OCR Chemistry A H432

Lesson activity: GCSE to A-level progression (Chemistry)

Student booklet with information about:

- the specification and structure of the assessment
- and key skills activities to support the move from GCSE to A-level Chemistry.

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1. Buy this book https://www.amazon.co.uk/Head-Start-level-Chemistry-Level/dp/1782942807/ref=sr_1_1?crid=CI9NG68MJSTM&keywords=head+start+to+a+level+chemistry&qid=1656576636&sprefix=head+start+to+a+level+chemistry+%2Caps%2C54&sr=8-1 'Head start to A level Chemistry' You should work through this book during the summer so that you have an understanding of the key concepts from GCSE and how we will build upon these during Year 12. Copies of this book are available for £3 in school.
2. Complete activity 1-16 from this booklet

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Aim of the booklet

This booklet will support your transition from GCSE science to A-level. At first, you may find the jump in demand a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt. As you follow the course you will see how the skills and content you learnt at GCSE will be developed and your knowledge and understanding of all these elements will progress.

We have organised the guide into two sections:

1. Understanding the specification and the assessments
2. Transition activities to bridge the move from GCSE to the start of the A-level course.

Understanding the specification and the assessments

Specification at a glance

The specification is a useful reference document for you. You can download a copy from our website https://www.ocr.org.uk/Images/171720-specification-accredited-a-level-gce-chemistry-a-h432.pdf

The most relevant areas of the specification for students are the following:

Section 3: Subject content

Section 6: Maths requirements and examples

Section 7: Practical assessment

In Chemistry the subject content is split into three broad areas:

Physical chemistry
Inorganic chemistry
Organic chemistry

There are several sections within each of these broad areas. The content of each of these three broad areas is then split between AS and A-level.

The split of content between AS and A-level is shown in the tables below.

Content common to AS and A-level

Physical chemistry	Inorganic chemistry	Organic chemistry
Atomic structure	Periodicity	Introduction to organic chemistry
Amount of substance	Group 2, the alkaline earth metals	Alkanes
Bonding	Group 7(17), the halogens	Halogenoalkanes
Energetics		Alkenes
Kinetics		Alcohols
Chemical equilibrium, Le Chatelier's principle and K_c		Organic analysis
Oxidation, reduction and redox equations		

A-level only content

Physical chemistry	Inorganic chemistry	Organic chemistry
Thermodynamics	Properties of Period 3 elements and their oxides	Optical isomerism
Rates of equations	Transition metals	Aldehydes and ketones
Equilibrium constant K_p for homogeneous systems	Reactions of ions in aqueous solution	Carboxylic acids and derivatives
Electrode potentials and electrochemical cells		Aromatic chemistry
Acids and bases		Amines
		Polymers
		Amino acids, proteins and DNA
		Organic synthesis
		Nuclear magnetic resonance spectroscopy
		Chromatography

Each section of the content begins with an overview, which describes the broader context and encourages an understanding of the place each section has within the subject. This overview will not be directly assessed.

The specification is presented in a two-column format:

- the left-hand column contains the specification content that you must cover, and that can be assessed in the written papers.
- the right-hand column exemplifies the opportunities for maths and practical skills to be developed throughout the course. These skills can be assessed through any of the content on the written papers, not necessarily in the topics we have signposted.

Assessment structure

AS

The assessment for the AS consists of two exams, which you will take at the end of year 12 (if you are planning on dropping the subject). Each exam is 1 hr 30 mins and is out of a total of 70 marks. The past papers can be found here https://www.ocr.org.uk/qualifications/as-and-a-level/chemistry-a-h032-h432-from-2015/assessment/

A-level

The assessment for the A-level consists of three exams, which you will take at the end of the course.

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

All components include synoptic assessment.

Assessment objectives

As you know from GCSE, we have to write exam questions that address the Assessment objectives (AOs). It is important you understand what these AOs are, so you are well prepared. In Chemistry there are three AOs.

There are three assessment objectives in OCR's A Level in Chemistry A. These are detailed in the table below.

