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EDEXCEL GCSE SCIENCES 2011

Edexcel GCSE in Chemistry - 2CH01

Accredited specification booklet

This booklet provides:
an introduction to the sample assessments

- an introduction to the specification
- annotated specification pages
- the accredited specification

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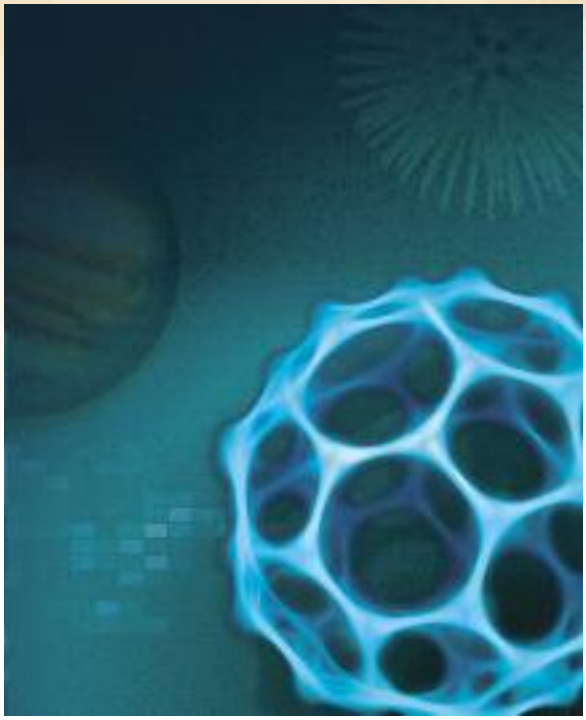


Welcome

We are delighted to introduce you to our new GCSE in Chemistry for 2011. At the front of this publication, we have supplied a handy guide containing annotated pages from the accredited specification that provide you with explanations and insights into its content and structure.

This introduction is then followed by the accredited specification. We've listened to science teachers and the wider science community, ensuring the development of a new suite of GCSE science qualifications that:

- puts good science at the heart of teaching, learning and assessment
- is presented in clear and detailed specifications
- has examination papers designed and trialled to be accessible to all, with appropriate stretch for your able students
- provides clear and manageable controlled assessments
- has an achievable approach to practical work.

Accompanying this specification are our accredited sample assessment and sample controlled assessment materials, plus a selection of valuable support materials that make up our Enhanced Specifications Pack. Together, these items have been created to provide you with the information you need to prepare, teach and assess our exciting new qualification.

Our team of experts are on hand to discuss any questions you may have about the information contained in this pack. You can contact our Science Subject Advisor team, led by Stephen Nugus by calling **0844 372 2188**, or emailing **ScienceSubjectAdvisor@edexcelexperts.co.uk**

Supporting science, supporting you

The following section contains annotated pages from our accredited GCSE in Chemistry specification to help you see quickly and easily how we've developed our qualifications to give you clear and detailed support.

Unit C1: Chemistry in our world

Overview

Content and How Science Works overview

Chemistry is everywhere. Indeed, we live and breathe as a result of essential and highly successful chemical reactions. Every substance in the world is a chemical substance: everything we use, everything we eat, everything we need to survive. Whether they are naturally occurring or man-made, all substances have their origin in the Earth and its atmosphere.

In Unit C1 students study five topics that will build a knowledge and understanding of some simple chemistry around them and equip them to make informed, critical comments on what appears in the media, helping them to become knowledgeable members of society, capable of making responsible decisions in areas involving chemistry.

Work on the Earth's early atmosphere provides opportunities to use models and theories to explain observed data. The importance of collecting data to develop new theories is illustrated by the data scientists have used to show how human activities have changed the composition of the atmosphere and also caused acid rain. Students will look at how new materials are developed to suit new applications, especially in the field of shape-memory alloys. They will also consider issues such as those that arise when humans use raw materials from the Earth; and how chemists can take non-useful substances and obtain useful materials from them. Students will also model decomposition, cracking and polymerisation reactions using the rearrangement of atoms, and model the structures of alkanes and alkenes.

