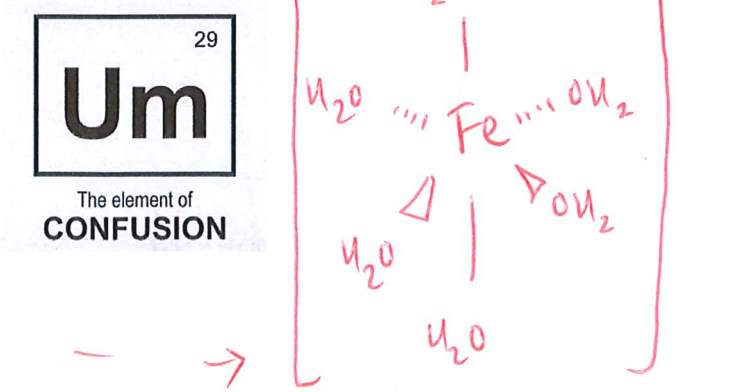
https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Balance the following equations

1. 2 C + O_2 → 2 CO
2. Ba + 2 H_2O → $Ba(OH)_2$ + H_2
3. C_2H_6 + 3.5 O_2 → 2 CO_2 + 3 H_2O
4. 2 HCl + $Mg(OH)_2$ → $MgCl_2$ + 2 H_2O
5. N_2 + O_2 → 2 NO
6. 2 Fe_2O_3 + 3 C → 4 Fe + 3 CO_2
7. CH_3CH_2OH + 2 [O] → CH_3COOH + H_2O
8. 2 HNO_3 + CuO → $Cu(NO_3)_2$ + H_2O
9. Al^{3+} + 3 e^- → Al (Reduction is gain of e-)
10. 2 $[Fe(H_2O)_6]^{3+}$ + 3 CO_3^{2-} → 2 $Fe(OH)_3(H_2O)_3$ + 3 CO_2 + 3 H_2O

* when you have 3's & 2's find the common multiple.

This is a Complex ion.



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 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 → 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.

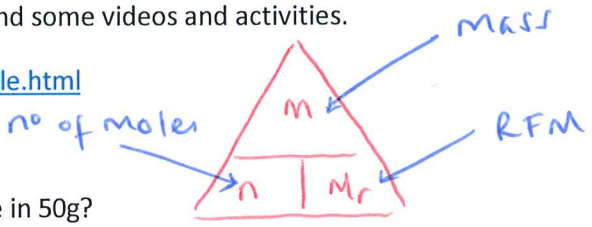
From the periodic table: Mg = 24.3 and S = 32.1

If I weigh 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 chloride?

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. $MgSO_4.7H_2O \rightarrow MgSO_4 + 7H_2O$

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?

2.4g

$2Mg + O_2 \rightarrow MgO$

0.098 0.049

Answer

a) $n = \frac{m}{Mr} = \frac{50}{18} = 2.78\ mol$

b) $n = \frac{m}{Mr} = \frac{100}{(39.1 + 35.5)} = 1.34\ mol$

c) $n = \frac{300g}{(24.3 + 32.1 + 4(16) + 7(18))} = \frac{300g}{246.4} = 1.2175 = 1.22\ (3sf)$

c) cont....

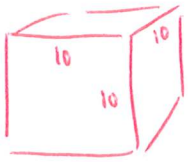
$MgSO_4.7H_2O \rightarrow MgSO_4 + 7H_2O$

$1.22\ mol \rightarrow 1.22\ mol + 8.52$

$\therefore$ 8.52 moles of H_2O.

d) $m = n \times Mr = 0.28 \times 46 = 12.88g$

e) 1.58g

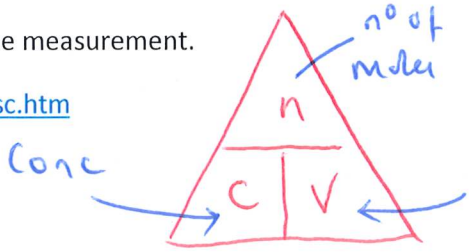


10 x 10 x 10

3 – Solutions and concentrations

The dm^3 is a cubic decimeter, 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



$c = \frac{n}{V}$

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 ($AgNO_3$)? $m = n \times M_r$

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 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