Learners are expected to demonstrate their ability to:

	Assessment Objective
AO1	Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.
AO2	Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data.
AO3	Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: • make judgements and reach conclusions • develop and refine practical design and procedures.

AO weightings in A Level in Chemistry A

The relationship between the assessment objectives and the components are shown in the following table:

Component	% of A Level in Chemistry A (H432)		
	AO1	AO2	AO3
Periodic table, elements and physical chemistry (H432/01)	13–14	15–16	8–9
Synthesis and analytical techniques (H432/02)	13–14	15–16	8–9
Unified chemistry (H432/03)	5–6	10–12	9–10
Practical endorsement in chemistry (H432/04)*	N/A	N/A	N/A
Total	**31–34**	**40–44**	**25–28**

Other assessment criteria

At least 20% of the marks for AS and A-level Chemistry will assess mathematical skills, which will be equivalent to Level 2 (Higher Tier GCSE Mathematics) or above.

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

Command words

Command words are used in questions to tell you what is required when answering the question. You can find definitions of the command words used in chemistry assessments below. They are very similar to the command words used at GCSE.

Balance

Students need to balance a chemical equation.

Calculate

Students should use numbers given in the question to work out the answer.

Choose

Select from a range of alternatives.

Compare

This requires the student to describe the similarities and/or differences between things, not just write about one.

Complete

Answers should be written in the space provided, for example, on a diagram, in spaces in a sentence or in a table.

Define

Specify the meaning of something.

Describe

Students may be asked to recall some facts, events or process in an accurate way.

Design

Set out how something will be done.

Determine

Use given data or information to obtain and answer.

Draw

To produce, or add to, a diagram.

Estimate

Assign an approximate value.

Evaluate

Students should use the information supplied, as well as their knowledge and understanding, to consider evidence for and against when making a judgement.

Explain

Students should make something clear, or state the reasons for something happening.

Give

Only a short answer is required, not an explanation or a description.

How/What/When/Where/Which/Who/Why

These can be used for more direct questions.

Identify

Name or otherwise characterise.

Justify

Use evidence from the information supplied to support an answer.

Label

Provide appropriate names on a diagram.

Measure

Find an item of data for a given quantity.

Name

Only a short answer is required, not an explanation or a description. Often it can be answered with a single word, phrase or sentence.

Plan

Write a method.

Plot

Mark on a graph using data given.

Predict

Give a plausible outcome.

Show

Provide structured evidence to reach a conclusion.

Sketch

Draw approximately.

Suggest

This term is used in questions where students need to apply their knowledge and understanding to a new situation.

Use

The answer must be based on the information given in the question. Unless the information given in the question is used, no marks can be given. In some cases students might be asked to use their own knowledge and understanding.

Write

Only a short answer is required, not an explanation or a description.

Subject-specific vocabulary

You can find a list of definitions of key working scientifically terms used in our AS and A-level specification below.

You will become familiar with, and gain understanding of, these terms as you work through the course.

Term	Definition	Notes
accuracy	a measurement result is considered accurate if it is judged to be close to the true/acceptable value	Accuracy is a property of a single result. Random and systematic errors reduce accuracy.

Term	Definition	Notes
anomaly (outlier)	value in a set of results that is judged not to be part of the inherent variation	Calculate the mean without the anomaly if you suspect an anomaly due to an error or due to different conditions. If you identify an anomaly during the practical, then consider repeating the measurement. In **Maths**, you may use the term 'outlier'.
control variable	variables other than the independent and dependent variables which are kept the same	These are quantities or conditions that are kept the same in a practical. Changes in these conditions could affect the validity of your method and results.
dependent variable	variable which is measured whenever there is a change in the independent variable	The dependent variable is recorded as either numerical values with units (quantitative) or in the form of descriptive comments (qualitative).
independent variable	variable which is deliberately changed or selected by the person in the planning of a practical activity	The independent variable is recorded in the first column of a results table. The dependent variable is recorded to the right with processed data in the far right columns. In a graph, the independent variable is usually plotted on the *x*-axis with the dependent variable on the *y*-axis.
line of best fit	a line drawn on a graph that passes as close as possible to the data points. It represents the best estimate of the underlying relationship between the variables.	A line of best fit can be a straight line or a curve. This differs from **GCSE Maths**, where a line of best fit is always a straight line.
precision	a quality denoting the closeness of agreement between measured values obtained by repeated measurements	Precision refers to more than one value. Precise results are clustered together. You can only determine if your results are precise by repeating the measurement. Reducing the effect of random errors improves precision. A systematic error does not affect precision, as it is the same error each time. You may have precise results with a systematic error, but not accurate results.
random error	error in a measurement due to small uncontrollable effects	We can't correct random errors, but we can reduce their effect by making more measurements and calculating the mean. Random errors contribute to uncertainty.

