Coloma Sixth Form

# CHEMISTRY

***"The country which is in advance of the rest of the world in chemistry will also be foremost in wealth and in general prosperity."***

**William Ramsay, British chemist, discoverer of noble gases, Nobel Prize winner 1904**

# Specification

https://www.aqa.org.uk/subjects/science/as-and-a-level/chemistry-7404-7405

**Course Content**

AQA Chemistry is a content-led approach. Teaching of practical skills is integrated with the theoretical topics and they're assessed both through written papers and within a teacher assessed Practical Endorsement. The AQA Chemistry specification aims to encourage learners to develop: essential knowledge and understanding of different areas of the subject and how they relate to each other; a deep appreciation of the skills, knowledge and understanding of scientific methods; competence and confidence in a variety of practical, mathematical and problem solving skills.

**The content is divided into 3 key areas:**

1. **Physical Chemistry**
   **Topics include:** Atomic structure; Amount of substance; Bonding; Energetics; Kinetics and rate equations; Chemical equilibrium. Thermodynamics, Acids and bases; Redox and Electrochemistry.

2. **Inorganic Chemistry**
   **Topics include:** Periodicity, Group 2 – the Alkaline Metals, Group 7 – the Halogens, the properties of Period 3 elements, Transition Metal chemistry and the reactions of ions in aqueous solution

3. **Organic Chemistry**
   **Topics include:** Alkanes, Alkenes, Halogenoalkanes, Alcohols, Carbonys, Carboxylic Acids and their derivatives, Aromatics, Amines, Polymers, Amino Acids, Proteins and DNA, Organic Analysis – I.R, N.M.R and Mass spectroscopy and synthetic pathways.

**Assessment**

The A Level is a linear qualification assessed after 2 years.

Paper 1: Physical and Inorganic paper. 2 hours, 35% of A Level
Paper 2: Physical and Organic paper. 2 hours, 35% of A Level
Paper 3: Practical Skills, Data Handling and Synopsis. 2 hours, 30% of A Level

# What could this qualification lead to?

Chemistry is sometimes known as the "central science" because it helps to connect physical sciences, like maths and physics with applied sciences, like biology, medicine and engineering.

## What skills will I get from studying chemistry?

All that questioning and experimentation can be really handy when it comes to building a whole range of skills for your future career.

Chemistry helps you to develop research, problem-solving and analytical skills. It helps to you challenge ideas and show how you worked things out through logic and step-by-step reasoning. Chemistry often requires teamwork and good communication skills too, which is great for project management.

## What careers will chemistry be good for?

Chemistry will help you get ahead in most STEM (science, technology, engineering and maths) careers and more besides.

Chemistry is a facilitating subject for careers in: medicine, veterinary science, environmental science, engineering, toxicology, development of consumer products, metallurgy (studying how metals behave), space exploration, forensics, development of perfumes and cosmetics, pharmaceuticals, energy, teaching, science writing, patent attorney, software development, accountancy and scientific policy writing.

**Relevant Links to Websites**

**To find out about careers:**

**http://www.rsc.org/careers/future/**

**For support in your studies of chemistry:**

**https://edu.rsc.org/student**

**To inspire you how Chemistry filters in to our everyday life:**

**http://www.aquimicadascoisas.org/en/** (with English subtitles)

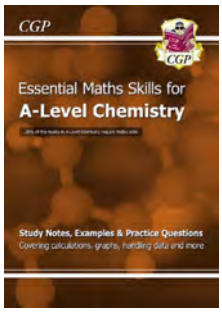
# How to be an A* Chemistry Student

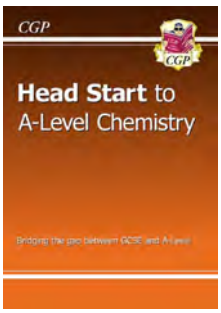
- Get a copy of your syllabus if you haven't already got one.
- Syllabi are often quite difficult to interpret, so you need to know exactly what questions your examiners are asking, and how they are marking them.
- Explore the examiners' web site. You will be able to download specimen papers (including mark schemes) and legacy papers from the previous syllabus that are still relevant.
- If you want the best possible grade, you should be working with exam papers all the way through your course. Leaving looking at exam papers until your last minute revision is too late.
- Complete at least two past exam papers within the time set (and many more for practice), as it is easy to run out of time. Remember to include checking back over your question paper within your strategy, as it is easy to confuse numbers and amounts in calculations as well as other mistakes including missing information in the question, missing bits in diagrams, improperly balanced equations or simple spelling mistakes or words missing.
- When you meet a new reaction, learn the equation(s) for it, the conditions, the states, the catalysts/reagents, the products.
- When you see a graph, take note of the axis, the units and what it is actually showing. Ensure you have a model answer to describe the graph
- When you meet a new term, memorise its definition.
- When you meet a new calculation, practise. Practise. Practise. Until you've mastered it. Take note of the mistakes you seem susceptible to, so that you can check and watch out for them later.
- Practise drawing out all organic reaction mechanisms using a variety of starting molecules including cyclic ones.
- Use your textbook to extend your class notes and complete all the practice questions.
- After a Chemistry lesson: look at what section of the syllabus you have covered, then make sure you remember and understand everything as well as the additional material your teacher has covered. Practice everything you're supposed to be able to do. Go back to your teacher to explain any points you're not 100% clear on.

