# How to use this booklet

This booklet includes an introduction to the subject and any initial questions you may have about the course, such the content studied, the previous content needed, the university courses or careers the A-Level would lead to etc.

It also includes information about films, books and documentaries you could watch that would enhance and deepen your knowledge around the subject in the wider world.

Most importantly, each week there are three tasks set. Each week there will be at least one task that reviews some content or skills that is essential from GCSE which you should complete

The best in everyone™
Part of United Learning

# A Level Chemistry Handbook


## 2019-2020

**Name**_____

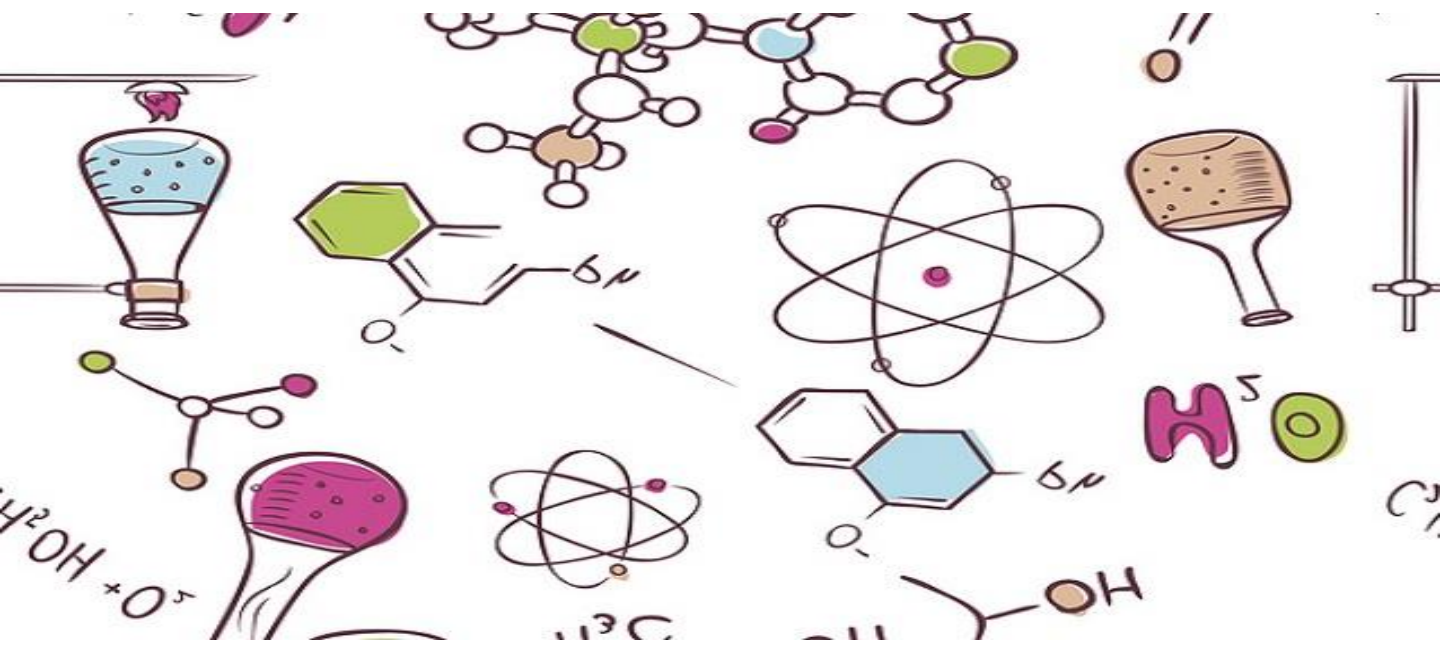
**Teachers** _____

**Target grade**_____

**Current grade** _____

# CONTENTS





# Welcome to Chemistry!

## Why choose to study Chemistry?

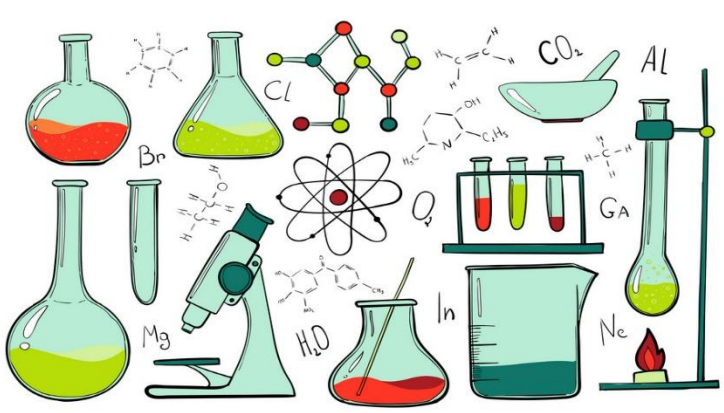
**Chemistry will give you essential analytical, mathematical and evaluative skills. You will have the opportunity to further develop your scientific skills from GCSE. There are three main disciplines within Chemistry. They are Physical Chemistry, Inorganic Chemistry and Organic Chemistry. It is also an A-Level that is highly regarded by Universities and studying it will open up opportunities on a range of degree courses and opportunities for a range of professions.**

## What knowledge and understanding do you need prior to studying AS and A-Level Chemistry?

**You will need to have achieved at least a 6/7 grade at GCSE.**
**You will be secure in your knowledge of the fundamental aspects of Chemistry. These include:**

- **Atomic structure**
- **Writing equations**
- **Formula of compounds**
- **Periodic Table of the elements**
- **Bonding-Metallic, ionic and covalent structures**
- **Bonding and structure eg High melting point of diamond and low melting point of carbon dioxide**
- **Rates of reaction**

# What will you study at AS and A-Level?



**Physical Chemistry** – This is the Chemistry of the energetics and physics of reactions. Some examples of the topics you will study are energy changes within reactions, rate of reaction and equilibria.

**Inorganic Chemistry –** This is the chemistry of the elements. Some examples of the topics you will study are trends across periods, trends across groups and the transition metals.

**Organic Chemistry –** This is also known as carbon Chemistry. Some examples of the topics you will study are mechanisms of reactions, alcohols, drugs and mechanisms of organic reactions.

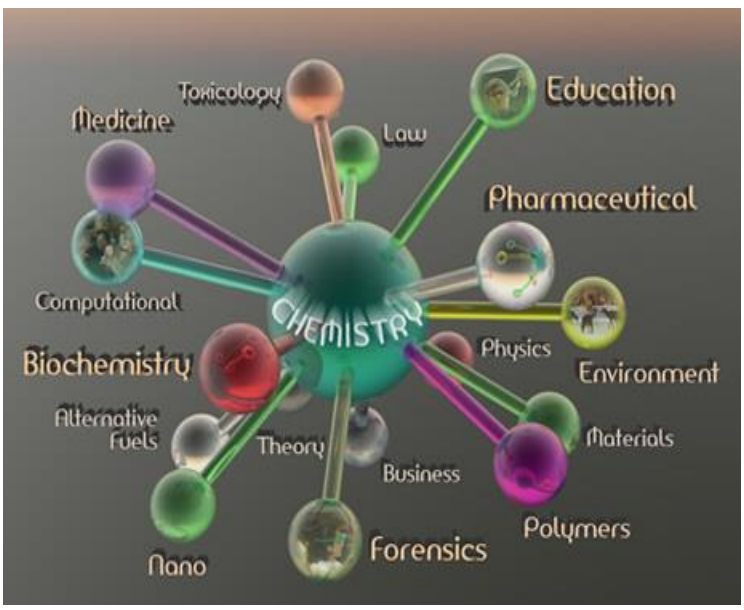
## What can I do with my Chemistry A-Level?

**Here are just some of the courses that require an A-Level in Chemistry:**

- **Medicine**
- **Pharmacology**
- **Biochemistry**
- **Biotechnology**
- **Medical engineering**
- **Dentistry**
- **Teaching**
- **Forensic scientist**
- **Chemical Engineer**
- **Geology**

**Further courses students with A-Level Chemistry choose are: physiology, Law, nursing, midwifery, entomology, medical physics, forensic science, zoology, biology, botany, physics, astronomy, architecture, archaeology, etc**

**Chemistry is a challenge but it is a worthwhile challenge. You will gain lifelong transferable skills as well as a deeper understanding of the Science.**



# Expectations and Code of Conduct

- To be on time for all lessons.
- To come to class fully prepared (i.e. to bring a pen, folder, paper, textbook etc.). If a work booklet is lost, I will again complete the work that I have lost.
- To switch off all mobile phones, MP3 players and any other electronic equipment before I arrive in the classroom.
- To show respect for all members in the class and allow them to learn.
- To be respectful of other people's views and opinions even if they are contradictory to my own.
- To listen to the teacher when they are giving instructions.
- To listen to other students and not shout out when partaking in discussions and debates.
- To keep noise levels at a suitable level when learning independently.
- To complete all work set to the best of my ability.
- To meet all deadlines set for homework projects.