Term	Definition	Notes
range (of a variable)	the maximum and minimum values of the independent or dependent variables	In **Maths** the range is the difference between the biggest and smallest value of a variable.
repeatability	precision obtained when measurement results are produced in one laboratory, by a single operator, using the same conditions, over a short timescale	A measurement is repeatable when repetition under the same conditions gives similar results. Anomalous results can be identified by repeating the measurement. However, never discard data simply because it does not correspond with expectations.
reproducibility	precision obtained when measurement results are produced by different laboratories and therefore by different operators using different pieces of equipment	A measurement is reproducible when similar results are produced by different groups or different equipment or altered methods. If the results are reproducible then you can be more confident in the quality of the results.
resolution	smallest change in the input quantity being measured by a measuring instrument that gives a perceptible change in the reading of the measuring instrument	For example, the resolution of a ruler is 1 mm and the resolution of a burette is 0.1 cm^3. It is not correct to describe equipment with a higher resolution as being more precise, as precision is a property of repeated results.
systematic error	error due to the measured value differing from the true value by the same amount each time	Methods or equipment may introduce systematic errors, producing consistent errors in results. Using the same equipment each time avoids introducing more systematic errors. Calibrating equipment where appropriate reduces systematic errors. A **zero error** is when the measuring device indicates a value when the quantity being measured is zero. Systematic errors contribute to uncertainty.
uncertainty	interval within which the true value can be expected to lie, with a given level of confidence or probability	Uncertainties depend on a range of factors, including systematic and random errors. Analogue apparatus have an uncertainty of ± half the smallest graduation. The uncertainty of digital apparatus is ± the resolution of the apparatus. The A Level Practical Skills handbooks contain further guidance on uncertainties.
validity (of an experiment)	suitability of the method used to answer the question being asked	To ensure validity, identify control variables and keep them constant to avoid affecting the dependent variables. In field studies there are naturally changing variables. Ensure the control variables are as similar as possible when repeating.

Transition activities

The following activities cover some of the key skills from GCSE science that will be relevant at AS and A-level. They include the vocabulary used when working scientifically and some maths and practical skills.

You can do these activities independently or in class. The booklet has been produced so you can complete it electronically or print it out and do the activities on paper.

The activities are **not a test**. Try the activities first and see what you remember and then use textbooks or other resources to answer the questions. **Don't** just go to Google for the answers, as actively engaging with your notes and resources from GCSE will make this learning experience much more worthwhile.

The answer booklet guides you through each answer. It is not set out like an exam mark scheme but is to help you get the most out of the activities.

Understanding and using scientific vocabulary

Understanding and applying the correct terms are key for practical science. Much of the vocabulary you have used at GCSE for practical work will not change but some terms are dealt with in more detail at A-level so are more complex.

Activity 1 Scientific vocabulary: Designing an investigation

Link each term on the left to the correct definition on the right.

Term	Definition
Hypothesis	The maximum and minimum values of the independent or dependent variable
Dependent variable	A variable that is kept constant during an experiment
Independent variable	The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres
Control variable	A proposal intended to explain certain facts or observations
Range	A variable that is measured as the outcome of an experiment
Interval	A variable selected by the investigator and whose values are changed during the investigation

Activity 2 Scientific vocabulary: Making measurements

Link each term on the left to the correct definition on the right.

