Mulberry Academy Shoreditch

Sixth Form

A-Level Chemistry

Name:

Mulberry Academy Shoreditch

Sixth Form

Summer Assignment

Chemistry A-level

Aim of the booklet

This booklet will support your transition from GCSE science to A-level Chemistry. 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 four sections:

1. Understanding the specification, course and assessment structure
2. Practical course information
3. How to be successful independent learner
4. Transition activities to bridge the move from GCSE to the start of the A-level course

The specification can be found here https://filestore.aqa.org.uk/resources/chemistry/specifications/AQA-7404-7405-SP-2015.PDF

Specification at a glance

Topics covered in Y12

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 the halogens**	**Halogenoalkanes**
Energetics		**Alkenes**
Kinetics		**Alcohols**
Chemical equilibria, Le Chatelier's principle and K_c		**Organic analysis**
Oxidation, reduction and redox reactions		

Topics covered in Y13

Physical Chemistry	**Inorganic Chemistry**	**Organic Chemistry**
Thermodynamics	**Properties of Period 3 element and oxides**	**Optical chemistry**
Rate equations	**Transition metals**	**Aldehydes and ketones**
Equilibrium constant K_p for homogeneous systems	**Reactions of ions in aqueous solutions**	**Carboxylic acids and derivatives**
Electrode potentials and electrochemical cells		**Aromatic chemistry**
Acids and bases		**Amines**
		Polymers
		Amino acids, proteins and DNA
		Organic synthesis
		NMR spectroscopy
		Chromatography

The assessment for the A-level consists of three exams

Paper 1	+	Paper 2	+	Paper 3
What's assessed • Relevant Physical chemistry topics (sections 3.1.1 to 3.1.4, 3.1.6 to 3.1.8 and 3.1.10 to 3.1.12) • Inorganic chemistry (section 3.2) • Relevant practical skills		**What's assessed** • Relevant Physical chemistry topics (sections • 3.1.2 to 3.1.6 and 3.1.9) • Organic chemistry (section 3.3) • Relevant practical skills		**What's assessed** • Any content • Any practical skills
How it's assessed • Written exam: 2 hours • 105 marks • 35% of A-level		**How it's assessed** • Written exam: 2 hours • 105 marks • 35% of A-level		**How it's assessed** • Written exam: 2 hours • 90 marks • 30% of A-level
Questions • 105 marks of short and long answer questions		**Questions** • 105 marks of short and long answer questions		**Questions** • 40 marks of questions on practical techniques and data analysis • 20 marks of questions testing across the specification • 30 marks of multiple choice questions

Assessment objectives

As you know from GCSE, exam questions are written to 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.

- AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques, and procedures (30% of all the marks at A-level).
- 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

  (45% of all the marks at A-level).
- AO3: Analyse, interpret, and evaluate scientific information, ideas, and evidence, including in relation to:
    - make judgements and reach conclusions
    - develop and refine practical design and procedures