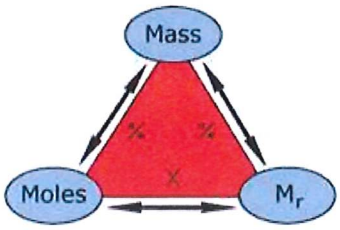
Step 5: Calculate concentration. concentration = moles/volume ←in dm^3 = 0.00137/0.025 = ***0.0548 moldm^{-3}***

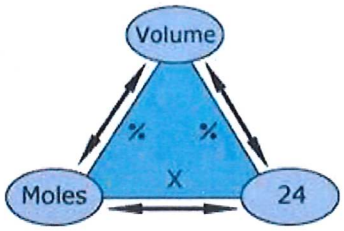
Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.

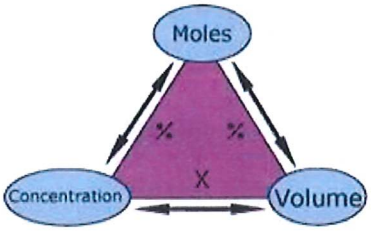
http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm

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....

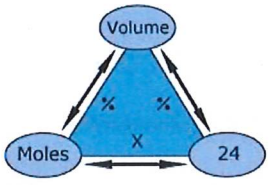
   a) 31.0 g of phosphorus molecules, P_4

   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: _____



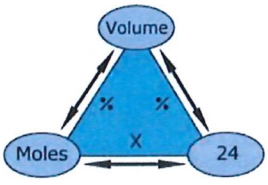
4. Use this formula to calculate the amount of gas (in mol) of....

   (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....

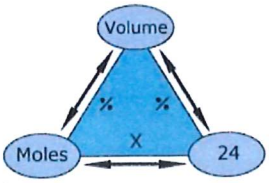
   (a) 6 mol of hydrogen gas, SO_2

   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?

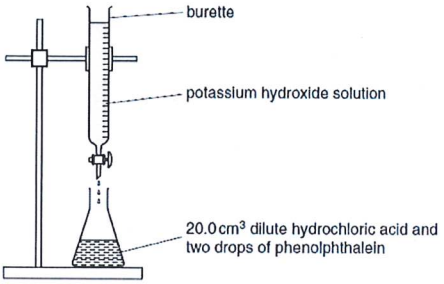
(c) The final volume of the solution is 50.0cm^3. What is the concentration of $Mg(NO_3)_{2(aq)}$ formed?

11

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

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

Look at the apparatus she uses.



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**.

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

X

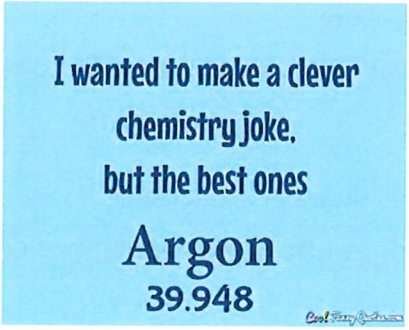
O = Concordant results. They differ by ± 0.1.

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?

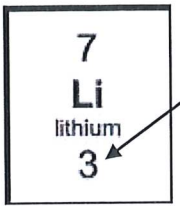


5 – Electronic structure, how electrons are arranged around the nucleus (In Y12 Topic Elements of life)

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

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) $NaClO_3$ 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

You should know what molecules look like, that are called alkanes, alkenes, alcohols, carboxylic acids and esters. These different molecules behave differently 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 propanoate

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?

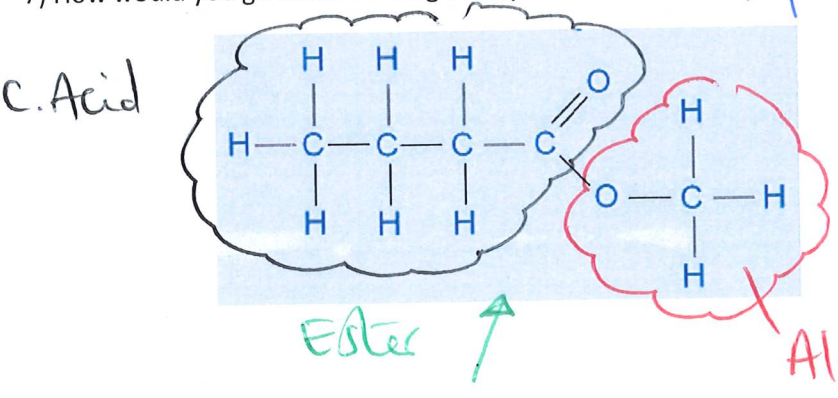
6) NEW MOLECULES - Aldehydes and ketones

