The Transition to A-Level Chemistry

WKGS

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Introduction

Many students find that the transition from GCSE to A-Level Chemistry a challenging one. This booklet aims to make that transition smoother and to give you the best possible start in September.

It is important that you read through all the information carefully. This booklet contains material such as:

- Course information
- Books recommended to support your learning on the course
- Books recommended for wider reading
- Websites you will find useful throughout the course
- Videos that will help to promote a curiosity in the subject
- A wide range of activities and resources to ensure that your GCSE knowledge needed for A-Level is secure

You will have a short assessment on the tasks in the section of this booklet called 'Preparation for A Level Chemistry' in September. Please ensure that you have attempted this section and self -assessed

Contents

Course Information

Introduction, exam board and course content

This course will suit any student with a genuine interest and enthusiasm for all that is around them; it will provide a firm scientific foundation for those wanting to make their mark in the world of science and technology in the future. You will develop practical, analytical and problem-solving skills through regular practical work. These skills are invaluable, universally accepted and highly sought after by universities and employers.

The course itself is AQA A-Level Chemistry and it is split it to three different disciplines, with each discipline containing several different topics.

- **Physical Chemistry**
  - Atomic structure; Amount of substance; Bonding; Energetics; Kinetics; Chemical equilibria, Le Chatelier's principle and Kc; Oxidation, reduction and redox equations; Thermodynamics; Rate equations; Equilibrium constant Kp for homogeneous systems; Electrode potentials and electrochemical cells; Acids and bases

- **Inorganic Chemistry**

- Periodicity; Group 2 - the alkaline earth metals; Group 7(17) - the halogens; Properties of Period 3 elements and their oxides; Transition metals ; Reactions of ions in aqueous solution

- **Organic Chemistry**

  - Introduction to organic chemistry; Alkanes; Halogenoalkanes; Alkenes; Alcohols; Organic analysis; Optical isomerism; Aldehydes and ketones; Carboxylic acids and derivatives; Aromatic chemistry ; Amines ; Polymers; Amino acids, proteins and DNA; Organic synthesis; Nuclear magnetic resonance spectroscopy; Chromatography

Assessment

If you choose to take Chemistry as an AS you will sit two written papers of 1 hour and 30 minutes at the end of Y**12**. Paper 1 will assess content from the Inorganic and Physical topics and Paper 2 will assess content from the Organic and Physical topics.

For the full A-Level, there will be three written papers of 2 hours each. Paper 1 will assess content from the Inorganic and Physical topics, paper 2 will assess content from the Organic and Physical topics and paper 3 will assess content from across the entire course.

20% of the overall assessment for A-Level Chemistry will contain questions which assess your mathematical skills.

At least 15% of the overall assessment for A-Level Chemistry will assess knowledge, skills and understanding in relation to practical work.

Practical Assessment

No Chemistry course would be complete without practical work and you will carry out many practical experiments to aid your understanding throughout the course. Similar to GCSE, some of these practical activities will be classes as 'required practicals'. The methods and theory behind these practicals can be assessed in your A-level examinations.

Unlike GCSE, however, you also be assessed on your performance during these practicals and the subsequent practical write-ups. This will be done using the CPAC system.

There are five CPAC (Common Practical Assessment Criteria) skill areas that students are assessed in over the two years. Each student will have the opportunity to master each skill area and gain a pass which will be on their A-level examination certificate. The skills areas are:

- CPAC1 – Follows written procedures
- CPAC2 – Investigative approaches and methods
- CPAC3 – Safety
- CAPC4 – Makes and records observations
- CPAC 5 – Researches, references and reports

You will have plenty of opportunities to gain all of these CPACs throughout the course and you will be awarded with an endorsement of your practical skills, alongside your A-Level.

Specification

This single most important resource for any student that wants to truly exceed at A-Level Chemistry is the AQA A-Level Specification. Not only does it contain more in-depth information about the course, assessments and practical work; but it also contains an itemised list of all of the content you should know and all of the things you will be expected to be able to do in assessments.

- Link to specification https://filestore.aqa.org.uk/resources/chemistry/specifications/AQA-7404-7405-SP-2015.PDF

Recommended Resources to Support Your Learning

Up Learn

Every student at WKGS will given a log-in to the online learning platform Up Learn. This contains a variety of useful resources that you can use to support your learning including quizzes, exam questions practice and support. Teachers will set assignments on Up Learn to complete, to aid in your understanding of a topic area.

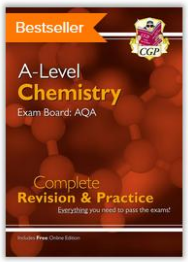
You will be shown how to access and use UpLearn at the beginning of the course in September.

Other Recommended Resources

At WKGS, we will ensure you have access to plenty of resources to help you progress through the course. These include notes for each topic including exercise questions, access to a wide range of past papers and mark schemes, lesson PowerPoints and revision materials. However, we are often asked what other resources we would recommend if you did wish to purchase some additional support materials.