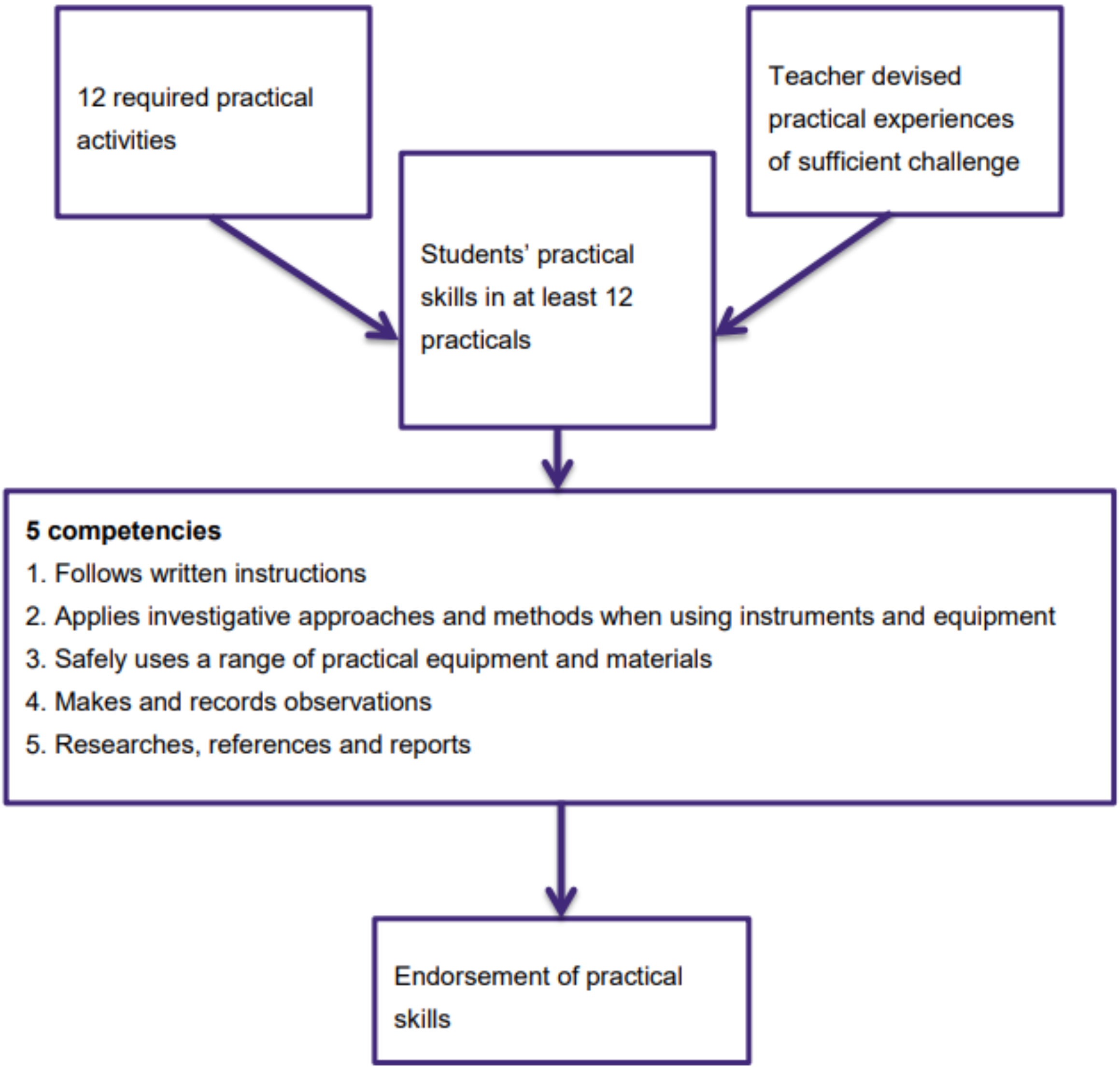
  (25% of all the marks at A-level).

Other assessment criteria

At least **20%** of the marks for A-level Chemistry will assess **mathematical skills**, which will be equivalent to skills covered in the GCSE Mathematics higher paper.

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

Practical Course Information



Over the 2 year course, you will complete 12 required practical experiments, each relating to a different topic. Within these practical experiments, you will need to demonstrate a range of techniques and correct use of apparatus, designed to prepare you for degree level practical work.

You will also need to meet the 5 Core Practical Assessment Criteria (CPAC) in order to pass the overall practical endorsement, which will be assessed by your teachers. You will have multiple opportunities to meet the CPAC.

The 12 required practical experiments and apparatus and techniques are listed on the following pages.