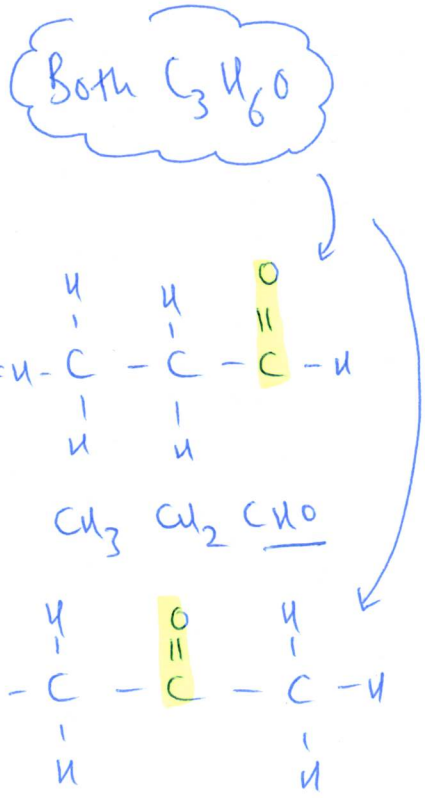
Look up and draw the structures of

a) propanal b) propanone

How are these two functional groups different?

7) How would you go about making methyl butanoate?





To make this ester; Methanol + Butanoic Acid.

Things to Research!

This will be our ice breaker week (1)

Use your online searching abilities to see if you can find out as much as you can about 1 the topics listed below.

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. ↑ 5-10 mins

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?

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

Task 4: Aspirin

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

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

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?

3 – Solutions & Concentrations (Page 7)

a) $c = \frac{n}{V}$ ← You need to calc moles first

$n = \frac{m}{Mr} = \frac{9.53}{(24.3 + 35.5 + 35.5)} = \frac{9.53}{95.3} = 0.1 \text{ mol}$

$c = \frac{0.1}{0.1 \left(\frac{100}{1000}\right)}$ $\quad c = \underline{1.0} \text{ mol/dm}^3$

b) $c = \frac{n}{V}$

$n = \frac{13.248}{331} = 0.04 \text{ mol}$

$c = \frac{0.04}{2} = \underline{0.02} \text{ mol/dm}^3$

c) Adding 100 cm^3 to 1900 cm^3 makes 2000 cm^3 which is 2 dm^3.

$c = \frac{n}{V} = \frac{1.0}{2} = \underline{0.5} \text{ mol/dm}^3$

(Molarity = Concentration)

d) $n = c \times v$

$= 1 \times 0.1$

$= 0.1 \text{ mol}$

$\text{mass} = n \times Mr$

$= 0.1 \times 107.9$

$= 10.79 \text{ g}$

e) 0.0526 moles per dm^3

$\text{mass} = n \times Mr$

$= 0.0526 \times 79.9$

$= 4.2 \text{ g}$

4 – Titration (Page 7)

1. a) $m = n \times M_r$
$= 2.5 \times 2$
$= 5\,g$

b) $m = n \times M_r$
$= 0.5 \times 58.5$
$= 29.25\,g$

2. a) $n = \frac{m}{M_r} = \frac{31}{4(31)} = 0.25\ mol$

b) $n = \frac{m}{M_r} = \frac{50}{100} = 0.5\ mol$

3. $M_r = \frac{m}{n} = \frac{11}{0.25} = 44\ g/mol$

$X = CO_{2\,(g)}$ $\quad (12 + 16 + 16 = 44)$

4. a) 1 mol of any gas = 24,000 cm^3 @ RTP.
$V = dm^3$ ∴ divide vol of gas by 1000.