## Punctuality/attendance

All students are expected to attend all lessons without fail. If you are absent it is your responsibility to collect/to make your own class notes. You are also expected to be punctual to all lessons.

## Homework

All students are expected to complete homework/coursework regularly and to meet deadlines. Homework is given to monitor your understanding and to ascertain the skills you have developed. Homework also provides you with important feedback which will help with your development. You will receive a piece of homework from both Chemistry teachers every week and you are expected to manage your own time efficiently to complete both pieces on time. Study periods should be sued to enhance your knowledge of the subject or for completion of homework tasks

## Private Study

Private study tasks will be set weekly. This could take the form of a scientific journal, news article, science magazine article or textbook. You must make sure you do any set reading and make notes on it to further consolidate your understanding and deepen your subject knowledge.

In addition to this revision notes must be made after each lesson, which help consolidate your learning. You may do this in your own revision booklet, using mind maps, flip charts or other online resources

# Course details

**Examination Board:** OCR A
**Specification name:** A-Level Chemistry (H432)

Learners must complete all components (01, 02, 03 and 04).

| Content Overview | Assessment Overview | |
|---|---|---|
| Content is split into six teaching modules:<br>• Module 1 – Development of practical skills in chemistry<br>• Module 2 – Foundations in chemistry<br>• Module 3 – Periodic table and energy<br>• Module 4 – Core organic chemistry<br>• Module 5 – Physical chemistry and transition elements<br>• Module 6 – Organic chemistry and analysis<br>Component 01 assesses content from modules 1, 2, 3 and 5.<br>Component 02 assesses content from modules 1, 2, 4 and 6.<br>Component 03 assesses content from all modules (1 to 6). | Periodic table, elements and physical chemistry (01)<br>100 marks<br>2 hours 15 minutes written paper | **37%** of total A level |
| | Synthesis and analytical techniques (02)<br>100 marks<br>2 hours 15 minutes written paper | **37%** of total A level |
| | Unified chemistry (03)<br>70 marks<br>1 hour 30 minutes written paper | **26%** of total A level |
| | Practical Endorsement in chemistry (04)<br>(non exam assessment) | Reported separately<br>(see Section 5) |

All components include synoptic assessment.

# The detailed AS specification

## Module 1 – Development of practical skills in chemistry

Module 1 of the specification content relates to the practical skills learners are expected to gain throughout the course, which are assessed throughout the written examinations.

## Module 2 – Foundations in chemistry

This module provides learners with a knowledge and understanding of the important chemical ideas that underpin the study of AS Chemistry this includes developing important quantitative techniques involved in measuring masses, gas and solution volumes, including use of volumetric apparatus. Learners are also able to develop their mathematical skills during their study of amount of substance and when carrying out quantitative practical work.

- Atoms, compounds, molecules and equations
- Amount of substance
- Acid–base and redox reactions
- Electrons, bonding and structure

## Module 3 – Periodic table and energy

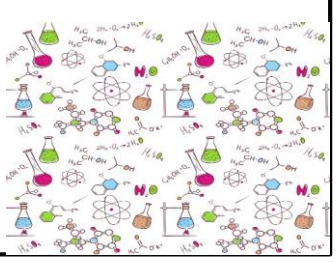
The focus of this module is inorganic and physical chemistry, the applications of energy use to everyday life and industrial processes, and current environmental concerns associated with sustainability.
This module provides learners with a knowledge and understanding of the important chemical ideas that underpin the study of inorganic and physical chemistry

- The periodic table and periodicity
- Group 2 and the halogens
- Qualitative analysis
- Enthalpy changes
- Reaction rates and equilibrium (qualitative)

## Module 4 – Core organic chemistry

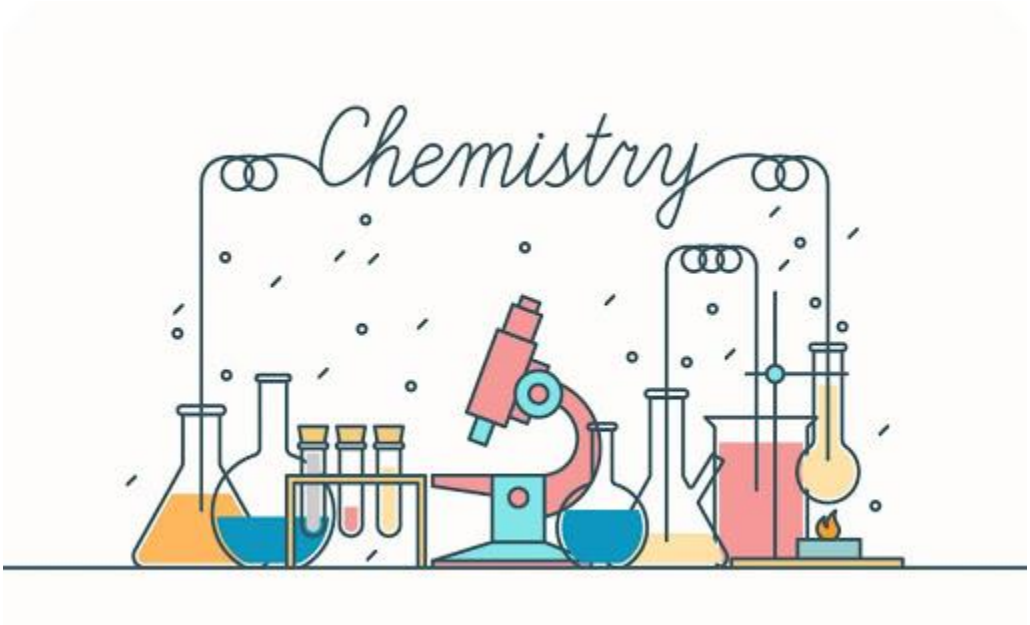
This module introduces organic chemistry and its important applications to everyday life, including current environmental concerns associated with sustainability. The module assumes knowledge and understanding of the chemical concepts developed in Module 2: Foundations in chemistry. The module provides learners with a knowledge and understanding of the important chemical ideas that underpin the study of organic chemistry

- Hydrocarbons
- Alcohols and halo-alkanes
- Organic synthesis
- Analytical techniques (IR and MS)



# Grade Descriptors

| | Description |
|---|---|
| **A/A*** | To achieve an A grade in Chemistry you must have an extensive knowledge of inorganic, organic and physical chemistry. You must be able to demonstrate excellent mathematical and analytical skills when answering examination questions. You need to be able to apply your understanding to new reactions, structures and elements that you haven't necessarily studied in detail before. However, you will have an understanding that it is the same Chemistry and be able to apply it. An A* is dependent on your UMS points. You will have achieved high UMS scores due to sound application of theoretical concepts in the final synoptic paper. |
| **B** | To achieve a B grade in Chemistry you must have a good knowledge of inorganic, organic and physical chemistry. You must be able to demonstrate good mathematical and analytical skills when answering examination questions. You need to be able to apply your understanding to new reactions, structures and elements that you haven't necessarily studied in detail before. |
| **C** | To achieve a C grade in Chemistry you must have a sound knowledge of inorganic, organic and physical chemistry. You should demonstrate an understanding of the mathematics that support the theories in chemistry and use them to support your answers. You will demonstrate some analytical skills. |
| **D** | To achieve a D grade in Chemistry you must have a sound knowledge of inorganic, organic and physical chemistry. You should demonstrate an understanding of the mathematics that support the theories in chemistry and use them to support your answers. |



# How to get an A/A*

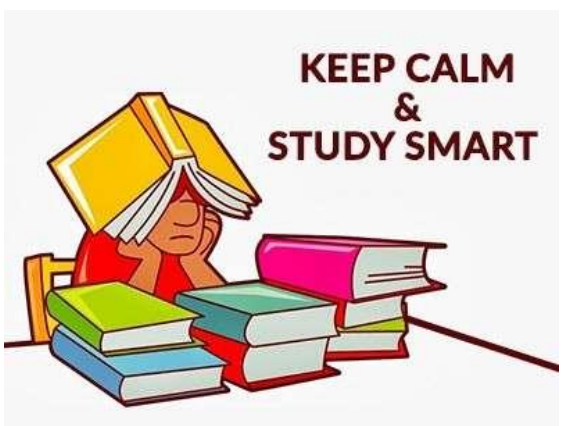
## What do you need to do?

To get the highest grade possible, you must do the following;

- Get over 90% on all papers – this is achievable by starting the revision earlier in your first year
- Use the specification when you are revising.
- Practice past paper questions.
- Ensure you can use evidence from the question and prior knowledge in your answers.
- Apply your knowledge and understanding.
- Complete all homework set and where possible make time for further independent study.

## How can you do this?

- Create study cards/mind maps as we go along. Don't leave it all till the last minute.
- Revise throughout the year- dedicate some of your free periods to Chemistry revision each week.
- Work through past questions and self-assess these using the mark scheme. You can find these on the AQA website.
- Reading around the subject – use the reading materials suggested in this handbook.
- Start an on line revision group with peers you can rely on.
- Pair up and create challenging questions.
- Attend revision sessions and trips.