# Summer Work

AQA A-Level Chemistry at Coloma is a rewarding but academically rigorous and demanding course, so it is vital you carry out some preparation work before your first A-Level Chemistry lesson in September.

Reviewing your GCSE Maths and Chemistry work will be extremely useful before you start Chemistry lessons. We can recommend the following books as an aid to your revision – please note that these are generic books and not exam-board specific:




*"New A-Level Chemistry: Essential Maths Skills"*
*published by CGP Books in October 2015*
*ISBN-13:* ***978-1782944720***

*"Head Start to A-level Chemistry"*
*published by CGP Books in March 2015*
*ISBN-13:* ***978-1782942801***

It is essential that you make the effort to plan your time effectively and develop your independent working skills throughout the year. However, you cannot wait until the beginning of the course – you will need to start doing this straight away!

You will need to complete the questions below, which have been divided into two sections:

- Section 1 (Mathematics for A-Level Chemistry) is aimed at refreshing some of the generic maths skills and concepts required for an A-Level Chemistry course

- Section 2 (A-Level Chemistry - Key Ideas) will reintroduce you to some of the most important ideas and topics you should have already covered at GCSE - these will be covered again in much more detail during the first year of the A-Level chemistry course. The focus here is on revising and developing quantitative chemistry skills.

- Section 3 (The Chemistry of….) is an opportunity to develop your research and communication skills in an area of interest.

**We estimate that the questions should take around 2 hours to complete and the research task a further 2-3 hours.**

You should bring the completed questions and your one-page summary with you to your first Chemistry lesson in September - it may also be used in Chemistry lessons during the first term of teaching.

Enjoy your summer holiday; we look forward to seeing you in September!

The Chemistry team at Coloma

# Section 1: Mathematics for A-Level Chemistry

## Task 1: Indices

1. Simplify the following expressions:

a) $x^3 \times x^4$ ..... *(1 mark)*

b) $y^9 \div y^4$ ..... *(1 mark)*

c) $(z^7)^3$ ..... *(1 mark)*

d) $\frac{x^4 \times x^2}{x^5}$ ..... *(1 mark)*

2. Solve the following equations for $x$

a) $2^{x+1} = 2^4$ ..... *(1 mark)*

b) $3^{x-2} + 1 = 28$ ..... *(1 mark)*

c) $2^{x+6} = 128$ ..... *(1 mark)*

3. The moon is approximately 4 x $10^5$ kilometres away. If an astronaut was to travel to the moon and back 3 times, how far would he have travelled in space?

.....
.....
.....
..... *(1 mark)*

4. If that same astronaut was to travel to the moon and back $10^3$ times, how far would he have travelled in space?

.....
.....
..... *(1 mark)*

## Task 2: Standard form

1. Convert the following numbers into standard form:

a) 32 000 ..... *(1 mark)*

b) 0.0006 ..... *(1 mark)*

c) 104 000 ..... *(1 mark)*

d) 9 230 000 ..... *(1 mark)*

2. Convert the following numbers from standard form into decimal notation:

a) $3.26 \times 10^4$ ..... *(1 mark)*

b) $8.4 \times 10^{-3}$ ..... *(1 mark)*

c) $7.29 \times 10^7$ ..... *(1 mark)*

d) $8 \times 10^{-6}$ ..... *(1 mark)*

3. Using the formula *Circumference = 3.14 × radius*, and given that the mean radius of the Earth is 6 378 000 m, calculate the approximate circumference of the Earth in metres, leaving your answer in standard form to two significant figures.

.....
..... *(1 mark)*

4. There are 86 400 seconds in a day. Calculate the number of seconds in a year leaving your answer in standard form to two significant figures.