$n = \frac{V}{24} = \frac{3.6}{24} = 0.15\ mol$

b) $n = \frac{V}{24} = \frac{4}{24} = 0.17\ mol$

5 a) $V = n \times 24$

$= 6 \times 24$

$= 144\ dm^3$

b) $V = n \times 24$

$= 0.25 \times 24$

$= 6\ dm^3$

6 a) $V = \frac{n}{C}$ ← n° of moles ← concentration

$V = \frac{2}{2}$

$V = 1\ dm^3$

b) $V = \frac{n}{C}$

$V = \frac{0.005}{0.25}$

$V = 0.2\ mol$

7 a) $c = \frac{n}{V}$ ← in dm^3 ∴ divide by 1000.

$c = \frac{0.5}{\left(\frac{250}{1000}\right)}$

$cm^3 \xrightarrow{\div 1000} dm^3 \xrightarrow{\div 1000} m^3$
$\xleftarrow{\times 1000} \quad \xleftarrow{\times 1000}$

$c = 2.0 \text{ mol} / dm^3$ or $\text{mol } dm^{-3}$

b) $c = \frac{n}{V}$

$c = \frac{0.00875}{\left(\frac{25}{1000}\right)}$

$c = 0.35 \text{ mol} / dm^3$

8 a) Concentration can be written as moles per litre (dm^3) or grams per litre.

$m = n \times Mr$
$= 0.0042 \times 63$
$= 0.2646 \text{ g}$ in $250 cm^3$
↓ ↓ scale up (x4)
1.0584 g in $1000 cm^3$ ($1 dm^3$)

$\text{Conc} = 1.06 \text{ g} / dm^3$.

8→

b) $m = n \times Mr$

$= 0.5 \times 36.5$

$= 18.25\ g$

$18.25\ g$ in $4\ dm^3$ — Scale down

$\downarrow \div 4$ $\quad$ $\downarrow \div 4$

$1\ dm^3$

$1.14\ g$

Conc $= 1.14\ g / dm^3$

9 a) $2NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$

$0.06\ mol$ $\quad$ $0.03\ mol$

b) $n\ NaHCO_3 = \frac{m}{Mr}$

$= \frac{5.04g}{84}$

$= 0.06\ moles$

The ratio from above is $NaHCO_3 : CO_2$

$2 : 1$

$0.06 : 0.03$

$V = n \times 24$

$= 0.03 \times 24$

$= 0.72\ dm^3 \xrightarrow{\times 1000} 720\ cm^3$

10. $MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + CO_2 + H_2O$

Mg^{2+} / NO_3^- NO_3^- charge cancel.

2+ : 2−

b. $n\ MgCO_3 = \frac{m}{Mr}$

$= \frac{2.529}{84.3}$

$= 0.03$ mol

ratio $MgCO_3 : CO_2$

1 : 1

0.03 : 0.03

$V = n \times 24$

$= 0.03 \times 24$

$= 0.72\ dm^3$ or $720\ cm^3$.

c) $c = \frac{n}{V} = \frac{0.03}{0.05}$ ← 1:1 ratio all $MgCO_3$ converted into $Mg(NO_3)_2$

$= 0.6$ mol/dm³

$\left(\frac{50}{1000}\right)$

11.

$n = C \times V$

$= 0.2 \times 0.02$

$= 4 \times 10^{-3}$ mol (HCl)

Ratio 1 : 1 $\therefore$ 4×10^{-3} mol of alkali neutralised.

$C = \frac{n}{V} = \frac{4 \times 10^{-3}}{\left(\frac{25}{1000}\right)}$

Ave titre → $\frac{25.1 + 25 + 24.9}{3}$

$C = 0.16$ mol/dm^3

12. $n\ Ba(NO_3)_2 = C \times V$

$= 0.15 \times \frac{12.5}{1000}$

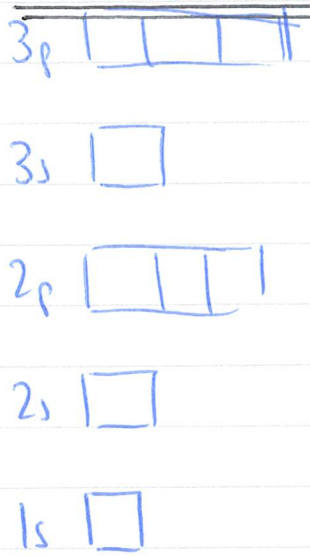
$= 1.875 \times 10^{-3}$ mol

Ratio 1:1 $\therefore$ 1.875×10^{-3} mol of Na_2SO_4 required.