True value	The range within which you would expect the true value to lie
Accurate	A measurement that is close to the true value
Resolution	Repeated measurements that are very similar to the calculated mean value
Precise	The value that would be obtained in an ideal measurement where there were no errors of any kind
Uncertainty	The smallest change that can be measured using the measuring instrument that gives a readable change in the reading

Activity 3 Scientific vocabulary: Errors

Link each term on the left to the correct definition on the right.

Term	Definition
Random error	Causes readings to differ from the true value by a consistent amount each time a measurement is made
Systematic error	When there is an indication that a measuring system gives a false reading when the true value of a measured quantity is zero
Zero error	Causes readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next

Understanding and using SI units

Every measurement has a size (eg 2.7) and a unit (eg metres or kilograms). Sometimes, there are different units available for the same type of measurement. For example, milligram, gram, kilogram and tonne are all units used for mass.

There is a standard system of units, called the SI units, which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

There are seven SI base units, which are given in the table.

Physical quantity	Unit	Abbreviation
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
luminous intensity	candela	cd

All other units can be derived from the SI base units. For example, area is measured in metres square (written as m^2) and speed is measured in metres per second (written as m s^{-1}: not that this is a change from GCSE, where it would be written as m/s).

Using prefixes and powers of ten

Very large and very small numbers can be complicated to work with if written out in full with their SI unit. For example, measuring the width of a hair or the distance from Manchester to London in metres (the SI unit for length) would give numbers with a lot of zeros before or after the decimal point, which would be difficult to work with.

So, we use prefixes that multiply or divide the numbers by different powers of ten to give numbers that are easier to work with. You will be familiar with the prefixes milli (meaning 1/1000), centi (1/100), and kilo (1 × 1000) from millimetres, centimetres and kilometres.

There is a wide range of prefixes. Most of the quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, we would quote a distance of 33 000 m as
33 km.

The most common prefixes you will encounter are given in the table.

Prefix	Symbol	Power of 10	Multiplication factor	
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 4 SI units and prefixes

1. What would be the most appropriate unit to use for the following measurements?

    a. The mass of water in a test tube.
    b. The volume of water in a burette.
    c. The time taken for a solution to change colour.
    d. The radius of a gold atom.
    e. The number of particles eg atoms in a chemical.
    f. The temperature of a liquid.

2. Re-write the following quantities using the correct SI units.

    a. 0.5 litres
    b. 5 minutes
    c. 20 °C
    d. 70 °F
    e. 10 ml (millilitres)
    f. 5.5 tonnes
    g. 96.4 microlitres (µl)

3. Scientists have been developing the production of a new material through the reaction of two constituents.

    Before going to commercial production, the scientists must give their data in the correct SI units.

    a. The flow rate of the critical chemical was reported as 240 grams per minute at a temperature of 20 °C.
    Re-write this flow rate using the correct SI units. Show your working.

Activity 5 Converting data

Re-write the following.

1. 0.1 metres in millimetres
2. 1 centimetre in millimetres
3. 104 micrograms in grams
4. 1.1202 kilometres in metres
5. 70 decilitres in millilitres
6. 70 decilitres in litres
7. 10 cm^3 in litres
8. 2140 pascals in kilopascals

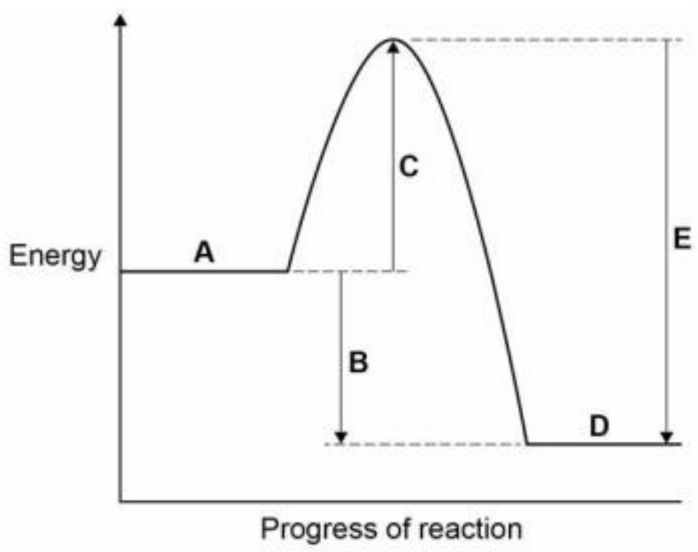
The delta symbol (Δ)

The delta symbol (Δ) is used to mean 'change in'. You might not have seen this symbol before in your GCSE Chemistry course, although it is used in some equations in GCSE Physics.