We recommend the use of GCP revision guides and workbooks to support your learning. We usually offer the chance, during the first term, to purchase these

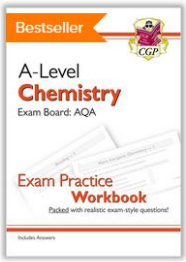
through school for a slightly reduced price. But please see the links below if you wish to purchase any before this time.



Quick View

New A-Level Chemistry: AQA Year 1 & 2 Complete Revision & Practice with Online Edition

CAR73

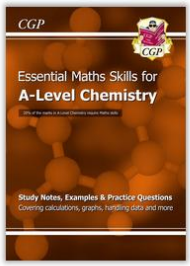


Quick View

New A-Level Chemistry: AQA Year 1 & 2 Exam Practice Workbook - includes Answers

CAQ71

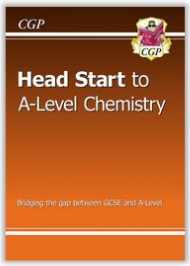
The "A-Level Chemistry: AQA Year 1&2 Complete Revision and Practice" and "A-Level Chemistry: AQA Year 1&2 Exam Practice Workbook" pictured above are two examples of non-essential, but extremely useful resources.



Quick View

A-Level Chemistry: Essential Maths Skills

CMR71



Quick View

Head Start to A-level Chemistry

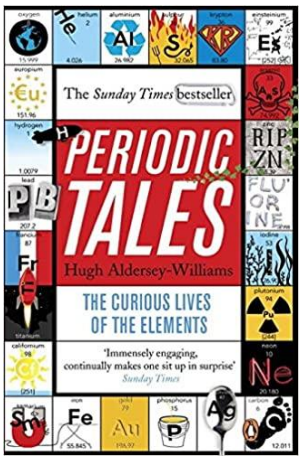
CBR71

These are two other potentially very useful resources from CGP. One of the main challenges many students face with the transition from GCSE at A-Level Chemistry is dealing with the mathematical nature of some parts of the course. If you do not feel as confident with your maths skills "A-level Chemistry: Essential Maths Skills" could be of great help. The second resource picture above "Head Start to A-Level Chemistry" aims to help bridge the gap between the GCSE and A-Level courses.

Link to recommended GCP Resources - GCP Resources

Recommended Wider Reading

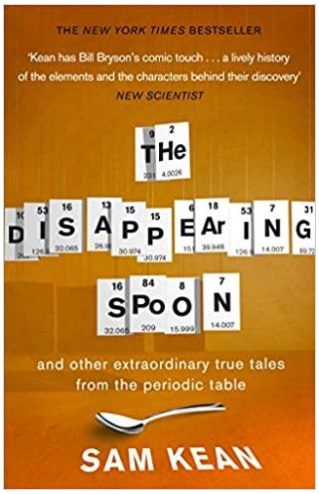
Studies have shown that students that read around their subject often have higher levels of academic performance then those who do not. Wider reading can help you to understand not only the history of your subject, but also how it fits in to everyday life. This can often help you have a deeper understanding of the content you cover as part of the course. Here is a short list some interesting and easily digestible books you may enjoy.



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

ISBN-10: 0141041455

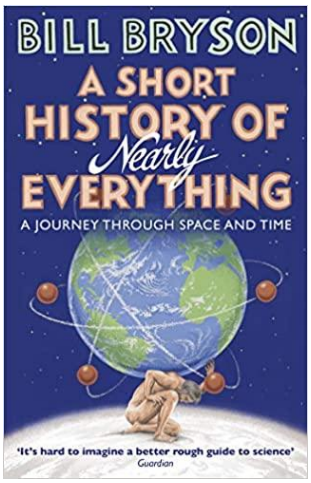
This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.



The Disappearing Spoon (Paperback) Sam Kean

ISBN-10: 0552777501

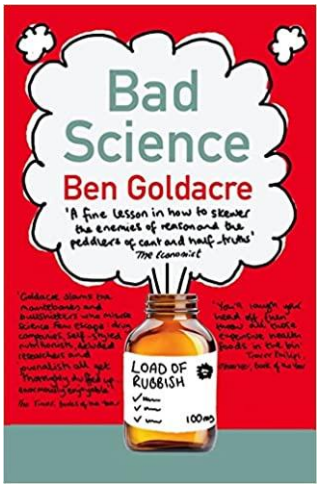
This is another book that contains amusing and informative tales about how many of the elements were discovered and the stories behind them and how many of the elements helped shape the course of human history itself.



A Short History of Nearly Everything (Paperback) Bill Bryson

ISBN-10: 9781784161859

This book covers the history of science itself and the stories of many of the greatest scientific discoveries of all time. It is written by a non-scientist, so it is great at explaining many scientific theories in ways that any layperson can understand. It tells the stories of the greatest heroes and villains across the history of science and will help you put a face to many of the scientists we mention throughout any of the three science courses. The audiobook version is also great!



Bad Science (Paperback) Ben Goldacre

ISBN-10: 000728487X

Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science. This book will make you think about everything the advertising industry tries to sell you by

making it sound 'sciency'. But it will also give a good idea of the importance of a robust scientific method.