Practical work throughout the unit will give students opportunities to work quantitatively, to assess and manage risks by interpreting hazard symbols and to plan practical ways to answer scientific questions and test hypotheses. Students will critically evaluate evidence, suggest reasons for inconsistencies in the data collected and ways to improve precision or reproducibility of results.

Students will be shown how to represent chemical reactions using word equations and balanced equations, using state symbols. They will have opportunities to work quantitatively in verifying conservation of mass, in balancing equations and in measuring pH during neutralisation reactions.

Throughout the unit students will see the significance of the application of chemistry to issues of global significance, such as removing acidic gases from power-station chimneys and reducing the proportion of carbon dioxide in the atmosphere. They have the opportunity to evaluate the advantages, disadvantages and risks of quarrying, extracting metals from ores, using crude oil, developing biofuels and using polymers, and to consider how decisions such as whether or not to recycle metals are taken.

The Examiner explains

This gives a basic overview of the unit. A more detailed overview can be found in the teacher support materials provided.

Examiner's teaching tip

Here are some suggestions for contextualising the content. However, there may be other opportunities.

In Topic 1 students will gain an overview of how the Earth and its atmosphere have evolved. They will begin to understand that human activity can have an impact on these by affecting the composition of the atmosphere.

In Topic 2 they will gain an elementary appreciation of different types of rock and how each is formed. Using limestone as an example, they will begin to appreciate that scientists have to balance factors when using the Earth's resources. They will also look at the chemistry of limestone and appreciate the wide uses to which it is put.

In Topic 3 students will see how acids can react to give useful products and how reactions of acids can solve some everyday problems. They will begin to appreciate how manufacturing supplies our world with useful products from land and sea.

In Topic 4 students will find out how metals are extracted from their ores and consider how metals are used. They will also learn the importance of humans moving to a more sustainable use of Earth's resources, and how recycling metals contributes by preserving ores. Students will also consider how chemists develop new alloys to fit new applications and how alloys have different properties from their component metals.

Topic 5 illustrates the usefulness of crude oil as a rich source of some of the substances we need in everyday life. Students will learn that these substances improve our lives but also cause problems, such as the effects of human activity on the environment, which we cannot ignore. Again, a responsible and sustainable approach to our use of the planet is considered by studying alternatives to fossil fuels.

Examiner's teaching tip

You can organise the way in which you divide up your topics. We will provide schemes of work which suggest the number of hours to be spent on each topic. However, the decision on how many hours to allocate is left to the discretion of the individual teacher.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark, tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

The Examiner explains

A more detailed assessment overview can be found within the *Assessment guide* provided.

Practical investigations in this unit

Within this unit, students will develop an understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations that exemplify the scientific process and may appear in the written examination for this unit:

1.7 *Investigate the proportion of oxygen in the atmosphere*

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

3.3 *Investigate the effectiveness of different indigestion remedies*

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

4.4 *Investigate methods for extracting a metal from its ore*

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

The following are further suggestions for practical work within this unit:

- *Investigate the presence of water vapour and carbon dioxide in the atmosphere*
- *Investigate the volume of air used up and products formed when candles are burned*
- *Investigate the effect of cooling rate on crystal sizes by melting crystals of salol and cooling them on hot and cold microscope slides; or by crystallisation of a saturated solution*
- *Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid*
- *Investigate mass changes before and after reactions eg copper sulfate and sodium chloride*
- *Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates*
- *Carry out tests for hydrogen, chlorine and oxygen*
- Carry out electrolysis of sea water/acidified water
- *Investigate the rusting of iron*

Examiner's teaching tip

As well as the practicals that are embedded in the specification, here is an extended list of practical activities which you may wish to carry out with your students if there is time.