Activity 6 Using the delta symbol

In exothermic and endothermic reactions there are energy changes.

The diagram below shows the reaction profile for the reaction between zinc and copper sulfate solution.



1. Which letter represents the products of the reaction?

2. Which letter represents the activation energy?

3. Complete the sentence using the words below.

The reaction is ________________ and therefore ΔH is ________________

endothermic exothermic negative positive

Practical skills

The practical skills you learnt at GCSE will be further developed through the practicals you undertake at A-level. Your teacher will explain in more detail the requirements for practical work in Chemistry.

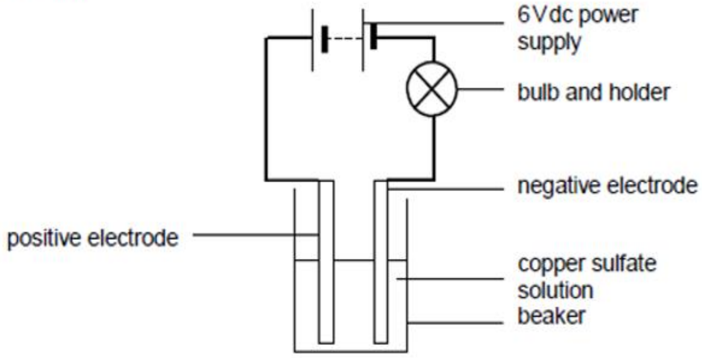
There is a practical handbook for Chemistry, which has lots of very useful information to support you in developing these important skills. You can download a copy here:

Activity 7 Electrolysis

Students were investigating if the time the current flows through an electrolyte affects the amount of copper deposited on the negative electrode.

Equipment:

Measuring cylinder
Balance
Two suitable electrodes eg carbon rods
6V bulb and holder
0.5 moles per dm^3 copper sulfate solution
Stopwatch
Wires
Power supply
100 cm^3 beaker



Method:

1. Measure 50 cm^3 of the copper sulfate solution into the beaker.
2. Measure and record the mass of the negative electrode.
3. Set up the circuit, setting the power pack at 6V dc.
4. Turn on the power supply for the time you have been given, then turn the power pack off.
5. Remove and carefully dry the negative electrode.
6. Measure and record the mass of the negative electrode.

1. Write a hypothesis for this investigation.
2. What do you predict will be the result of this investigation?
3. For this investigation, give
    a. the independent variable
    b. the dependent variable
    c. a control variable.
4. What is the difference between repeatable and reproducible results?