Magazines such as New Scientist, Scientific American, Chemistry World, and Periodic by Oxford University are also excellent ways to read about the exciting new advances across all fields of science and maybe even to give you ideas about a future career in science!

Periodic magazine | Department of Chemistry

Chemistry news, research and opinions | Chemistry World

New Scientist | Science news, articles, and features

Scientific American

Recommended Videos

Crash Course Chemistry – CrashCourse

This playlist offers a crash course in most of the topics we cover during the course. The videos often contain some of the history behind the science, as well as great animations and demonstrations of many of the concepts discussed.

https://www.youtube.com/playlist?list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr

Investigating the Periodic Table with Experiments - with Peter Wothers

Royal Institution lectures are always excellent and this one celebrates 150 years of the periodic table with lots of interesting facts and brilliant demonstrations.

https://www.youtube.com/watch?v=kqe9tEcZkno

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. (This video is a little old, so the quality isn't great)

https://www.youtube.com/watch?v=t46lvTxHHTA

10 weird and wonderful chemical reactions

10 good demonstration reactions, can you work out the chemistry of …. any… of them?

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

Preparation for A-Level Chemistry

In order to make the transition from GCSE to A-Level Chemistry as smooth as possible. It is important to have a solid grasp of many fundamental concepts that you learnt as part of your GCSE course.

The following section contains several activities that aim to consolidate these skills and improve any content you may be a bit rusty on. Once you have completed these tasks, you can check the answers using the answer section in this booklet.

You will then be ready to have a go at the "WKGS AS Chemistry Summer Work" booklet. This will be collected in and marked when you start the course in September.

Resources that will help you complete these activities include:

- http://www.bbc.co.uk/schools/gcsebitesize/
- http://www.s-cool.co.uk/gcse
- Any GCSE Additional Science / Chemistry revision guide
- Your own old GCSE Science / Chemistry folders or exercise books
- Head Start to AS Chemistry Published by CGP (although this is not essential!)

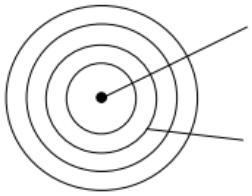
Some tasks have space for you to write your answers, but you will need to answer some sections on a separate piece of paper.

You will have a short assessment on the tasks in the next section of this booklet in September.

Task 1 – Atomic Structure

Atoms consist of a central …….. containing protons and …… . The nucleus is …….. compared to the size of the whole atom. The nucleus is surrounded by …… in energy levels (also called ……). Atoms have no electric charge because they contain the same number of protons and …….. .

sub-atomic particle	relative mass	relative charge
proton		
neutron		
electron		



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 can be represented as follows:

$^{\text{mass number}}_{\text{atomic number}}\textbf{Symbol}$ e.g. $^{19}_{9}F$ protons = ….. neutrons = ….. 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.

	$^{35}_{17}Cl$	$^{37}_{17}Cl$
protons		
neutrons		
electrons		

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
$^{235}_{92}U$					
$^{238}_{92}U$					

Task 2 – Writing Chemical Formulae

Being able to confidently write the correct chemical formulae for a substance is probably the single most important skill for any student that wants to succeed at A-Level chemistry.

If you are at all unsure on how to do this I highly recommend reading the guide in this link - https://www.my-gcsescience.com/tips-writing-chemical-formulae/

You should be able to use the information in the table below and the link above to correctly give chemical formulae for any substance you are asked.

Elements

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
helium neon argon krypton xenon radon	hydrogen nitrogen oxygen fluorine chlorine bromine iodine phosphorus sulfur	There are no ionic elements!!	The formula is just the symbol, e.g. magnesium iron sodium nickel	The formula is just the symbol diamond graphite silicon

Compounds

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
There are no monatomic compounds!!	Some common molecular compounds: carbon dioxide carbon monoxide nitrogen monoxide nitrogen dioxide sulfur dioxide sulfur trioxide ammonia methane hydrogen sulfide	These have to be worked out using ion charges – you have to know these at AS/A level! LEARN them ASAP. Note these acids: hydrochloric acid sulfuric acid nitric acid phosphoric acid	There are no metallic compounds!!	silicon dioxide

Remember, you will not be able to use the periodic table to work out every ion. For example, transition metals do not have a group number, but they will have a number after them in roman numerals which is equal to their charge. Also, some complex or polyatomic ions you will just have to learn. You will be expected to know the ions listed below (and more) at A-Level.

hydroxide - OH^-	manganate - MnO_4^-
nitrate - NO_3^-	phosphate - PO_4^{3-}
nitrite - NO_2^-	cyanide - CN^-
carbonate - CO_3^{2-}	chlorate - ClO_3^-
sulfate - SO_4^{2-}	peroxide - O_2^{2-}
sulfite - SO_3^{2-}	dichromate - $Cr_2O_7^{2-}$
thiosulfate - $S_2O_3^{2-}$	chromate - CrO_4^{2-}

ammonium - NH_4^+ (common exception to positive metal ions)

Write the chemical formulae for the following compounds:

1) lead (IV) oxide .....
2) copper .....
3) sodium .....
4) ammonium chloride .....
5) ammonia .....
6) sulfur .....
7) sulfuric acid .....
8) neon .....
9) silica .....
10) silicon .....
11) barium hydroxide .....
12) tin (IV) chloride .....
13) silver nitrate .....
14) iodine .....
15) nickel .....
16) hydrogen sulfide .....
17) titanium (IV) oxide .....
18) lead .....
19) strontium sulfate .....
20) lithium .....