# Textbooks and suggestions for reading

## Websites

### OCR – Essential reading

This is the website for the exam board. Here you can find past papers, and your specification in detail. Any queries you have about the examinations can usually be answered on this website.

**www.ocr.org.uk**

### Chemguide – useful

This website provides additional examples, explanations and questions to further support your study. It is a useful addition to your textbook, however, you shouldn't solely rely on it.

**www.chemguide.co.uk**

### The Royal Society of Chemistry

This has useful articles, support materials, videos and lots of other chemistry related things. It is worth a visit but can be overwhelming as it is designed for Chemists everywhere, including undergraduates, graduates, and PhD students. It does have support materials for A-Level students too, and it is useful to browse.

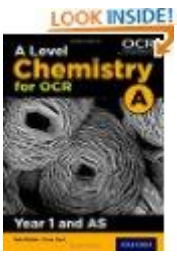
**www.rsc.org**

### Chemistry at Cambridge

This is the link to the University of Cambridge's chemistry department. As well as information at about studying at Cambridge it has videos, and lists of talks that are useful to look at.
**http://www.ch.cam.ac.uk/**

## Book list

Below is the list of OCR approved textbooks for A-Level Chemistry.

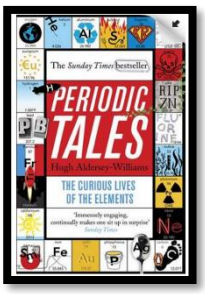



A Level Chemistry A for OCR Year 1 and AS Student Book (AS Only)

£24.99

There is a full A-Level version available to purchase that covers the entire content of the 2-year course which can be bought for £39.99.

# Book Recommendations

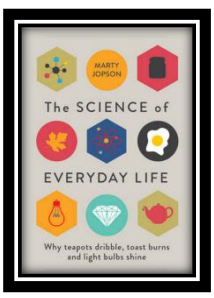



**Periodic Tales: The Curious Lives of the Elements** (Paperback) Hugh Aldersey-Williams

ISBN-10: 0141041455

http://bit.ly/pixlchembook1

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.

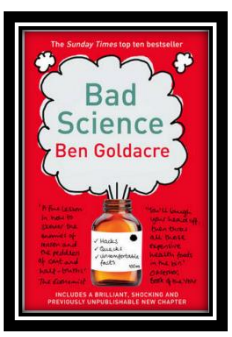



**The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine** (Hardback) Marty Jopson

ISBN-10: 1782434186

http://bit.ly/pixlchembook2

The title says it all really, lots of interesting stuff about the things around you home!

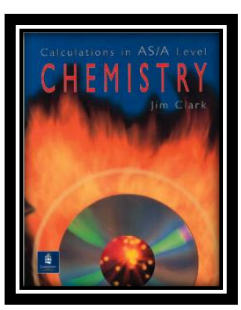



**Bad Science** (Paperback) Ben Goldacre

ISBN-10: 000728487X

http://bit.ly/pixlchembook3

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'.




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

ISBN-10: 0582411270

http://bit.ly/pixlchembook4

If you struggle with the calculations side of chemistry, this is the book for you. Covers all the possible calculations you are ever likely to come across. Brought to you by the same guy who wrote the excellent chemguide.co.uk website.

# Videos to watch online

**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://bit.ly/pixlchemvid1a

http://www.dailymotion.com/playlist/x2igjq_Rough-Science_rough-science-full-series/1#video=xxw6pr

or

http://bit.ly/pixlchemvid1b

https://www.youtube.com/watch?v=lUoDWAt259I

**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.

http://bit.ly/pixlchemvid2

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?

http://bit.ly/pixlchemvid3

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

## Chemistry in the Movies

Dantes Peak 1997: Volcano disaster movie.

Use the link to look at the Science of acids and how this links to the movie.
http://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantes-peak

http://www.flickclip.com/flicks/dantespeak1.html

http://www.flickclip.com/flicks/dantespeak5.html

Fantastic 4 2005 &2015: Superhero movie

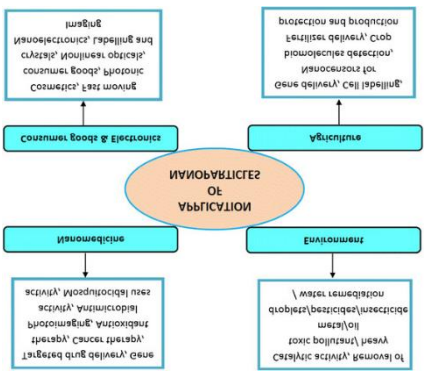
Michio Kaku explains the "real" science behind fantastic four
http://nerdist.com/michio-kaku-explains-the-real-science-behind-fantastic-four/

http://www.flickclip.com/flicks/fantastic4.html

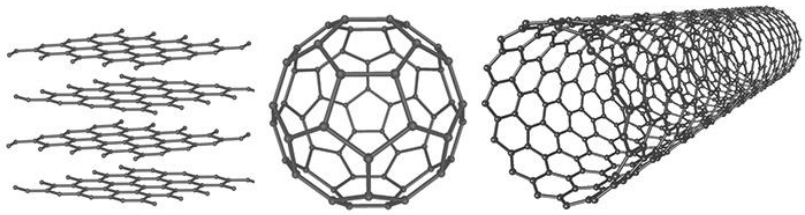
# Week 1 : The future is small: nanoparticles

Sci-fi movies and shows have, for a long time, wowed us with all the possibilities that could spawn when science and technology come together; we have all seen that now infamous hologram voicemail from Princess Laila in Star war episode 4: A new Hope, this is now becoming more of a reality with the sue of cobalt . The recently released Van Dissel movie sees him play a dead solider who was brought back to life by nanoparticles. These particles could rapidly repair his body and enhance it at the same time, the perfect hybrid between humans and AI. Also, who doesn't want Tony Stark's suit from Avengers: Infinity War?

Long before all that, Dr McCoy from Star Trek has been performing surgeries on his patients without a surgical knife in sight! This week you will explore the world of nanomaterials and technology both in the field of medicine and in every day use in a typical household.




Recap the structure of graphene from your GCSEs



**Task 1 :** The mighty power of nanomaterials


https://youtu.be/IkYimZBzguw

Uses of nanoparticles in the homes.

Read the information on the below website and watch the video

https://theconversation.com/a-guide-to-the-nanotechnology-used-in-the-average-home-59312

Answer the below questions

1. How useful is nanomaterials?
2. What is special about nanomaterials?
3. What kind of issues are related to the use of nanomaterials?
4. How are we using nanomaterials currently?

_____

_____

_____

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_____

**Task 2 :**

Watch the clip below from Star Trek: The voyage home; can you spot how nanoparticles may have been used by Dr McCoy to help the two patients he treated in this clip? Pay attention to what the medical issue was and the result was after his intervention.

https://www.youtube.com/watch?v=1i3gp_aN1cs

Research the current and future uses of nanomaterials in medicine or any other industrial field of your interest that connects to improving human beings.

You can read the below article to find some of the applications of nanoparticles in biology and medicine. For example : photodynamic cancer therapy, tissue engineering, protein detection.

https://jnanobiotechnology.biomedcentral.com/articles/10.1186/1477-3155-2-3

# Quantitative chemistry

## Task 3

- This is a crucial topic that will allow you to develop important quantitative techniques involved in measuring masses, gas and solution volumes, including use of volumetric apparatus.
- You will also develop your mathematical skills during the study of amount of substance and when carrying out quantitative practical work

1. **The Mole:** the amount of substance which has a mass equal to its relative formula mass / relative atomic mass / relative molecular mass in grams in reference to Carbon-12.

2. **One Mole** of any substance contains the same number of particle .

Number of particle in one mole of any substance is known as **Avogadro's constant/ number** which is equal to $6.023 \times 10^{23}$ particles. 1 mole contains $6.023 \times 10^{23}$ particles

Particles can be in the form of :atoms , ions , molecules.

3. **Relative molecular (formula) mass Mr:** sum of relative atomic masses of atoms in a compound expressed in grams.

4. **Empirical Formula:** is the simplest mole ratio between atoms forming the compound.

For example molecular formula of glucose is $C_6H_{12}O_6$ Empirical formula of glucose is C $H_2O$

*1. To calculate mass in g*

$$\boldsymbol{m = Mr\ n}$$

$\boldsymbol{m}$ *is the mass in g*

$\boldsymbol{M_r}$ *is the relative molecular mass in* $\frac{g}{mole}$

$\boldsymbol{n}$ *is the number of moles*

*2. To calculate volume of gas in* $dm^3$

$$\boldsymbol{V = n\ 24\ dm^3}$$

$\boldsymbol{V}$ *is the volume of the gas in* $dm^3$

$\boldsymbol{n}$ *is the number of moles of the gas*

$\boldsymbol{24\ dm3}$ is the volume that 1 mole of any gas occupy at r.t.p.