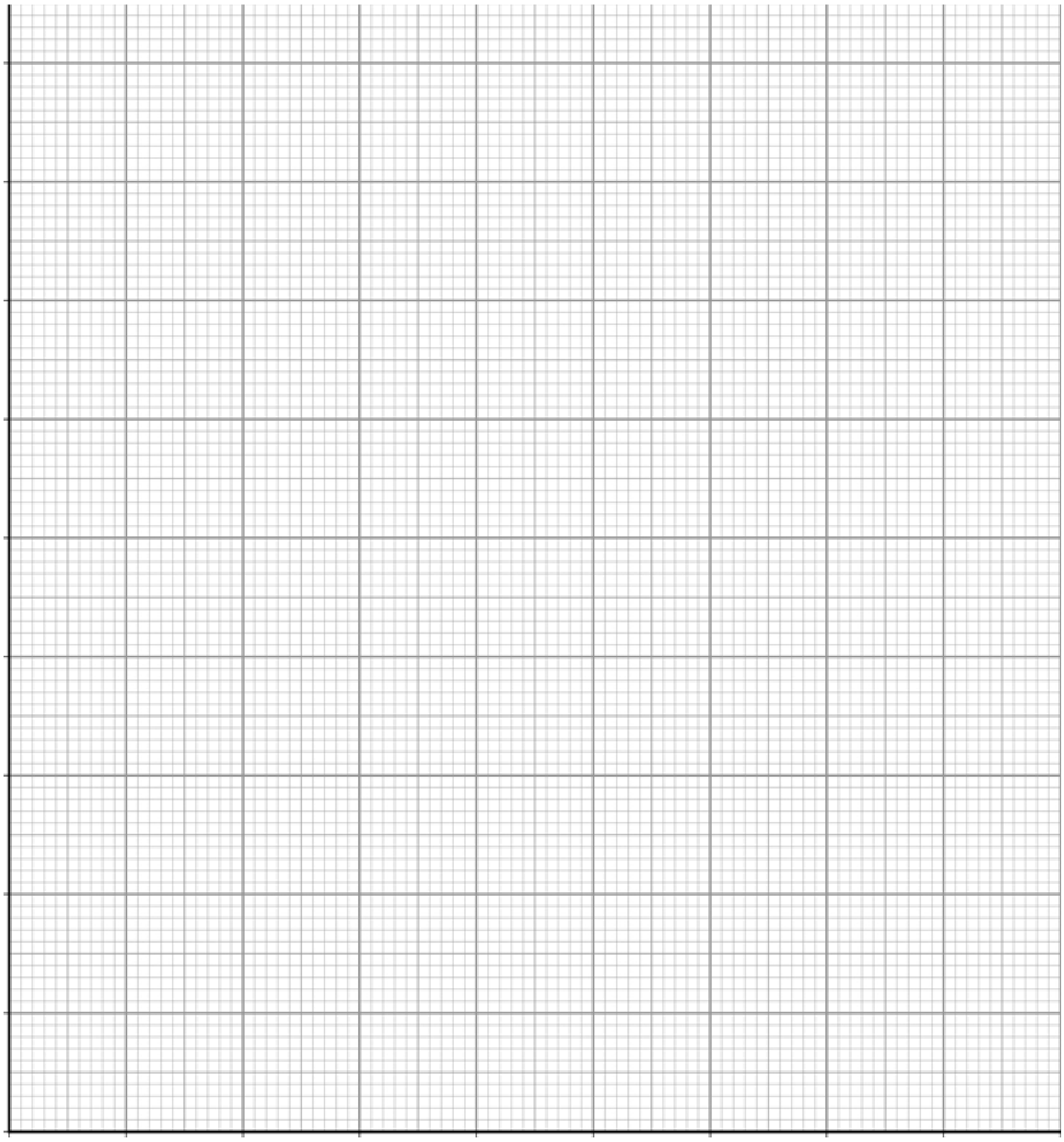
5. What would be the most likely resolution of the balance you use in a school lab?
6. How could you make the reading more precise?
7. Random errors cause readings to be spread about the true value.

   How could you reduce the effect of random errors and make the results more accurate?
8. The results the student recorded are given in the table.

Time / minutes	Increase in mass / g			Mean
2	0.62	0.64	0.45	
4	0.87	0.83	0.86	
6	0.99	1.02	0.97	
8	1.06	1.05	1.08	
10	1.10	1.12	1.10	

Calculate the mean increase in mass for each time measurement.

9. Plot a graph of your results.



Using maths skills

Throughout your A-level Chemistry course you will need to be able to use maths skills you have developed in your GCSE Chemistry and GCSE maths courses, such as using standard form, rounding correctly and quoting your answer to an appropriate number of significant figures.

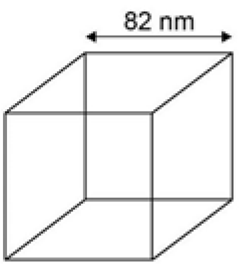
Activity 8 Using maths skills

1. Write the following numbers in standard form:

   a. 4000
   b. 1 000 000

2. Zinc oxide can be produced as nanoparticles.

   A nanoparticle of zinc oxide is a cube of side 82nm.