Task 3 – Chemical 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	$2\ Mg + O_2 \rightarrow 2\ MgO$ $2\ H_2S + 3\ O_2 \rightarrow 2\ H_2O + 2\ SO_2$ $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
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)	$CaCO_3 \rightarrow CaO + CO_2$

1) Balance the following equations.

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

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

c) $SO_2 + O_2 \rightarrow SO_3$

d) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

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

Write balance equations for the following reactions:

1) burning aluminium

2) burning hexane (C_6H_{14})

3) burning ethanethiol (CH_3CH_2SH)

4) reaction of lithium with water

5) reaction of calcium carbonate with nitric acid

6) thermal decomposition of lithium carbonate

7) reaction of ammonia with nitric acid

8) reaction of potassium oxide with sulfuric acid

9) reaction of calcium hydroxide with hydrochloric acid

10) reaction of zinc with phosphoric acid

11) reaction of sodium hydrogencarbonate with sulfuric acid

12) reaction of potassium hydroxide with sulfuric acid

Task 4 – Ionic Equations

A balanced ionic equation shows the reacting ions in a chemical reaction. These equations are used to represent what happens in precipitation reactions (reactions in which an insoluble solid is produced during a reaction in solution).

Ionic equations can be written out using 5 simple steps:

Step 1: Write down the word equation for the reaction.

Copper sulphate + Sodium Hydroxide → Copper Hydroxide + Sodium Sulphate

Step 2: Write down the balanced symbol equation for the reaction (incl. state symbols).

$$CuSO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Cu(OH)_{2(s)} + Na_2SO_{4(aq)}$$

Step 3: Split the ionic compounds into their constituent (individual) ions in the equation.

$$Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + 2Na^{+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Cu(OH)_{2(s)} + 2Na^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$$

NOTE: $Cu(OH)_{2(s)}$ is not written as: $Cu^{2+}_{(s)} + 2OH^{-}_{(s)}$ because this compound is a solid.

Step 4: Highlight the species which are UNCHANGED in going from reactants to products. These species are not involved in the reaction. They are called SPECTATOR IONS. A change can be a change in state.

$$Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + 2Na^{+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Cu(OH)_{2(s)} + 2Na^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$$

Step 5: The remaining species (the ones that have changed) are the ones involved in the ionic equation. Rewrite the equation showing ONLY the species involved in the reaction.

$$Cu^{2+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Cu(OH)_{2(s)}$$

This is the final ionic equation.

Write ionic equations for each of the following reactions.

a) reaction of hydrochloric acid (aq) with potassium hydroxide (aq)

b) precipitation of silver iodide from reaction between silver nitrate (aq) and potassium iodide (aq)

c) reaction of potassium carbonate (aq) with nitric acid (aq)

d) precipitation of calcium hydroxide from reaction between sodium hydroxide (aq) and calcium chloride (aq)

HINT: Look at the general reactions you should know on page 16 if you are struggling with a & c

Task 5 – Amount of Substance Calculations

At GCSE you will have studied various calculations to determine amounts of substance. This could have been the number of moles of a gas you have, the mass of a solid that will be produced from a reaction, the % yield or atom economy of a reaction. All these skills transfer directly over to the A-Level course. The more comfortable and confident you can be using these types of calculations, the easier you will find the transition to A-Level Chemistry.

I highly recommend you dig out your old Chemistry notes or revision guide and have a go at the following questions. Practice makes perfect!

1 Give the formula of the following ionic substances.

a) potassium oxide .....

b) aluminium bromide .....

c) iron(III) sulfide .....

d) magnesium hydroxide .....

e) ammonium iodide .....

f) calcium nitrate .....

2 Calculate the relative formula mass of the following substances.

a) chlorine, Cl_2 .....

b) ammonium sulfate, $(NH_4)_2SO_4$ .....

3 a) What mass of sodium reacts with 95 g of titanium chloride? $TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

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b) Calculate the percentage atom economy to make titanium in this reaction.

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4 Ammonia is made by reaction of nitrogen with hydrogen. $N_2 + 3H_2 \rightarrow 2NH_3$

a) Calculate the maximum mass of ammonia that could be formed from reaction of 12 g of hydrogen reacting with nitrogen.

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b) In this reaction, only 15 g of ammonia was formed. Calculate the percentage yield.

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c) Suggest two reasons why the yield was less than 100%.

1 .....

2 .....