*3. To calculate concentration or volume of any solution*

$\boldsymbol{n}$ *is the number of mole*

$\boldsymbol{conc.}$ *is the concenrtation of any solution in* $(mol\ dm-3)$

$\boldsymbol{V}$ *is the Volume of any solution in* $(cm^3)$

$$\boldsymbol{n = conc.\ (mol\ dm^{-3})X\ \ Vol.\ (cm^3)}$$

*4. Atom economy* $= \frac{Mr\ of\ desired\ product\ from\ equation}{sum\ of\ Mr\ of\ all\ produts\ from\ equation}\ X\ 100$

*5. % Yield* $= \frac{Mass\ of\ product\ actually\ made\ (given)}{Maximum\ theoretical\ mass\ of\ product\ (\ calculated)}\ X\ 100$

*6 % Purity* $= \frac{Mass\ of\ pure\ reactant\ (calculated)}{Total\ mass\ of\ impure\ reactant\ (given)}\ X\ 100$

## Task 3

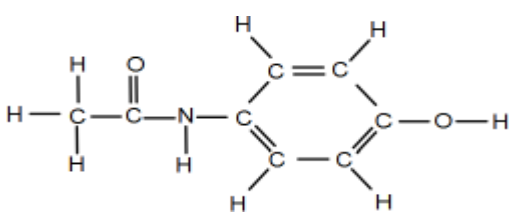
**Q 1**

- Aspirin is a medicine for use by adults.
- An aspirin tablet contains 300 mg of acetylsalicylic acid.
- Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.
- Give your answer in standard form to three significant figures.
- Relative formula mass ($M_r$) of aspirin = 180
- Number of moles = _____

**(4)**

**Q 2.**

- The main ingredient in Aqamed is a painkiller called paracetamol.
- The figure below represents a molecule of paracetamol.



- Give the molecular formula of paracetamol.
- Calculate its relative formula mass ($M_r$).
- Relative atomic masses ($A_r$): H = 1; C = 12; N = 14; O = 16
- Molecular formula _____
- Relative formula mass _____

$M_r$ = _____**(2)**

**Q 3.**

- Aspirin is a medicine for use by adults.
- An aspirin tablet contains 300 mg of acetylsalicylic acid.
- Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.
- Give your answer in standard form to three significant figures.
- Relative formula mass ($M_r$) of aspirin = 180

_____

_____

_____

_____

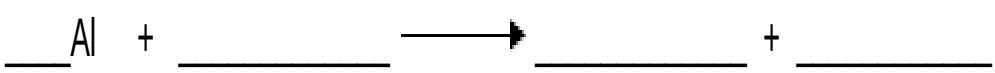
_____

_____

Number of moles = _____ **(4)**

**Q 4**

- Formulae and equations are used to describe chemical reactions.
- (a) Aluminium reacts with sulfuric acid ($H_2SO_4$) to produce aluminium sulfate, $Al_2(SO_4)_3$ and hydrogen ($H_2$).
- Complete and balance the equation for this reaction.




- (b) Calcium carbonate reacts with nitric acid to produce calcium nitrate.
- Calculate the relative formula mass ($M_r$) of calcium nitrate, $Ca(NO_3)_2$
- Relative atomic masses ($A_r$): N = 14; O = 16; Ca = 40

_____

_____

Relative formula mass ($M_r$) = _____ **(2)**

Q 5
Iron(III) chloride can be produced by the reaction shown in the equation:

$$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$$

(i) Calculate the maximum mass of iron(III) chloride ($FeCl_3$) that can be produced from 11.20 g of iron.
Relative atomic masses ($A_r$): Cl = 35.5; Fe = 56.

_____
_____
_____
_____
_____

Maximum mass of iron(III) chloride = _____ _____ g

**(3)**

(ii) The actual mass of iron(III) chloride ($FeCl_3$) produced was 24.3 g.
Calculate the percentage yield.
(If you did not answer part (b)(i) assume that the maximum theoretical mass of iron(III) chloride ($FeCl_3$) is 28.0 g. This is **not** the correct answer to part (b)(i).)

_____
_____

Percentage yield = _____%

Q 6.
Ammonia is produced from nitrogen and hydrogen.
The equation for this reaction is:

(a) (i) A company wants to make 6.8 tonnes of ammonia.
Calculate the mass of nitrogen needed.
Relative atomic masses ($A_r$): H = 1; N = 14

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

_____
_____
_____
_____
_____

Mass of nitrogen = _____ tonnes

**(3)**

(ii) The company expected to make 6.8 tonnes of ammonia.
The yield of ammonia was only 4.2 tonnes.
Calculate the percentage yield of ammonia.

_____
_____

Percentage yield of ammonia = _____ %

Q7.
Some students investigated magnesium oxide.
(a) Magnesium oxide has the formula MgO.
(i) Calculate the relative formula mass ($M_r$) of magnesium oxide.
Relative atomic masses: O = 16; Mg = 24.

_____
_____

Relative formula mass = _____

**(2)**

(ii) Calculate the percentage by mass of magnesium in magnesium oxide.

_____
_____

Percentage by mass of magnesium in magnesium oxide = _____%

**(2)**

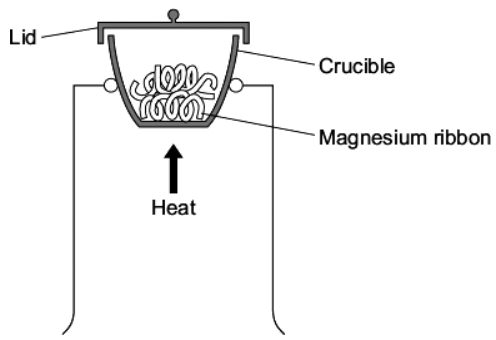
(iii) Calculate the mass of magnesium needed to make 25 g of magnesium oxide.

_____

Mass of magnesium = _____ g

**(1)**

(b) The students calculated that if they used 0.12 g of magnesium they should make 0.20 g of magnesium oxide.
They did this experiment to find out if this was correct.




The students weighed 0.12 g of magnesium ribbon into a crucible.

- They heated the magnesium ribbon.
- They lifted the lid of the crucible slightly from time to time to allow air into the crucible.
- The students tried to avoid lifting the lid too much in case some of the magnesium oxide escaped.
- When all of the magnesium appeared to have reacted, the students weighed the magnesium oxide produced.

The results of the experiment are shown below.

| | |
|---|---|
| Mass of magnesium used in grams | 0.12 |
| Mass of magnesium oxide produced in grams | 0.18 |

(i) The mass of magnesium oxide produced was lower than the students had calculated.
They thought that this was caused by experimental error.
Suggest **two** experimental errors that the students had made.

_____
_____
_____

**(2)**

(ii) The students only did the experiment once.
Give **two** reasons why they should have repeated the experiment.

_____
_____
_____
_____

**(2)**

# Week 2: The Chemistry of fireworks


https://youtu.be/nPHegSuII_M

Fireworks are a wonderful way to celebrate any event;
it is widely recognised around the world due to the bang
and the spectacular colours plastered all around the night sky.
All those glitters and bangs are due to chemistry, specifically metal oxides.

In A-level chemistry you will learn more about Red-Ox reactions and many other chemical topics such as exothermic reactions and combustion reactions during your GCSE science course.

**Task 1** : Watch the video and answer the following questions

1. Name the three component of any pyrotechnics.
2. What is the purpose of the oxidisers?
3. Why would Sulphur, aluminum powder, magnesium powder and charcoal be a good source of fuel?
4. What kind of reaction is taking place between the oxidizers and fuels?
5. Identify all the different parts of a typical aerial shell; state the function of each part.
6. Why do the metal elements produce colours when burnt?
7. Use you knowledge of flame test to make the perfect mixture that would produce a rainbow when the firework is lit.

# Task 2

**1.0** This question is about chemical analysis and chromatography.

**1.1** What is the test for chlorine gas?

Tick **one** box.

- A glowing splint relights ☐
- A lighted splint gives a pop ☐
- Damp litmus paper turns white ☐
- Limewater turns milky ☐

A student added sodium hydroxide solution to four different solutions labelled A, B, C and D. The student added 5 drops of sodium hydroxide. The student then added excess sodium hydroxide.

The student's results are shown in **Table 1**.

**Table 1**

| Sample | Effect of sodium hydroxide addition | |
|---|---|---|
| | 5 drops | excess |
| A | White precipitate formed | No further change |
| B | Blue precipitate formed | No further change |
| C | Green precipitate formed | No further change |
| D | White precipitate formed | Precipitate dissolves |

**1.2** Which sample from **Table 1** contains copper ions?

**[1 mark]**

Tick **one** box.

**A** ☐

**B** ☐

**C** ☐

**D** ☐

**1.3** Which sample from **Table 1** contains iron(II) ions?

**[1 mark]**

Tick **one** box.