   Calculate the surface area of a nanoparticle of zinc oxide. Give your answer in standard form

3. Express the following numbers to 3 significant figures:

   a. 57 658
   b. 0.045346

4. Toothpaste may contain sodium fluoride (NaF).

   The concentration of sodium fluoride can be expressed in parts per million (ppm). 1 ppm represents a concentration of 1 mg in every 1 kg of toothpaste.

   A 1.00 g sample of toothpaste was found to contain 2.88×10^{-5} mol of sodium fluoride.

Calculate the concentration of sodium fluoride, in ppm, for the sample of toothpaste.

Give your answer to 3 significant figures.

Use the following information to help you

To convert moles to grams use g = moles × relative formula mass

Relative formula mass of NaF = 42

Using the periodic table

During your course you will need to become familiar with the periodic table of the elements, and be able to use information from the table to answer questions.

There is a copy of the periodic table that you will be given to use in your exams on the next page.

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1.0 **H** hydrogen 1										*(18)* 4.0 **He** helium 2
(1)	*(2)*											*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	
6.9 **Li** lithium 3	9.0 **Be** beryllium 4											10.8 **B** boron 5	12.0 **C** carbon 6	14.0 **N** nitrogen 7	16.0 **O** oxygen 8	19.0 **F** fluorine 9	20.2 **Ne** neon 10
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	27.0 **Al** aluminium 13	28.1 **Si** silicon 14	31.0 **P** phosphorus 15	32.1 **S** sulfur 16	35.5 **Cl** chlorine 17	39.9 **Ar** argon 18
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29	65.4 **Zn** zinc 30	69.7 **Ga** gallium 31	72.6 **Ge** germanium 32	74.9 **As** arsenic 33	79.0 **Se** selenium 34	79.9 **Br** bromine 35	83.8 **Kr** krypton 36
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	96.0 **Mo** molybdenum 42	[97] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47	112.4 **Cd** cadmium 48	114.8 **In** indium 49	118.7 **Sn** tin 50	121.8 **Sb** antimony 51	127.6 **Te** tellurium 52	126.9 **I** iodine 53	131.3 **Xe** xenon 54
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La** * lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79	200.6 **Hg** mercury 80	204.4 **Tl** thallium 81	207.2 **Pb** lead 82	209.0 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac** † actinium 89	[267] **Rf** rutherfordium 104	[270] **Db** dubnium 105	[269] **Sg** seaborgium 106	[270] **Bh** bohrium 107	[270] **Hs** hassium 108	[278] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[281] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

Key

relative atomic mass
symbol
name
atomic (proton) number

*** 58 – 71** Lanthanides	140.1 **Ce** cerium 58	140.9 **Pr** praseodymium 59	144.2 **Nd** neodymium 60	[145] **Pm** promethium 61	150.4 **Sm** samarium 62	152.0 **Eu** europium 63	157.3 **Gd** gadolinium 64	158.9 **Tb** terbium 65	162.5 **Dy** dysprosium 66	164.9 **Ho** holmium 67	167.3 **Er** erbium 68	168.9 **Tm** thulium 69	173.0 **Yb** ytterbium 70	175.0 **Lu** lutetium 71
† 90 – 103 Actinides	232.0 **Th** thorium 90	231.0 **Pa** protactinium 91	238.0 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[247] **Bk** berkelium 97	[251] **Cf** californium 98	[252] **Es** einsteinium 99	[257] **Fm** fermium 100	[258] **Md** mendelevium 101	[259] **No** nobelium 102	[262] **Lr** lawrencium 103

Activity 9 Atoms

1. Give the atomic number of:

    a. Osmium
    b. Lead
    c. Sodium
    d. Chlorine

2. Give the relative atomic mass (A_r) of:

    a. Helium
    b. Francium
    c. Barium
    d. Oxygen

3. What is the number of neutrons in each of the following elements?

    a. Fluorine
    b. Beryllium
    c. Gold

Activity 10 Formulae of common compounds

State the formulae of the following compounds:

1. Methane
2. Sulfuric acid
3. Potassium manganate (VII)
4. Water

Activity 11 Ions and ionic compounds

The table below lists the formulae of some common ions.