$V = \frac{n}{C} = \frac{1.875 \times 10^{-3}}{0.25} = 7.5 \times 10^{-3}$ dm^3

$= 7.5$ cm^3.

5 – Electronic Structure (Page 11)



The order with which e⁻ fill up.

1s 2s 2p 3s 3p 4s 3d 4p

□ = empty orbital.

4th Period (row)

20 Ca $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

↑ 's' block.

13 Al $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

16 S $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

17 Cl $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

* 18 Ar $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

26 Fe $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

23 V $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

28 Ni $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

29 Cu $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

30 Zn $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$

33 As $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^3$

or * [Ar] $4s^2\ 3d^{10}\ 4p^3$

When atoms lose e⁻, the e⁻ in the (4s) sub-shell are lost first. It is just "easier" ie less energy required.

$_{19}K = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (4s^1)$

$_{19}K^+ = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ Noble gas! Argon

$O = 1s^2\ 2s^2\ 2p^4$

$O^{2-} = 1s^2\ 2s^2\ 2p^6$ Noble gas! Neon

$_{30}Zn = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (4s^2)\ 3d^{10}$

$Zn^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$ lost 2e⁻

$_{23}V = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (4s^2)\ (3d^3)$

$V^{5+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ lost 5e⁻

$_{27}Co = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (4s^2)\ 3d^7$

$Co^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^7$ lost 2e⁻

6- Redox. (Page 12)

$MgCO_3$ $\quad C = +4$

+2 +4 -2
-2
-2

$\boxed{+6 = -6}$

SO_3 $\quad S = +6$

+6 -2
-2
-2

$NaClO_3$ $\quad Cl = +5$

+1 +5 -2
-2
-2

MnO_2 $\quad Mn = +4$

+4 -2
-2

Fe_2O_3 $\quad Fe = +3$

+3 -2
+3 -2
-2

V_2O_5

$V = +5$

+5 −2
+5 −2
−2
−2
−2

$KMnO_4$

$Mn = +7$

+1 +7 −2
−2
−2
−2

$Cr_2O_7^{2-}$

$Cr = +6$

+6 −2
+6 −2
−2
−2
−2
−2
−2
+12 ≠ −14

Cl_2O_4

$Cl = +4.$

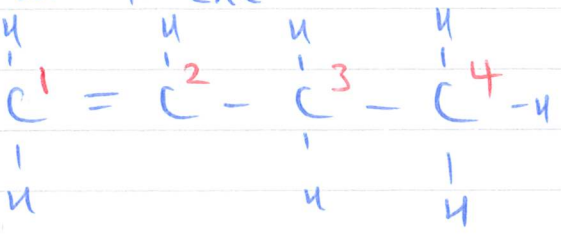
+4 −2
+4 −2
−2
−2

7 – Organic Chemistry. (Page 13)

1 a) Heptane = C_7H_{16} (C_nH_{2n+2})

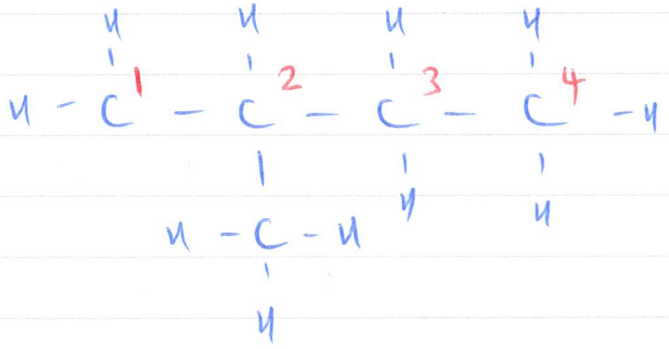
Alkane

b) But-1-ene



Alkene

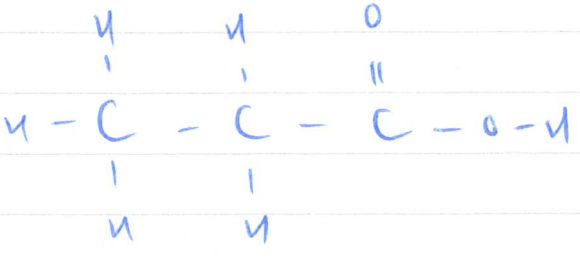
c)



– CH_3 = methyl.