**A** ☐

**B** ☐

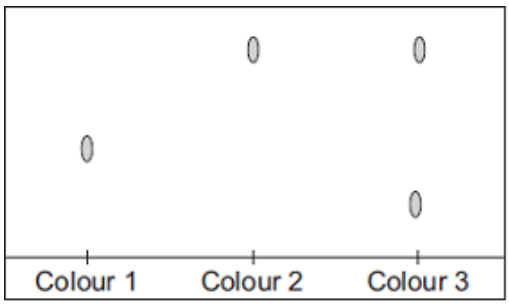
**C** ☐

**D** ☐

**1.4** Complete the sentence to show the reagents the student could add to show if a sample contains sulfate ions.

The reagents are barium _____ and dilute _____ acid.
If sulfate ions are present, a _____ precipitate is seen.

**1.5** Chromatography was used to compare three colours used as food colourings.




What do these results tell you about these three colours?

_____
_____
_____
_____

**1.6** State two advantages of using instrumental methods compared to chemical tests.

_____
_____

This question is about identifying metal ions in ionic compounds.
A student did a flame test on a white powder **A**.

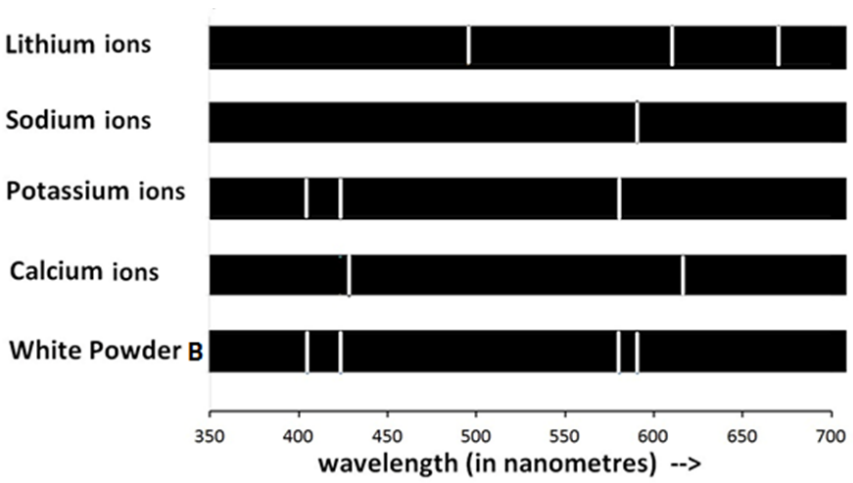
**2.1** Describe how to carry out a flame test.

_____
_____
_____
_____

**2.2** The flame turned crimson. Name the metal ion in the white powder **A**.

_____

**2.3** Metal ions can also be identified using flame emission spectroscopy.
The student then used flame emission spectroscopy to analyse a different white powder **B**.
**Figure 2** shows the spectra of compounds containing four metal ions, and the spectrum of the white powder **B**.



Use **Figure 2** to identify the **two** metal ions in the white powder **B**.

Metal 1: _____

Metal 2: _____

**2.4** An ionic compound can be analysed using

- a flame-test
- flame emission spectroscopy

Compare the advantages and disadvantages of these two methods

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

**3.0** Two students investigated a white salt, **Z**.

**3.1** The students dissolved **Z** in water.

They then added a few drops of sodium hydroxide solution to a fresh solution of **Z**.

A white precipitate was formed.

The students then added dilute nitric acid and silver nitrate solution to the solution of **Z.**

A cream precipitate was formed.

Student **A** concluded that compound **Z** was zinc sulfate.

Student **B** concluded that compound **Z** was copper bromide.

Which student, if any, was correct?

Explain your reasoning.

_____
_____
_____
_____
_____
_____
_____
_____

**3.2** Name **two** other metal ions that would also give a white precipitate when a few drops of sodium hydroxide solution are added.

**[2 marks]**

_____
_____

**4.0** A farmer has had his prize goat kidnapped! A ransom note, written in marker pen, has been left. The police arrest two suspects and search their houses. They find a marker pen at each house which could have been used to write the note. They decide to use paper chromatography to see whether the ink in the marker pens match the ransom note.

**4.1** Describe how you would use chromatography to test whether the ink in the felt tip pens matches the ink on the note.

_____

_____

_____

_____

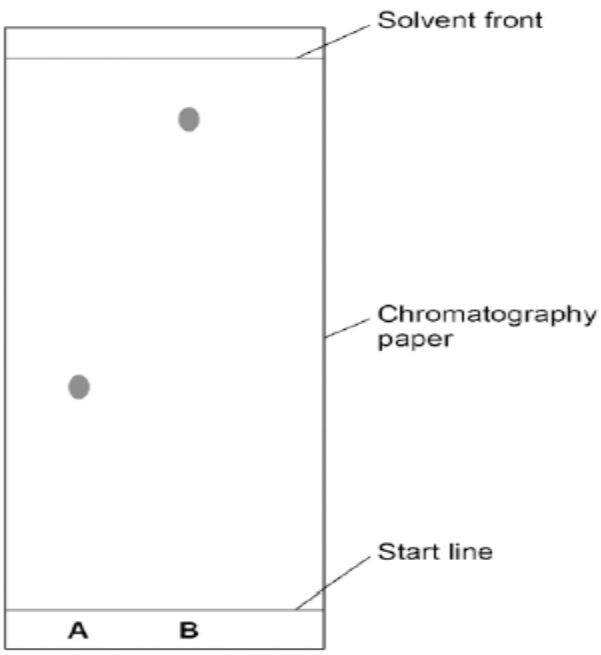
_____

_____

_____

_____

**4.2** The chromatogram shown below was taken from the suspects' marker pens.




Calculate the Rf value for ink spot **A**. Give your answer to 3 significant figures.

Rf value for ink spot A _____

**4.3** Explain why inks **A** and **B** move by different amounts during paper chromatography. You should refer to the stationary and mobile phases in your answer.

_____

_____

_____

_____

_____

_____

_____

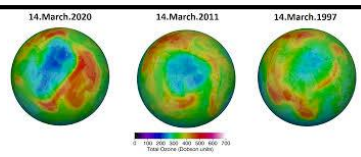
_____

_____

_____

_____

# Week 3: The Ozone layer




Today one of our concerns is global warming and the impact of greenhouse gases on our planet but 30 years ago it was all about the ozone layer. In module 4 of you're a level Chemistry course, you will study just how a certain organic compound found in everyday items such as aerosols and fridges was able to break down ozone layer and endanger the lives of all living organism on the face of the Earth. April of 2020, it was shown that the holes in the ozone layer have drastically reduced over the two months leading to it.

**Task 1** : Watch the following video and answer the questions below.

https://www.nationalgeographic.com/news/2016/06/antarctic-ozone-hole-healing-fingerprints/

Questions:

1. What is the role of the ozone layer and how the concentration of the ozone is maintained in the ozone layer ?

2. What is the chemical formula of ozone?

3. Use your knowledge of different types of bonding to state the type of bonding found in the ozone molecule.

4. Use a dot and cross diagram to show this bond.

5. Explain how CFCs compounds damage the ozone layer.

6. What key changes cause the hole in the ozone layer to gradually reduce?

**Task 2:** Recently it was announced that the biggest holes in the ozone layer has closed, read the article below. In A level chemistry you will learn of a radical substitution reaction which takes place between compounds such as CFCs and ozone, this reaction is a chain reaction and it is very hard to stop. One atom of chlorine can destroy thousands of ozone molecules over many years.

Write a hypothesis that in an "ideal world", you could test to explain why there is a sudden disappearance of the hole.

Article: https://www.independent.co.uk/environment/arctic-ozone-hole-closes-size-a9487961.html

# Task 3

1 Three substances are all solid at room temperature.
The table describes tests and the result of each test on the three substances.

| Substance | Effect of large force applied | Effect of heating gently at first, then strongly | Effect of passing electricity through solid | Effect of passing electricity through liquid |
|---|---|---|---|---|
| **A** | Breaks into many pieces | Easily melts and then boils | Does not conduct | Does not conduct |
| **B** | Breaks into many pieces | No change | Does not conduct | Conducts |
| **C** | Becomes thinner | No change | Conducts | Conducts |

**(a)** The covalent bonds in the molecules are not overcome when substance A is heated.
What forces are overcome when substance A melts?

_____

**(b)** What could substance A be?
Tick one box.

Graphite ☐
Iron ☐
Sodium chloride ☐
Sulfur ☐

(c) Suggest why substance B conducts electricity as a liquid but does not conduct electricity as a solid.

_____
_____
_____
_____

(d) Suggest why substance C becomes thinner when a large force is applied.

_____
_____
_____
_____
_____

e) What could substance C be?
Tick one box

Copper ☐
Diamond ☐
Iodine ☐
Magnesium oxide ☐

**2** This question is about the halogens.

(a) Which group in the periodic table is known as the halogens?