Positive ions		Negative ions	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Iodide	I^-
Hydrogen	H^+	Hydroxide	OH^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O_2^-
Lead	Pb^{2+}	Sulfate	SO_4^{2-}
Lithium	Li^+	Sulfide	S^{2-}
Magnesium	Mg^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Use the table to state the formulae for the following ionic compounds.

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Calcium nitrate
8. Iron (II) sulfate
9. Iron (III) sulfate

Activity 12 Empirical formula

Use the periodic table on page 21 to help you answer these questions.

1. The smell of a pineapple is caused by ethyl butanoate.
   A sample is known to contain:

   0.360 g of carbon
   0.060 g of hydrogen
   0.160 g of oxygen.

   What is the empirical formula of ethyl butyrate?

2. What is the empirical formula of a compound containing:

   0.479 g of titanium
   0.180 g of carbon
   0.730 g of oxygen

3. A 300g sample of a substance is analysed and found to contain only carbon, hydrogen and oxygen.
   The sample contains 145.9 g of carbon and 24.32 g of hydrogen.

   What is the empirical formula of the compound?

4. Another 300 g sample is known to contain only carbon, hydrogen and oxygen.
   The percentage of carbon is found to be exactly the same as the percentage of oxygen.
   The percentage of hydrogen is known to be 5.99%.

   What is the empirical formula of the compound?

Activity 13 Balancing equations

1. Write balanced symbol equations for the following reactions.

   You'll need to use the information on the previous pages to work out the formulae of the compounds.

   Remember some of the elements may be diatomic molecules.

   a. Aluminium + oxygen → aluminium oxide

   b. Methane + oxygen → carbon dioxide + water

   c. Calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

2. Chalcopyrite is a sulfide mineral with formula $CuFeS_2$.

   Chalcopyrite is the most important copper ore. It is a sulfide mineral, a member of iron (2+) sulfides and a copper sulfide.

   Copper can be produced from rock that contains $CuFeS_2$ in two stages.

   Balance the equations for the two stages in this process.
   Hint: remember that sometimes fractions have to be used to balance equations.

   Stage 1: $CuFeS_2 + O2 + SiO_2 \rightarrow Cu_2S + Cu_2O + SO_2 + FeSiO \rightarrow$

   Stage 2: $Cu_2S + CuO \rightarrow Cu + SO2$

Activity 14 Moles

The amount of a substance is measured in moles (the SI unit). The mass of one mole of a substance in grams is numerically equal to the relative formula mass of the substance. One mole of a substance contains the same number of the stated particles, atoms or ions as one mole of any other substance. The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is

6.02×10^{23} per mole.

Complete the table. Use the periodic table on page 21 to help you.

Substance	Mass of substance in grams	Amount in moles	Number of particles
Helium			18.12×10^{23}
Chlorine (Cl)	14.2		
Methane		4	
Sulfuric acid	4.905		

Activity 15 Isotopes and calculating relative atomic mass

1. What is the relative atomic mass of bromine if the two isotopes ^{79}Br and ^{81}Br exist in equal amounts?

2. A sample of neon is made up of three isotopes:

   ^{20}Ne accounts for 90.9%
   ^{21}Ne accounts for 0.3%
   ^{22}Ne accounts for 8.8%.

   What is the relative atomic mass of neon?
   Give your answer to 4 significant figures.

3. Copper's isotopes are ^{63}Cu and ^{65}Cu.

   If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Extended writing

The ability to write coherently in a logical, well-structured way is an essential skill to develop. At GCSE the 6-mark extended response questions are used so students can demonstrate this skill. At A-level you will still need to write precise answers using the correct scientific language.

The command word in a question, like at GCSE, is important as it gives you an indication of what to include in your answers. For example, ‘explain’ means you must give reasons why things are happening, not just give a description. A comparison needs advantages and disadvantages or points for and against.

Activity 16 Types of bonding
Compare the similarities and differences between ionic, covalent and metallic bonding.