5 In an experiment, 4.0 g of calcium was reacted with 4.0 g of chlorine. One of the chemicals was in excess. Determine which is the limiting reagent and then calculate the mass of calcium chloride formed.

$$Ca + Cl_2 \rightarrow CaCl_2$$

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6 25.0 cm^3 of a solution of calcium hydroxide was titrated against a solution of 0.100 mol/dm^3 hydrochloric acid. 26.3 cm^3 of the hydrochloric acid was needed to neutralise the calcium hydroxide.

b) Calculate the concentration of the calcium hydroxide in mol/dm^3. The equation for the reaction is shown.

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$$

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c) Calculate the concentration of the calcium hydroxide in g/dm^3.

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6) 0.595 g of tin (Sn) reacts with 0.71 g of chlorine (Cl_2) to form tin chloride. Find the simplest molar ratio in which tin reacts with chlorine and use it to find the formula of the tin chloride. Finally, write a balanced equation for the reaction.

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7) Lead reacts with chlorine to form lead(II) chloride. When 6.21 g of lead reacts with 2.84 g of chlorine, which is the limiting reagent and what mass of lead(II) chloride is formed?

$Pb + Cl_2 \rightarrow PbCl_2$

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8) Find the concentration of oxalic acid ($H_2C_2O_4$) in mol/dm^3 and g/dm^3 given that 25.0 cm^3 of this solution reacts with 22.8 cm^3 0.100 mol/dm^3 sodium hydroxide solution in a titration.

$H_2C_2O_4 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$

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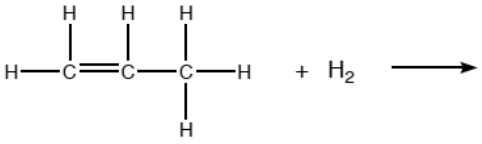
Task 6 – Structure & Bonding – Use your old notes / revision guide / BBC Bitesize to complete the table below

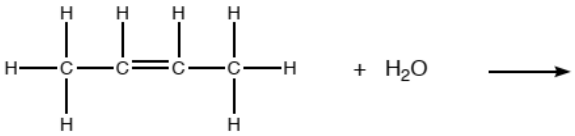
Type of bonding	**Ionic**	**Covalent**		**Metallic**
Structure	Giant ionic lattice	Simple molecular	Macromolecular	Giant metallic lattice
Examples				
Particles present				
Forces between particles				
Melting point (high or low) and explanation				
Conductivity (yes or no) and explanation	Solid Molten/aqueous		Diamond Graphite	

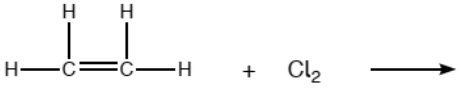
Task 7 – Organic Chemistry

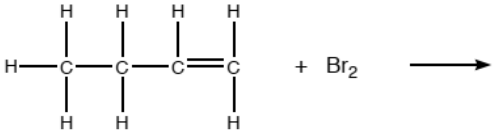
Organic Chemistry is one of the most important areas of all Chemistry. Many of the materials, fuels and medicines we use on a regular basis are based on Organic Chemistry and it makes up a significant portion of the A-Level Chemistry course. For this reason, it is important you are familiar with the basics. Use your old notes / revision guide / BBC Bitesize to help you answer the questions below.

1) Complete the equations shown below for some addition reactions of alkenes. You should show the displayed structure of the products.

a)  (2)

b)  (2)

c)  (2)

d)  (2)

2) Hexene and hexane are both colourless liquids containing six carbon atoms.

a) Give the molecular formula of each. *hexene* ..... *hexane* ..... (2)

b) Describe a test that could be used to distinguish these two compounds and give the result for each compound.

test .....

hexene ..... *hexane* ..... (3)

c) Which of these two molecules is saturated? Explain your answer. .....

.....

..... (2)

3) a) The alkenes propene (C_3H_6) and ethene (C_2H_4) can be formed with one other product when decane ($C_{10}H_{22}$) is cracked. Write an equation for a cracking reaction of decane that forms propene, ethene and one other product.

..... (2)

b) Describe one way in which cracking is done. .....

.....

.....

..... (2)

c) Explain why cracking is done. .....

.....

.....

..... (3)

4) a) Complete the table below about some alkanes. (5)

name	methane	propane	butane
molecular formula			C_4H_{10}
structure			

b) Which of these three alkanes.

i) has the highest boiling point? .....

ii) is the most flammable? .....

iii) is the most volatile? .....

iv) burns with the cleanest flame? .....

5) Crude oil is a mixture of hydrocarbons which are mainly alkanes. These alkanes are separated at an oil refinery by fractional distillation. Describe how this is done and explain how it works.

.....

.....

.....

.....

.....

.....

.....

.....