Tick **one** box.

Group 1 ☐

Group 2 ☐

Group 7 ☐

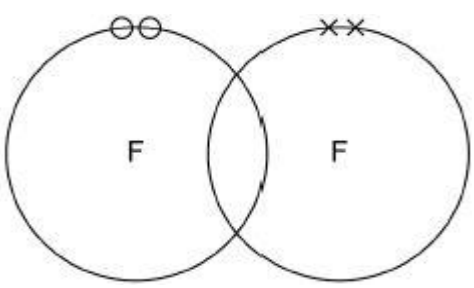
Group 0 ☐

(b) A fluorine atom has 7 electrons in the outer shell.

The diagram below shows part of a dot and cross diagram to represent a molecule of fluorine (F2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.




(c) Chlorine reacts with potassium bromide solution.

Complete the word equation.

chlorine + bromide → _____ + _____

potassium

_____

(d) What type of reaction happens when chlorine reacts with potassium bromide solution?

Tick one box.

decomposition ☐

displacement ☐

neutralisation ☐

precipitation ☐

(e) Complete the sentence.

Choose the answer from the box.

| an atom | an electron | a neutron | a proton |
|---|---|---|---|

Chlorine is more reactive than bromine.

This is because chlorine gains _____ more easily.

(f) How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

| bigger than | the same size as | smaller than |
|---|---|---|

A chlorine atom is _____ a bromine atom.

(g) Give a reason for your answer to part (f)

Reason

_____

_____

_____

(h) Fluorine reacts with chlorine to produce ClF3

Balance the chemical equation for the reaction.

$$Cl_2 + \_\_\_\_\_F_2 \longrightarrow 2\ ClF_3$$

(i) Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

**energy** **forces** **molecules** **weak**

_____

_____

_____

_____

_____

_____

_____

_____

_____

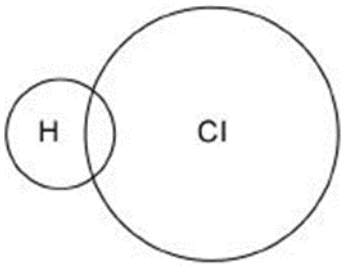
3. This question is about hydrogen chloride.

(a) A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

Complete **Figure 1** to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.

Figure 1




Hydrogen gas (H2) reacts with chlorine gas to produce hydrogen chloride.

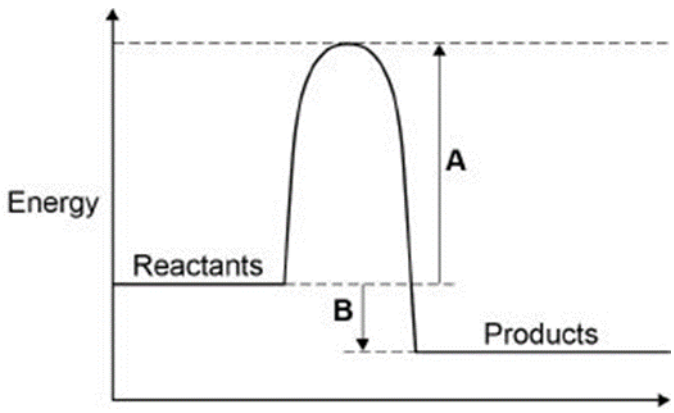
(b) Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

H2 + _____ → _____

(2)

Figure 2 shows the reaction profile diagram for the reaction between hydrogen and chlorine.

**Figure 2**




(c) What do A and B represent on Figure 2?

A _____

B _____

(d) How does the reaction profile diagram show that the reaction is exothermic?

_____

_____

(e) Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Hydrochloric acid contains hydrogen ions and chloride ions.

Explain why hydrogen chloride gas does not conduct electricity but hydrochloric acid is able to conduct electricity.

_____

_____

_____

_____

# Week 4: Aspirin


Aspirin the one of the oldest know pain killers;

Witch doctors around the world would boil the bark of certain trees and give the water to those who want to be cured of their pain. Today we now know that the barks of those tress contained a compound called salicin which the body converts to Salicylic acid, a compound that acts as an anti-inflammatory which relieves minor aches and pains. There was no witchcraft at play, it was organic chemistry!

As part of you're a level chemistry course, you will learn about reaction mechanisms; how one type of compound like alcohols can be converted to another type of compounds. You will have the opportunity to synthesised aspirin from scratch.

**Task 1** Below is an article from a modern day naturalist sharing tips on how to make your own pain killers; there is also a video showing synthesised step taking in labs to synthesised aspirin (acetyl salicylic acid).

The article:

https://www.artofmanliness.com/articles/how-to-harvest-and-use-natures-aspirin/

The video

https://www.youtube.com/watch?v=6lFQaxiRAmI


Use the two to answer the questions below

1, Name the family of trees from which Salicin was isolated.

2. What is the difference between modern day aspirin brought in local shops and pain killers found in those trees? Compare structures and mode of action in the body

3. Is there any similarities between the two methods used to produce the pain killers?

**Task 2** :If you get the opportunity to, take some new barks from a willow tree, device a method at home to produce a dried solid sample of Salicin. Recap the various separation techniques, pick the one you feel most suitable to carry out your experiment.

Film or create a tick toc to document your experiment.

Below are links to how to make a tic toc and places in Lambeth where willow tress can be found and how to identify them as well as how to use tic toc.

**Location of Willow tress near our school:**

1. Corner of Worsopp drive and Allott way, SW4. The tree is located latterly in the corner where the two paths merge. The drive can be reached via Notre Dame estate or via Abbeville rd.
2. Willington rd, SW9 via Landor rd. Landor rd is not far from Clapham North station and the three willow tress are located towards the end of Willington rd.
3. Trinity Gardens, off Acre lane Brixton, SW9. This garden road is not far from the Town hall, the willow trees are found in front of the first a role of three houses as you enter the road.
4. Pasley park, off Braganza rd, SE17. This park is located a the end of Braganza St and has many willow trees within its compound.

How to identify willow trees:

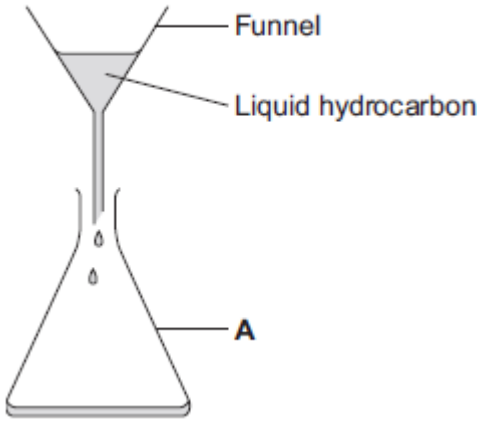
They tend to have slender leaves that a long and droopy. The branches also drop, weeping willow variety has its branches touching the flow in a droopy weeping sort of ways and can be found near wet habitats. The white willow looks silvery and it is more upright but like other willow trees, not very tall and is likely to have it's trunk closer to the ground than most trees.

# Task 3

**1.0** A student investigated the viscosity of liquid hydrocarbons.
The student used this method:

1. Measure 40 $cm^3$ of the liquid hydrocarbon.
2. Pour the liquid hydrocarbon into the funnel.

**Figure 1**




3. Time how long it takes for all of the liquid hydrocarbon to run out of the funnel.
4. Repeat the experiment for the other liquid hydrocarbons**.**

1.1 Give the name of apparatus **A** in **Figure 1.**

_____

1.2 Name the apparatus that could be used to measure 40cm3 of liquid hydrocarbon.

_____

The student's results for six liquid hydrocarbons are shown in **Table 1**.

**Table 1**

| **Formula of liquid hydrocarbon** | **Time for liquid hydrocarbon to run out of the funnel in seconds** | | | **Mean time in seconds** |
|---|---|---|---|---|
| | **Experiment 1** | **Experiment 2** | **Experiment 3** | |
| $C_6H_{14}$ | 12.2 | 11.8 | 12.0 | 12.0 |
| $C_7H_{16}$ | 14.7 | 15.2 | 15.4 | 15.1 |
| $C_8H_{18}$ | 18.7 | 19.9 | 18.9 | |
| $C_{10}H_{22}$ | 27.6 | 26.8 | 28.2 | 27.5 |
| $C_{12}H_{26}$ | 48.3 | 48.5 | 48.1 | 48.3 |
| $C_{14}H_{30}$ | 65.9 | 67.1 | 69.0 | 67.3 |

**1.3** Explain how the data show that the student's results are **precise**.

_____

_____

**1.4** Describe the pattern shown on **Table 1** between the number of carbon atoms in a molecule of liquid hydrocarbon and the time taken for the liquid hydrocarbon to run out of the funnel.

_____

_____

**1.5** Identify the anomalous result on the table.
Suggest **one** error the student may have made to get this anomalous result.