.....
..... *(1 mark)*

# Task 3: Units

1. Convert the following numbers into metres:

a) $550\ \text{nm}$ ..... *(1 mark)*

b) $0.0025\ \text{km}$ ..... *(1 mark)*

c) $1.001\ \text{km}$ ..... *(1 mark)*

2. Simplify the following units:

a) $\text{cm} \times \text{cm}$ ..... *(1 mark)*

b) $\text{km}^2 \times \text{km}$ ..... *(1 mark)*

c) $\text{nm}^2 \times \text{nm}^{-1}$ ..... *(1 mark)*

d) $\frac{\text{kg m}}{\text{m}}$ ..... *(1 mark)*

3. Concrete has a density of 2400 kg $m^{-3}$. What volume of concrete would have a mass of 96 kg?

.....
.....
..... *(1 mark)*

4. What would this volume be in:
   (a) $dm^3$ ..... *(1 mark)*
   (b) $cm^3$ ..... *(1 mark)*

# Task 4: Ratio

1. Find the simplest whole number ratio of the following (Example $6:4 = 3:2$):

a) $120:50$ ..... *(1 mark)*

b) $64:24$ ..... *(1 mark)*

c) $13:52$ ..... *(1 mark)*

d) $100:10\,000$ ..... *(1 mark)*

2. Find $x$ by scaling the ratio.

a) $1:2 = 4:x$ ..... *(1 mark)*

b) $8:3 = x:9$ ..... *(1 mark)*

c) $25:10 = x:2$ ..... *(1 mark)*

3. A toy is made from red bricks and yellow bricks. The ratio of the number of red bricks to number of yellow bricks is 5:2. There are 210 more red bricks than yellow bricks. How many red bricks are in the toy?

.....
.....
.....
.....*(3 marks)*

# Section 2: A-Level Chemistry - Key Ideas

## Task 1: Balancing equations

Balance the following equations - note that some equations may already be balanced. *(1 mark each)*

1. $CH_4 + O_2 \rightarrow CO_2 + H_2O$

2. $Na + O_2 \rightarrow Na_2O$

3. $Mg + H_2O \rightarrow Mg(OH)_2 + H_2$

4. $BaCO_3 + H_2SO_4 \rightarrow BaSO_4 + CO_2 + H_2O$

Write a balanced equation for the following reactions, including state symbols. *(2 marks each)*

8. sodium + oxygen → sodium oxide

9. aluminium + chlorine → aluminium chloride

10. calcium + hydrochloric acid → calcium chloride + hydrogen

## Task 2: Simple unit conversions

1. Convert the following masses into grams (1 tonne = 1000 kg):

(a) 0.25 kg ..... *(1 mark)*

(b) 15 mg ..... *(1 mark)*

(c) 100 tonnes ..... *(1 mark)*

2. Convert the following volumes into $dm^3$ (1 $dm^3$ = 1000 $cm^3$)

(a) 100 $cm^3$ ..... *(1 mark)*

(b) 25 $cm^3$ ..... *(1 mark)*

(c) 50 $m^3$ ..... *(1 mark)*

# Task 3: Moles calculations - masses

*What is a mole?*

Atoms and molecules are very small – far too small to count individually! It is important to know how much of something we have, but we count particles in MOLES because you get simpler numbers

**1 mole = 6.02 x $10^{23}$ particles**

**(6.02 x $10^{23}$ is known as Avogadro's number)**

1. (a) If you have 2.5 x $10^{21}$ atoms of magnesium, how many moles do you have?

*(1 mark)*

(b) If you have 0.25 moles of carbon dioxide, how many molecules do you have?

*(1 mark)*

The number of moles of a substance can be calculated from a measurement of **mass**:

You can find the number of moles of a substance if you are given its **mass** and you know its **molar mass (relative formula mass or $M_r$)**:

$$\textit{number of moles} = \textit{mass} / M_r$$

$$n = m / M_r$$

Mass MUST be measured in grams!

Molar mass ($M_r$) has units of g $mol^{-1}$ (grams per mole)

2. Calculate the number of moles present in:

a) 2.3 g of Na ..... *(1 mark)*

b) 240 kg of $CO_2$ ..... *(1 mark)*

3. Calculate the mass of:

a) 0.05 moles of $Cl_2$ ..... *(1 mark)*

b) 0.075 moles of $Ca(OH)_2$ ..... *(1 mark)*

3. Calculate the $M_r$ of the following substances:

a) 0.015 moles, mass of 0.42 g ..... *(1 mark)*

b) 0.0125 moles, 0.50 g..... *(1 mark)*

## Task 4: Reacting quantities calculations - mole ratios

Balanced chemical equations show the ratio in which different species react in a chemical equation.

$$\mathbf{6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2}$$

The equation above shows that **6** moles carbon dioxide of react with **6** mole of water to make **1** mole of glucose and **6** moles of oxygen.