Required activity	Apparatus and technique reference
1 Make up a volumetric solution and carry out a simple acid–base titration	a, d, e, f, k
2 Measurement of an enthalpy change	a, d, k
3 Investigation of how the rate of a reaction changes with temperature	a, b, k
4 Carry out simple test-tube reactions to identify: • cations – Group 2, NH_4^+ • anions – Group 7 (halide ions), OH^-, CO_3^{2-}, SO_4^{2-}	d, k
5 Distillation of a product from a reaction	b, d, k
6 Tests for alcohol, aldehyde, alkene and carboxylic acid	b, d, k
7 Measuring the rate of reaction: • by an initial rate method • by a continuous monitoring method	a, k, l a, k, l
8 Measuring the EMF of an electrochemical cell	j, k
9 Investigate how pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base	a, c, d, k
10 Preparation of: • a pure organic solid and test of its purity • a pure organic liquid	a, b, d, g, h, k b, d, g, k
11 Carry out simple test-tube reactions to identify transition metal ions in aqueous solution	b, d, k
12 Separation of species by thin-layer chromatography	i, k

	Apparatus and techniques
AT a	Use appropriate apparatus to record a range of measurements (to include mass, time, volume of liquids and gases, temperature)
AT b	Use water bath or electric heater or sand bath for heating
AT c	Measure pH using pH charts, or pH meter, or pH probe on a data logger
AT d	Use laboratory apparatus for a variety of experimental techniques including: • titration, using burette and pipette • distillation and heating under reflux, including setting up glassware using retort stand and clamps • qualitative tests for ions and organic functional groups • filtration, including use of fluted filter paper, or filtration under reduced pressure
AT e	Use volumetric flask, including accurate technique for making up a standard solution
AT f	Use acid–base indicators in titrations of weak/strong acids with weak/strong alkalis
AT g	Purify: • a solid product by recrystallisation • a liquid product, including use of separating funnel
AT h	Use melting point apparatus
AT i	Use thin-layer or paper chromatography
AT j	Set up electrochemical cells and measuring voltages
AT k	Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances
AT l	Measure rates of reaction by at least two different methods, for example: • an initial rate method such as a clock reaction • a continuous monitoring method

Independent learning

A-level Chemistry is a rewarding but challenging course, featuring a large amount new content/scientific terminology. In order to be successful on this course, it is important you are completing **regular, high quality independent learning**. This could be in the form of:

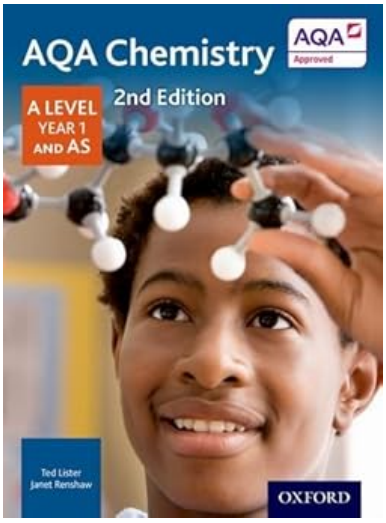
- Reviewing class notes/finishing off class work
- Completing practice questions
- Completing exam questions
- Condensing content into revision notes
- Completing consolidation booklets on each topic
- Wider reading – magazines (MAS has a new scientist subscription – ask for a copy!)
- Assigned lesson pre reading
- Seneca
- Youtube – be careful here, look at the source/specification, date uploaded to make sure what you are watching is relevant
- Completing practical write up/research

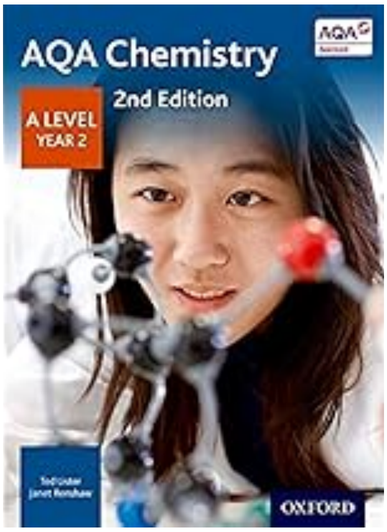
Regular independent learning will help you to consolidate knowledge as you progress through the course and relieve the burden of revision before your A-level exams!