Anomalous result: _____
Error: _____

**1.6** Use the data in **Table 1** to calculate the mean time in seconds for $C_8H_{18}$.
Give your answer to an appropriate number of significant figures.
**[1 mark]**

Mean time = _____s

**1.7** Give **one** safety precaution the student should take when carrying out this experiment.
**[1 mark]**

_____
_____

**2.0** This question is about organic molecules.

2.1 Large hydrocarbon molecules can be broken into smaller molecules by heating with a catalyst.
The equation shows one example of this type of reaction.
C11H24 → 2C3H6 + C5H12

Which word describes this type of reaction?

Tick **one** box.

Cracking ☐

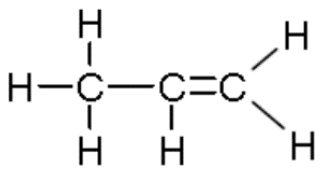
Polymerisation ☐

Precipitation ☐

Reduction ☐

**2.2** **Figure 2** shows propene as a displayed structure.

**Figure 2**



Draw a ring around the part of the molecule which makes propene unsaturated

**2.3** Bromine water changes colour when mixed with an unsaturated compound like propene.

Complete the sentences.
Use words from the box.

| Blue | Colourless | Green | Orange | Red |
|---|---|---|---|---|

Before mixing with propene, bromine water is _____.
After mixing with propene, bromine water is _____.

2.4 Propene reacts with steam to produce an alcohol, propanol.
Complete the equation for the reaction.

$C_3H_6 + H_2O \rightarrow$ _____

**2.5** Which two statements are true about propanol?

Tick **two** boxes.

Propanol can be oxidised to propanoic acid ☐

Propanol mixes with water to form a solution ☐

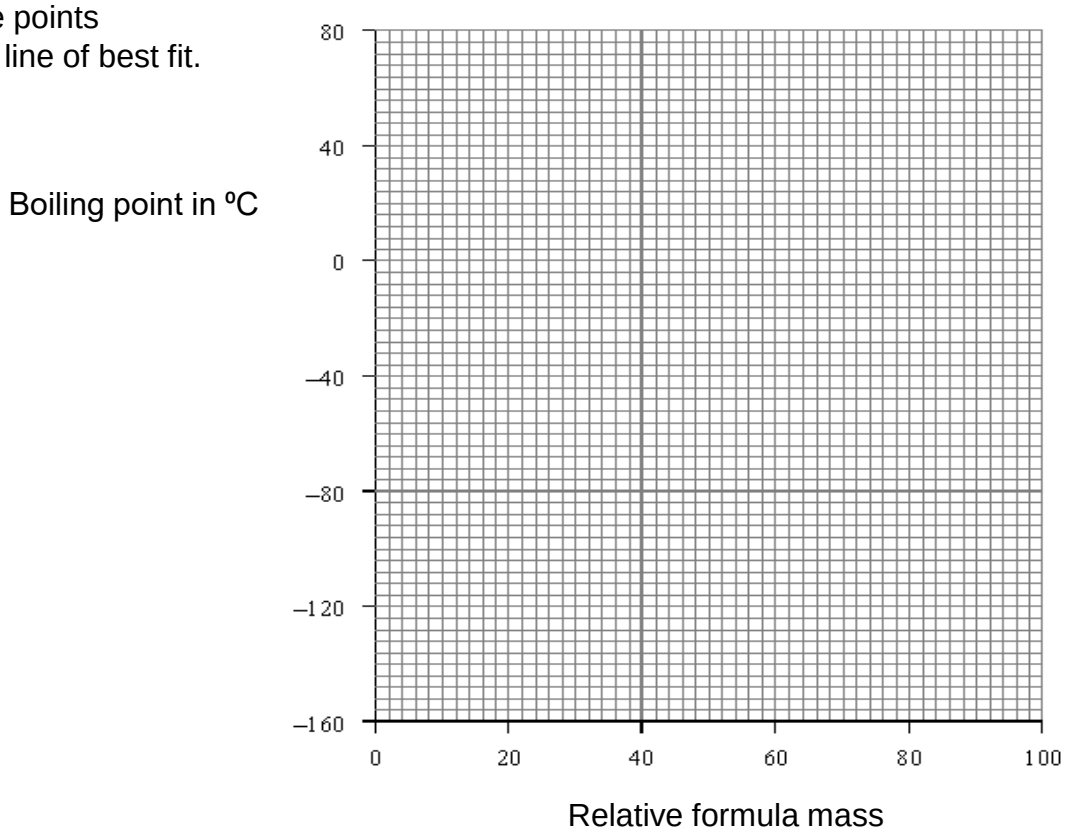
Propanol is a hydrocarbon ☐

Propanol reacts with sodium carbonate to make carbon dioxide ☐

Propanol is a strong acid ☐

**2.5** Draw a graph of relative formula mass against boiling point.
On the graph:

- plot the points
- draw a line of best fit.




2.6 Give two conclusions you can make from your graph.

_____

_____

_____

# BALANCING EQUATIONS

It's a key skill in chemistry. You must be able to do it. Have a go and if you are

struggling, get it sorted.

Balance the following equations:-

1) $Mg(s) + O_2(g) \rightarrow MgO(s)$

2) $H_2(g) + 02(g) \rightarrow H_2O(l)$

3) $Fe(s) + HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$

4) $CuO(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2\ (aq) + H_2O(l)$

5) $Ca(OH)_2(aq) + HCl(aq) \rightarrow CaCl2(aq) + H_2O(l)$

6) $KHCO3(s) + H2SO4(aq) \rightarrow K_2SO_4(aq) + CO_2(g) + H_2O(l)$

7) $Al(s) + Cl_2(g) \rightarrow AlCl_3(s)$

Deduce the chemical formulae of the following ionic compounds:-

a) calcium chloride

b) sodium oxide

c) magnesium sulfide

d) aluminium hydroxide

e) potassium carbonate

f) calcium nitrate

**Useful websites**

**Khan Academy**

Khan Academy produce lovely on-line tutorials. Brief, clear and informative. If you are struggling with equation balancing, this tutorial is well worth watching

https://www.khanacademy.org/science/chemistry/chemical-reactionsstoichiome/balancing-chemical-equations/v/balancing-chemical-equations-introduction

A chemical equation balancing game.

http://education.jlab.org/elementbalancing/

# Chemistry A level transition - baseline assessment

**40 marks/40 Min**

1. Here is part of a periodic table, use it to answer the following questions

| | | | | | |
|---|---|---|---|---|---|
| 10.8 **B** 5 boron | 12.0 **C** 6 carbon | 14.0 **N** 7 nitrogen | 16.0 **O** 8 oxygen | 19.0 **F** 9 fluorine | 20.2 **Ne** 10 neon |
| 27.0 **Al** 13 aluminium | 28.1 **Si** 14 silicon | 31.0 **P** 15 phosphorus | 32.1 **S** 16 sulphur | 35.5 **Cl** 17 chlorine | 39.9 **Ar** 18 argon |

All data is given on this paper, you will not need a periodic table

Answer all questions.

I) Which is the correct electron configuration for a nitrogen atom, circle the correct answer [1]

$1s^22p^5$ $1s^12p^6$ $1s^22s^22p^3$ $1s^22s^5$ $1s^22s^22p^63s^23p^2$

II) Which is the correct electron configuration for a chlorine atom, circle the correct answer [1]

$1s^22s^82p^7$ $1s^22s^22p^82d^5$ $1s^22s^22p^63d^7$ $1s^22s^22p^63p^7$ $1s^22s^22p^63s^23p^5$

III) Which is the correct electron configuration for an aluminium **ion**, $Al^{3+}$? Circle the correct answer [1]

$1s^22s^22p^6$ $1s^22s^22p^63s^23p^3$ $1s^22s^22p^63s^2$ $1s^22s^22p^62d^1$

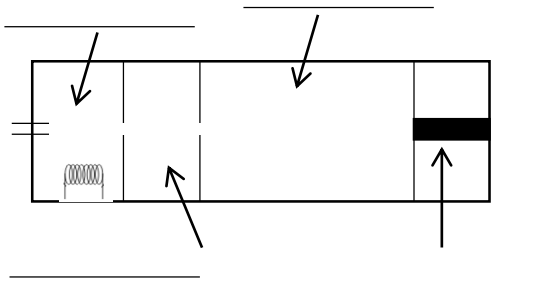
2. Draw a dot and cross diagram to show the covalent bonding in a molecule of water, H2O.

Atomic numbers: H =1, O =8

[2]

3. A time of flight mass spectrometer has 4 main stages. put the correct stage in the diagram below:

**Drift region** **Ionisation** **Detector** **Acceleration**



**4**. A mass spectrometer was used to analyse a sample of chlorine; the results of the analysis are as follows:

| isotope mass | % of sample |
|---|---|
| Cl-35 | 75.53 |
| Cl-37 | 24.47 |

Calculate the accurate atomic mass of chlorine. Give your answer to 3 decimal places.