6 : 6 : 1 : 6

1. (a) How many moles of water are needed to react with 0.03 moles of carbon dioxide?

*(1 mark)*

(b) How many moles of glucose can you make from 0.03 moles of carbon dioxide?

*(1 mark)*

(c) How many moles of oxygen can you make from 0.03 moles of carbon dioxide?

*(1 mark)*

2. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

a) How many moles of magnesium would be needed to react with 0.01 moles of hydrochloric acid?

*(1 mark)*

b) How many moles of hydrogen could be produced from 0.01 moles of hydrochloric acid?

*(1 mark)*

# Task 5: Reacting quantities calculations - reacting masses

You can calculate the reacting quantities of substances in a chemical reaction in three steps:

- calculate the number of moles of one of the substances (you will either be given the mass, or the volume and the concentration, or the gaseous volume)
- use the equation to work out the number of moles of the other substance
- use one of the mole relationships to work out the quantity you need

1) What mass of hydrogen is produced when 192 g of magnesium is reacted with hydrochloric acid?

$$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$$

*(3 marks)*

2) What mass of oxygen is needed to react with 8.5 g of hydrogen sulphide ($H_2S$)?

$$2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$$

*(3 marks)*

3) What mass of potassium oxide is formed when 7.8 g of potassium is burned in oxygen?

$$4\,K + O_2 \rightarrow 2\,K_2O$$

*(3 marks)*

# Section 3 – The Chemistry of…..

You are tasked with designing a chemistry-focused research article on a topic of your choice. We are providing you with several possible areas of interest; you must choose an area of interest and identify a particular topic within that area that you are interested in writing about. You must be able to access up-to-date research information on this topic.

| **Areas of interest** | **Possible topics – SUGGESTIONS ONLY!** |
|---|---|
| Chemistry of Space | Analysing space rock<br><br>Molecules found in outer space<br><br>Aurora Borealis |
| Chemistry of Art | Restoration of paintings<br><br>Prehistoric pigments and dyes<br><br>Pottery and sculpture |
| Chemistry of Health | Making and testing medicines<br><br>Drug resistant microbes<br><br>Molecules against malaria |
| Chemistry of Sport | Chemistry of the 400 m sprint<br><br>Performance-enhancing drugs<br><br>Biosensors |
| Chemistry of Materials | Metallurgy and applications<br><br>Petrochemicals and plastics<br><br>Chemistry of lipstick |
| Chemistry of Engineering | Fuel and solar cells<br><br>Nuclear reprocessing<br><br>Bioreactors and sewage treatment |
| Chemistry of Food | Flavours and smells<br><br>Fizzy drinks<br><br>Chocolate |

The article must contain chemical ideas and concepts that could be understood by a fellow A-level chemistry student. This may require you to read around the topic before you settle on a final title. Your article may be displayed in the department to provide an opportunity for other A-level chemistry students to read your work and learn from you. You will also find it *very* useful to refer to this work in your future UCAS personal statement as wider research and reading!

**The article must fit on max. <u>ONE</u> side of A4 OR A3 paper (<u>including</u> any pictures or diagrams), and must cite at least 2 research references. Ideally it will be able to be displayed in the department, so do NOT exceed this limit!**

# Extra Suggestions for the Summer

- Explore the Periodic Table:

  **Royal Society of Chemistry's interactive Periodic Table** with podcasts and videos
  https://www.rsc.org/periodic-table

- Read a book:

  **'A Short History of Nearly Everything'** by Bill Bryson
  ISBN 9781784161859

  **'Periodic Tales: The Curious Lives of the Elements'** by Hugh Aldersey-Williams
  ISBN 9780141041452

  **'Nature's Building Blocks: An A-Z Guide to the Elements'** by John Emsley
  ISBN 9780199605637

  **'Uncle Tungsten: Memories of a Chemical Boyhood'** by Oliver Sacks
  ISBN 9780330523660

  **'Napoleon's Buttons: How 17 molecules changed history'** by Penny Le Couteur & Jay Burreson
  ISBN 9781585423316

- Play a game:

  **Gridlocks**
  http://www.rsc.org/learn-chemistry/resources/gridlocks/