..... (5)

1) Draw the displayed structure of the molecule stated in each box. (4)

propene	butanol
methanoic acid	ethane

2) Identify the functional group in each of the following compounds. (3)

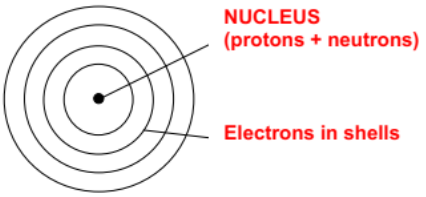
molecule	add bromine water	add sodium	add sodium carbonate	is it miscible with water?	functional group
A	yellow-orange	fizzes	fizzes	✓	
B	yellow-orange	fizzes	no reaction	✓	
C	colourless	no reaction	no reaction	×	

Now you have completed all of the tasks, you should be ready to have a go at the "WKGS AS Chemistry Summer Work" booklet. As mentioned previously, this will be collected in by your teacher during the first few weeks of the new term in September.

Task 1 – Answers

Atoms consist of a central **NUCLEUS** containing protons and **NEUTRONS**. The nucleus is **TINY** compared to the size of the whole atom. The nucleus is surrounded by **ELECTRONS** in energy levels (also called **SHELLS**). Atoms have no electric charge because they contain the same number of protons and **ELECTRONS**.

sub-atomic particle	relative mass	relative charge
proton	1	+1
neutron	1	0
electron	0.0005 or $\frac{1}{1836}$	-1



Atomic number = number of **PROTONS**

Mass number = number of **PROTONS** + number of **NEUTRONS**

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

Number of protons = **ATOMIC NUMBER**
Number of neutrons = **MASS NUMBER - ATOMIC NUMBER**
Number of electrons = **ATOMIC NUMBER**

Atoms can be represented as follows:

$^{\text{mass number}}_{\text{atomic number}}\textbf{Symbol}$ e.g. $^{19}_{9}\text{F}$ protons = **9** neutrons = **10** electrons = **9**

Atoms of the same element have the same number of **PROTONS.** In fact, it is the number of **PROTONS** 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 **PROTONS**.

Isotopes are atoms with the same number of **PROTONS** but a different number of **NEUTRONS** . This means they are atoms of the same **ELEMENT** with the same **ATOMIC** number but a different **MASS** number.

	$^{35}_{17}\text{Cl}$	$^{37}_{17}\text{Cl}$
protons	17	17
neutrons	18	20
electrons	17	17

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{23}_{11}\text{Na}$	11	23	11	12	11
$^{7}_{3}\text{Li}$	3	7	3	4	3
$^{40}_{18}\text{Ar}$	18	40	18	22	18
$^{39}_{19}\text{K}$	19	39	19	20	19
$^{27}_{13}\text{Al}$	13	27	13	14	13
$^{235}_{92}\text{U}$	92	235	92	143	92
$^{238}_{92}\text{U}$	92	238	92	146	92

Task 2 - Answers

1	PbO_2	2	Cu	3	Na	4	NH_4Cl	5	NH_3	6	S_8
7	H_2SO_4	8	Ne	9	SiO_2	10	Si	11	$Ba(OH)_2$	12	$SnCl_4$
13	$AgNO_3$	14	I_2	15	Ni	16	H_2S	17	TiO_2	18	Pb
19	$SrSO_4$	20	Li								

Task 3 – Answers

1 a $Mg + 2\ HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

b $CuCl_2 + 2\ NaOH \rightarrow Cu(OH)_2 + 2\ NaCl$

c $2\ SO_2 + O_2 \rightarrow 2\ SO_3$

d $C_4H_{10} + 6½\ O_2 \rightarrow 4\ CO_2 + 5\ H_2O$ or $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

2 a $4\ Na + O_2 \rightarrow 2\ Na_2O$

b $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$

c $Ca + 2\ HCl \rightarrow CaCl_2 + H_2$

d $2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

1 $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

2 $C_6H_{14} + 9½\ O_2 \rightarrow 6\ CO_2 + 7\ H_2O$ or $2\ C_6H_{14} + 19\ O_2 \rightarrow 12\ CO_2 + 14\ H_2O$

3 $CH_3CH_2SH + 4½\ O_2 \rightarrow 2\ CO_2 + SO_2 + 3\ H_2O$ or $2\ CH_3CH_2SH + 9\ O_2 \rightarrow 4\ CO_2 + 2\ SO_2 + 6\ H_2O$