[3]

mass: _____ g

**5**. Give the oxidation state of the underlined atom in the following chemicals.

Useful information: H = +1, K = +1, Na = +1, Mg = +2, O = -2, Cl = -1

[7]

a) $\underline{C}O_2$ b) $\underline{S}O_3$ c) $H_2\underline{S}O_4$ d) $\underline{Al}Cl_3$

e) $\underline{Cr}_2O_3$ f) $Na\underline{N}O_3$ g) $\underline{V}Cl_4$

**6**. Balance the following chemical equations:

a) $C_3H_8$ + ___ $O_2$ → ___ $CO_2$ + ___ $H_2O$

[3]

b) ___ HCl + $Mg(OH)_2$ → $MgCl_2$ + ___ $H_2O$

[2]

c) $Na_2CO_3$ + ___ HCl → ___ NaCl + ___ $H_2O$ + $CO_2$

[3]

7. Calculate the relative formula masses of the following:

Atomic masses: H = 1, O = 16, S = 32.1, C = 12, Ca = 40.1, Na = 23, Cl = 35.5, Zn = 65.4

a) $CaCl_2$

b) b) $H_2CO_3$

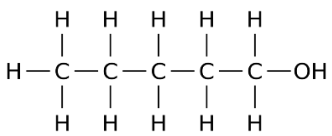
c) ) $Na_2SO_4$

d) d) $C_3H_7OH$

e) e) $Zn(NO_3)_2$

[5]

8. A student carried out a reaction with this molecule:



a. What is the name of this molecule?

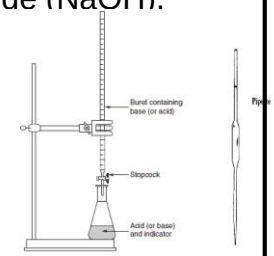
_____

[2]

**9.** Vinegar is a solution of ethanoic acid ($CH_3COOH$) in water. A student carried out a titration of a sample of vinegar.

He used a pipette to measure exactly 25.0cm$^3$ of vinegar into a flask, added an indicator and titrated it with a 1.00 mol dm$^{-3}$ solution of sodium hydroxide (NaOH). The reaction is:

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$




The student found that his average titration was 27.50cm3

c = n/v  c = concentration (mol dm$^{-3}$), n = number of moles, v = volume (dm$^3$)

n = m/Mr  n = number of moles, m = mass in grams, Mr =is the molecular mass

1dm$^3$ = 1000 cm$^3$

a. Using the chemical equation, how many moles of sodium hydroxide will react with 1 mole of ethanoic acid?

_____moles [1]

a. How many moles of sodium hydroxide are in 27.50cm$^3$ of 1.00 moldm$^{-3}$ sodium hydroxide?

_____moles [2]

a. How many moles of ethanoic acid are in 25.0cm$^3$ of the vinegar sample?

_____moles [1]

a. How many moles of ethanoic acid are in 1dm$^3$ of vinegar?

_____moles [1]

a. Ethanoic acid has a formula mass of 48. What mass of ethanoic acid is present in 1dm$^3$ of vinegar?

_____g [2]

# Chemistry A level transition - baseline assessment. - Answers

1. .

   a. Which is the correct electron configuration for a nitrogen atom, circle the correct answer [1]

   $1s^2 2p^5$ $1s^1 2p^6$ $1s^2 2s^2 2p^3$ $1s^2 2s^5$ $1s^2 2s^2 2p^6 3s^2 3p^2$

   b. Which is the correct electron configuration for a chlorine atom, circle the correct answer [1]

   $1s^2 2s^8 2p^7$ $1s^2 2s^2 2p^8 2d^5$ $1s^2 2s^2 2p^6 3d^7$ $1s^2 2s^2 2p^6 3p^7$ $1s^2 2s^2 2p^6 3s^2 3p^5$

   c. Which is the correct electron configuration for an aluminium **ion**, $Al^{3+}$? Circle the correct answer [1]

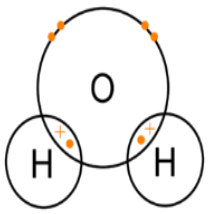
   $1s^2 2s^2 2p^6$ $1s^2 2s^2 2p^6 3s^2 3p^3$ $1s^2 2s^2 2p^6 3s^2$ $1s^2 2s^2 2p^6 2d^1$

2. Draw a dot and cross diagram to show the bonding in a molecule of water, $H_2O$. [2]

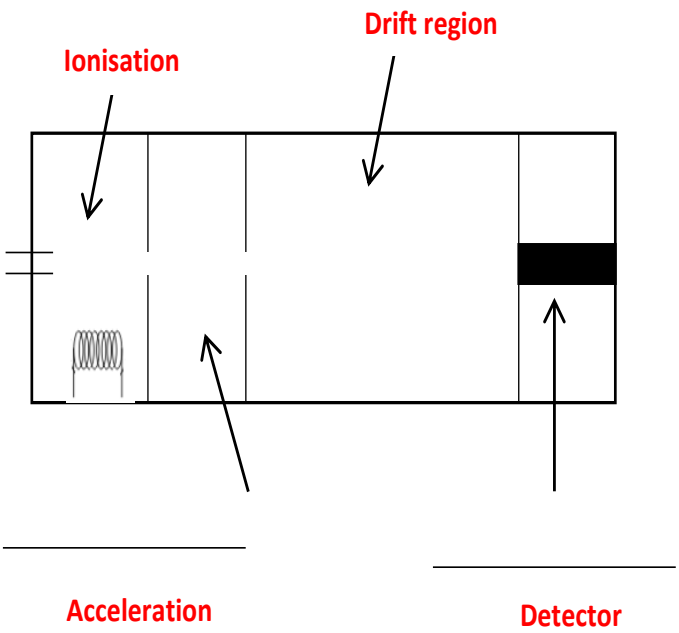
   Atomic numbers: H =1, O =8

1 mark for 2 x shared electrons

1 mark for lone pairs




3. A time of flight mass spectrometer has 4 main stages. put the correct stage in the diagram below:




[4]

4. A mass spectrometer was used to analyse a sample of chlorine, the results of the analysis are as follows:

| isotope mass | % of sample |
|---|---|
| Cl-35 | 75.53 |
| Cl-37 | 24.47 |

(35x75.53) + (37x24.47)/100 = 35.4894 [1]

To 3dp = 35.489 [1] [2 marks if above line is missing]

1. Give the oxidation state of the underlined atom in the following chemicals.
Useful information: H = +1, K = +1, Na = +1, Mg = +2, O = -2, Cl = -1 [7]

a) $\underline{C}O_2$ +4 b) $\underline{S}O_3$ +6 c) $H_2\underline{S}O_4$ +6 d) $\underline{Al}Cl_3$ +3

e) $\underline{Cr}_2O_3$ +3 f) $Na\underline{N}O_3$ +5 g) $\underline{V}Cl_4$ +4

2. Balance the following chemical equations:

a) $C_3H_8$ + _5_ $O_2$ → _3_ $CO_2$ + _4_ $H_2O$ [3]

b) _2_ HCl + $Mg(OH)_2$ → $MgCl_2$ + _2_ $H_2O$ [2]

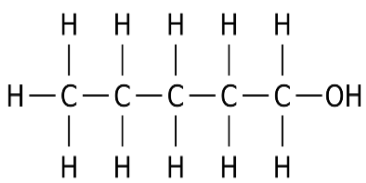
c) $Na_2CO_3$ + _2_ HCl → _2_ NaCl + _1_ $H_2O$ + $CO_2$ [3]

3. Calculate the relative formula masses of the following:
Atomic masses: H = 1, O = 16, S = 32.1, C = 12, Ca = 40.1, Na = 23, Cl = 35.5

a) $CaCl_2$ b) $H_2CO_3$ c) $Na_2SO_4$ d) $C_3H_7OH$ e) $Zn(NO_3)_2$ [5]

111.1 62 142.3 60 189.4

4. A student carried out a reaction with this molecule:



a. What is the name of this molecule? pentan-1-ol [2]

Pentanol = 1 mark pentan-1-ol = 2 marks

5.

a. Using the chemical equation, how many moles of sodium hydroxide will react with 1 mole of ethanoic acid?

_____1_____moles [1]

b. How many moles of sodium hydroxide are in 27.50$cm^3$ of 1.00 $moldm^{-3}$ sodium hydroxide?

27.5/1000 [1] x 1.00 = 0.0275 [1]

0.0275 [2] moles [2]

c. How many moles of ethanoic acid are in 25.0$cm^3$ of the vinegar sample?

___0.0275 __moles [1]

a. How many moles of ethanoic acid are in $1dm^3$ of vinegar?

0.0275 x 1000/25 = 1.10

___1.10____moles [1]

b. Ethanoic acid has a formula mass of 48. What mass of ethanoic acid is present in $1dm^3$ of vinegar?

1.1 x 48 = 52.8g

___52.8g ___g [1]