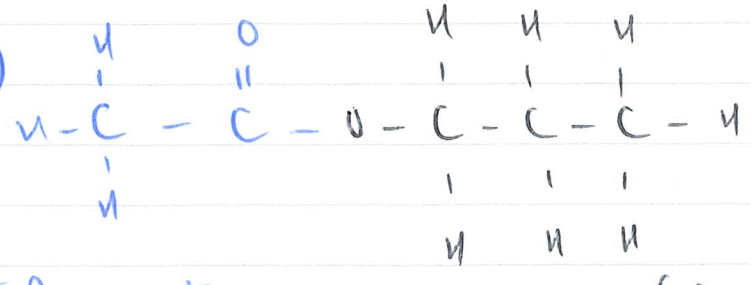
Branched Alkene

d) Propanoic



Carboxylic Acid.

e)



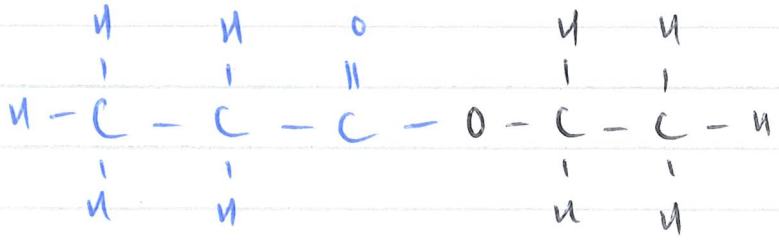
Ester

Ethanoate from ethanoic acid

propyl (from propanol)

f) ethyl propanoate

↑ ethanol ↑ Propanoic acid — Ester.



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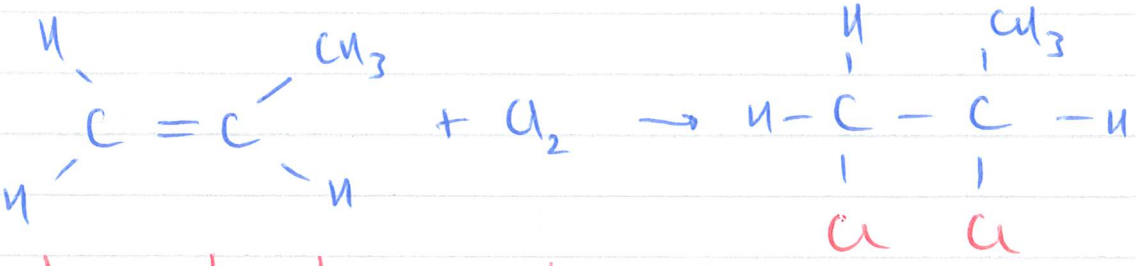
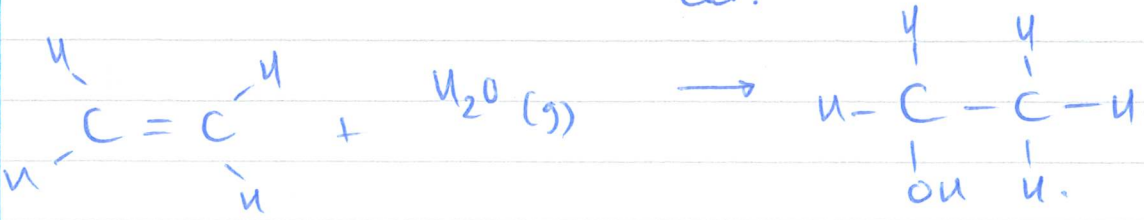


double bond opens & Re 2 Cl atoms add across.

3

4 Ethene + Steam $\xrightarrow[\text{Cat.}]{H_3PO_4}$ Ethanol



Ethanol + Sodium → Sodium ethoxide + H_2

Similar = Re Na disappears & bubbles of H_2 form.

Diff = less vigorous Rxn with water as Re O–H bond in ethanol is stronger than O–H bond in H_2O.