4 $2\ Li + 2\ H_2O \rightarrow 2\ LiOH + H_2$

5 $CaCO_3 + 2\ HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$

6 $Li_2CO_3 \rightarrow Li_2O + CO_2$

7 $NH_3 + HNO_3 \rightarrow NH_4NO_3$

8 $K_2O + H_2SO_4 \rightarrow K_2SO_4 + H_2O$

9 $Ca(OH)_2 + 2\ HCl \rightarrow CaCl_2 + 2\ H_2O$

10 $3\ Zn + 2\ H_3PO_4 \rightarrow Zn_3(PO_4)_2 + 3\ H_2$

11 $2\ NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O + 2\ CO_2$

12 $2\ KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\ H_2O$

Task 4 - Answers

a $H^+ + OH^- \rightarrow H_2O$

b $Ag^+ + I^- \rightarrow AgI$

c $2\ H^+ + CO_3^{2-} \rightarrow H_2O + CO_2$

d $Ca^{2+} + 2\ OH^- \rightarrow Ca(OH)_2$

Task 5 - Answers

1 Give the formula of the following ionic substances.

a) potassium oxide **K_2O**

b) aluminium bromide **$AlBr_3$**

c) iron(III) sulfide **Fe_2S_3**

d) magnesium hydroxide **$Mg(OH)_2$**

e) ammonium iodide **NH_4I**

f) calcium nitrate **$Ca(NO_3)_2$**

2 Calculate the relative formula mass of the following substances.

a) chlorine, Cl_2 **2(35.5) = 71**

b) ammonium sulfate, $(NH_4)_2SO_4$ **2(14) + 8(1) + 32 + 4(16) = 132**

3 a) What mass of sodium reacts with 95 g of titanium chloride?

$$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$$

mol $TiCl_4$ = $\frac{95}{190}$ = 0.50 mol

mol Na = 4 x 0.50 = 2.0 mol

mass Na = 23 x 2.0 = 46 g

b) Calculate the percentage atom economy to make titanium in this reaction.

% atom economy = 100 x $\frac{48}{190+4(23)}$ = 17.0%

4 Ammonia is made by reaction of nitrogen with hydrogen.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

a) Calculate the maximum mass of ammonia that could be formed from reaction of 12 g of hydrogen reacting with nitrogen.

mol H_2 = $\frac{12}{2}$ = 6.0 mol

mol NH_3 = 4.0 mol

mass NH_3 = 17 x 4.0 = 68 g

b) In this reaction, only 15 g of ammonia was formed. Calculate the percentage yield.

% yield = 100 x $\frac{15}{68}$ = 22.1%

c) Suggest two reasons why the yield was less than 100%.

- **reaction is reversible / incomplete**
- **some products lost**
- **other reactions may take place**

5 In an experiment, 4.0 g of calcium was reacted with 4.0 g of chlorine. One of the chemicals was in excess. Determine which is the limiting reagent and then calculate the mass of calcium chloride formed.

$$Ca + Cl_2 \rightarrow CaCl_2$$

mol Ca = $\frac{4.0}{40}$ = 0.10 mol

mol Cl_2 = $\frac{4.0}{71}$ = 0.056 mol

∴ Ca is in excess and Cl_2 is the limiting reagent

∴ mol $CaCl_2$ = 0.056 mol

∴ mass $CaCl_2$ = 111 x 0.056 = 6.25 g

6 25.0 cm^3 of a solution of calcium hydroxide was titrated against a solution of 0.100 mol/dm^3 hydrochloric acid. 26.3 cm^3 of the hydrochloric acid was needed to neutralise the calcium hydroxide.

b) Calculate the concentration of the calcium hydroxide in mol/dm^3. The equation for the reaction is shown.

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$$

mol HCl = 0.100 x $\frac{26.3}{1000}$ = 0.00263 mol

mol $Ca(OH)_2$ = ½ x 0.00263 = 0.001315 mol

conc $Ca(OH)_2$ = $\frac{0.001315}{\frac{25.0}{1000}}$ = 0.0526 mol/dm^3

c) Calculate the concentration of the calcium hydroxide in g/dm^3.

conc $Ca(OH)_2$ = 0.0526 x 74 = 3.89 g/dm^3

6) 0.595 g of tin (Sn) reacts with 0.71 g of chlorine (Cl_2) to form tin chloride. Find the simplest molar ratio in which tin reacts with chlorine and use it to find the formula of the tin chloride. Finally, write a balanced equation for the reaction.

Moles of Sn = $\frac{0.595}{119}$ = 0.005 mol **Moles of Cl_2 = $\frac{0.71}{71}$ = 0.010 mol**

Reacting ratio Sn : Cl_2 = 0.005 : 0.010 = 1 : 2

∴ $Sn + 2Cl_2 \rightarrow SnCl_4$

7) Lead reacts with chlorine to form lead(II) chloride. When 6.21 g of lead reacts with 2.84 g of chlorine, which is the limiting reagent and what mass of lead(II) chloride is formed? $Pb + Cl_2 \rightarrow PbCl_2$

moles Pb = $\frac{6.21}{207}$ = 0.030 mol

moles Cl_2 = $\frac{2.84}{71}$ = 0.040 mol

Pb is limiting reagent and so 0.030 mol of $PbCl_2$ is formed

Mass $PbCl_2$ = 278 x 0.030 = 8.34 g

8) Find the concentration of oxalic acid ($H_2C_2O_4$) in mol/dm^3 and g/dm^3 given that 25.0 cm^3 of this solution reacts with 22.8 cm^3 0.100 mol/dm^3 sodium hydroxide solution in a titration. $H_2C_2O_4 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$

moles NaOH = $0.100 \times \frac{22.8}{1000}$ = 0.00228 mol

moles $H_2C_2O_4$ = $\frac{0.00228}{2}$ = 0.00114 mol

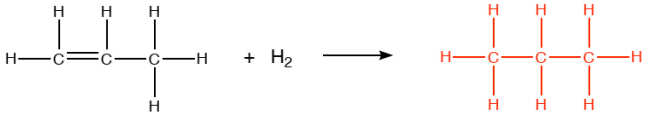
concentration $H_2C_2O_4$ in mol/dm^3 = $\frac{0.00114}{\frac{25}{1000}}$ = 0.0456 mol/dm^3