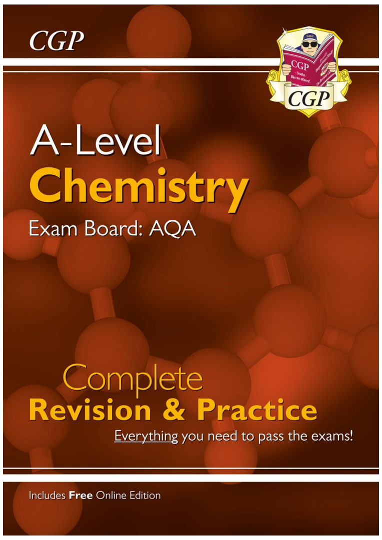
Resources

At the beginning of Year 12 you will be lent an A-level textbook to use throughout the course, which contains the complete course content, practice questions and a glossary of definitions you will need to know for your exam.

In addition to this, CGP (same company as GCSE) make an AQA A-level revision guide and work book you can purchase from the science office.







Transition activities

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

Complete these activities independently over the summer break. The first lesson back in September will be based around this work, so it is **really important you complete it to a high standard.**

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 and better prepare you for A-level Chemistry.

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.

Term	Definition
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 (m^2) and speed is measured in metres per second (written as $m\ s^{-1}$: note 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 strand of 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.

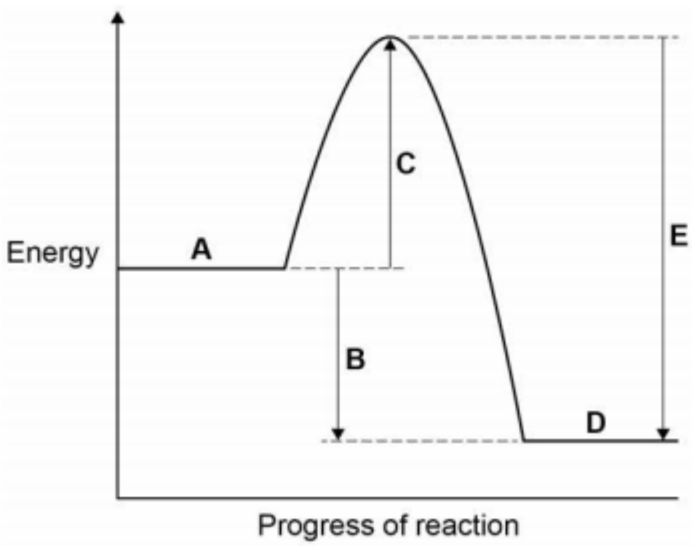
Activity 5 Converting data

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. Word Bank: endothermic, exothermic, negative, positive The reaction is ______________ and therefore ΔH is ________________ .

Practical skills

The practical skills you learnt at GCSE will be further developed through the practicals you undertake at A-level.

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

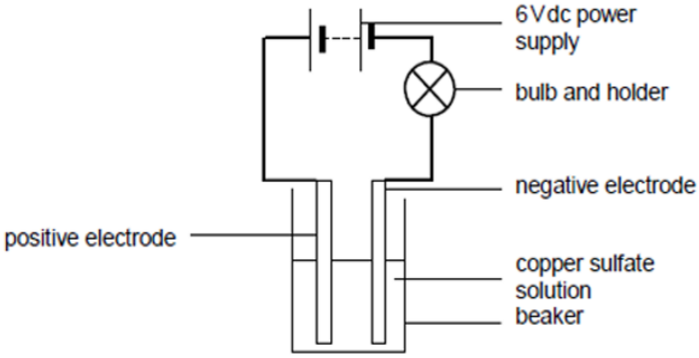
0.5 moles per dm^3 copper sulfate solution

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 kills

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

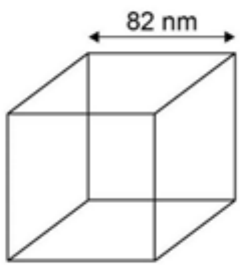
1. Write the following numbers in standard form:

    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

Key

relative atomic mass
symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
							1.0 **H** hydrogen 1										4.0 **He** helium 2
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											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

* 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: $CuFeS_2 + O2 + SiO_2 \rightarrow Cu_2S + Cu_2O + SO_2 + FeSiO$ ▯

   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. ____ ____ ____ ____ ____ ____ ____ ____ ____ ____