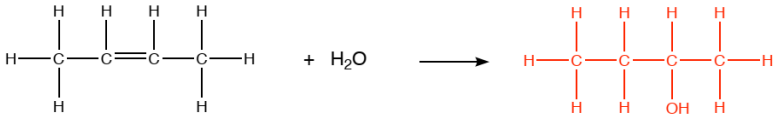
concentration $H_2C_2O_4$ in g/dm^3 = 0.0456 x 90 = 4.104 g/dm^3

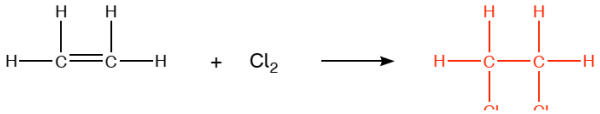
Task 6 – Answers

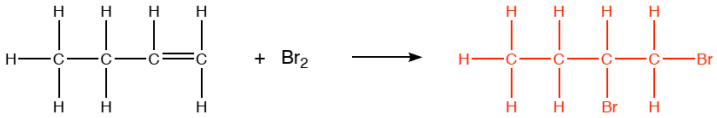
Type of bonding	Ionic	Covalent		Metallic
Structure	Giant ionic lattice	Simple molecular	Macromolecular	Giant metallic lattice
Examples	$NaCl$, $PbBr_2$, $CuCl_2$ (metal and non-metal)	H_2O, CH_4, Cl_2 (a few non-metals atoms joined)	Diamond, Graphite (lots of non-metal atoms joined)	Al, Mg, Cu (metals)
Particles present	+ve and –ve ions	molecules	atoms	+ve metal ions and delocalised electrons
Forces between particles	Attraction between +ve and –ve ions	Intermolecular forces	Covalent bonds	Attraction between +ve metal ion and delocalised electrons
Melting point (high or low) and explanation	<u>High</u> Lots of energy needed to overcome the strong attraction between +ve and –ve ions.	<u>Low</u> Not much energy needed to overcome the weak intermolecular forces between molecules.	<u>High</u> Lots of energy needed to overcome the many, strong covalent bonds between atoms.	<u>High</u> Lots of energy needed to overcome the strong attraction between +ve and delocalised electrons.
Conductivity (yes or no) and explanation	<u>Solid</u> -No -Ions are not free to move <u>Molten/aqueous</u> -yes -ions are free to move and carry charge	-No -the molecules have no charge	<u>Diamond</u> -No -it has no charged particles <u>Graphite</u> -yes -only 3 electrons are involved in bonding -fourth electron delocalised and free to move between layers	-yes -delocalised electrons free to move throughout structure and carry charge

Task 7 – Answers

1) a) 

b) 

c) 

d) 

2) a) hexene = C_6H_{12}, hexane = C_6H_{14}

b) test = bromine water, hexene = goes colourless, hexane = stays yellow-orange

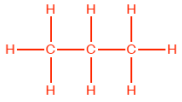
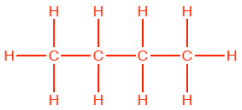
c) hexane is saturated as it contains only single bonds / no double bonds

3) a) $C_{10}H_{22} \rightarrow C_5H_{12} + C_3H_6 + C_2H_4$

b) vaporise alkanes, pass over hot catalyst; or mix with steam, heat to high temperature

c) creates valuable products, alkenes used to make polymers, shorter alkanes to use as fuels

4) a)

name	methane	propane	butane
molecular formula	CH_4	C_3H_8	C_4H_{10}
structure			

b) i) butane

ii) methane

iii) methane

iv) methane

5) vaporise oil

pass into tower/column that is hot at bottom and cool at top

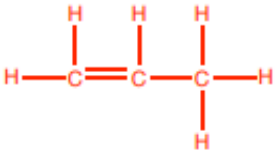
molecules cool and condense at different heights

as molecules have different boiling points

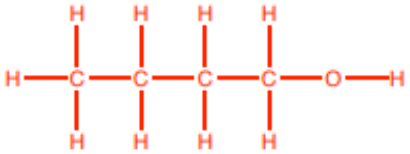
smaller molecules are collected higher up tower/column

1)

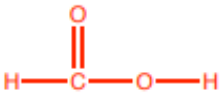
propene



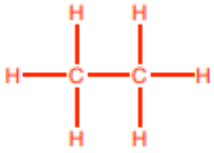
butanol



methanoic acid



ethane



2)

molecule	add bromine water	add sodium	add sodium carbonate	is it miscible with water?	functional group
A	yellow-orange	fizzes	fizzes	✓	carboxylic acid
B	yellow-orange	fizzes	no reaction	✓	alcohol
C	colourless	no reaction	no reaction	✗	alkene