- *Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides*
- *Make an alloy or investigate the properties of alloys*
- *Investigate the properties of a metal, such as electrical conductivity*
- *Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions*
- *Investigate the products produced from the complete combustion of a hydrocarbon*
- *Test for unsaturation using bromine water*
- *Investigate the cracking of paraffin oil*

The controlled assessment task (CAT) for the GCSE in Chemistry will be taken from any of these practical investigations (specification points and further suggested practical work). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Recall the formulae of elements and simple compounds in the unit

0.2 Represent chemical reactions by word equations **and simple balanced equations**

0.3 **Write balanced chemical equations including the use of state symbols (s), (l), (g) and (aq) for a wide range of reactions in this unit**

0.4 Assess practical work for risks and suggest suitable precautions for a range of practical scenarios for reactions in this unit

0.5 Demonstrate an understanding that hazard symbols used on containers:
- a indicate the dangers associated with the contents
- b inform people about safe working procedures with these substances in the laboratory

Topic 1

The Earth's sea and atmosphere

1.1 Recall that the gases produced by volcanic activity formed the Earth's early atmosphere

1.2 Recall that the early atmosphere contained:
- a little or no oxygen
- b a large amount of carbon dioxide
- c water vapour and small amounts of other gases

1.3 Explain why there are different sources of information about the development of the atmosphere which makes it difficult to be precise about the evolution of the atmosphere

1.4 Describe how condensation of water vapour formed oceans

1.5 Describe how the amount of carbon dioxide in the atmosphere was reduced by:
- a the dissolution of carbon dioxide into the oceans
- b the later incorporation of this dissolved carbon dioxide into marine organisms which eventually formed carbonate rocks

1.6 Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased

1.7 *Investigate the proportion of oxygen in the atmosphere*

1.8 Describe the current composition of the atmosphere and interpret data sources showing this information

Examiner's teaching tip

These statements should be considered across all topics within the unit.

1.9 Demonstrate an understanding of how small changes in the atmosphere occur through:
- a volcanic activity
- b human activity, including the burning of fossil fuels, farming and deforestation

Topic 2

Materials from the Earth

2.1 Describe that igneous rocks, such as granite, are:
- a formed by the solidification of magma or lava
- b made of crystals whose size depends on the rate of cooling

2.2 Describe chalk and limestone as examples of sedimentary rocks

2.3 Describe how sedimentary rocks are formed by the compaction of layers of sediment over a very long time period

2.4 Recall that sedimentary rocks:
- a may contain fossils
- b are susceptible to erosion

2.5 Describe marble as an example of a metamorphic rock

2.6 Describe the formation of metamorphic rocks by the action of heat and/or pressure, including the formation of marble from chalk or limestone

2.7 Recall that limestone, chalk and marble exist in the Earth's crust and that they are all natural forms of calcium carbonate

2.8 Demonstrate an understanding of the balance between the demand for limestone and the economic, environmental and social effects of quarrying it

2.9 Demonstrate an understanding of the commercial need for quarrying calcium carbonate on a large scale, as a raw material, for the formation of glass, cement and concrete

2.10 Describe the thermal decomposition of calcium carbonate into calcium oxide and carbon dioxide

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

2.12 Describe the ease of thermal decomposition of different metal carbonates

2.13 Demonstrate an understanding that:
- a atoms are the smallest particles of an element that can take part in chemical reactions
- b during chemical reactions, atoms are neither created nor destroyed
- c during chemical reactions, atoms are rearranged to make new products with different properties

2.14 Describe the effect of water on calci

The Examiner explains

We've designed the specification so that the level of detail needed to teach is apparent.

2.15 Describe how calcium hydroxide dissolves in water to form a solution, known as limewater

2.16 Demonstrate an understanding that the total mass before and after a reaction in a sealed container is unchanged, as shown practically by a precipitation reaction

2.17 Explain how calcium oxide, calcium hydroxide and calcium carbonate can be used to neutralise soil acidity

2.18 Explain how calcium carbonate can be used to remove acidic gases from coal-fired power station chimneys, reducing harmful emissions and helping to reduce acid rain

Topic 3

Acids

3.1 Recall that hydrochloric acid is produced in the stomach to:
- a help digestion
- b kill bacteria

3.2 Describe indigestion remedies as containing substances that neutralise excess stomach acid

3.3 *Investigate the effectiveness of different indigestion remedies*

3.4 Recall that acids are neutralised by:
- a metal oxides
- b metal hydroxides
- c metal carbonates

to produce salts (no details of salt preparation techniques or ions are required)

3.5 Recall that:
- a hydrochloric acid produces chloride salts
- b nitric acid produces nitrate salts
- c sulfuric acid produces sulfate salts

3.6 Describe electrolysis as a process in which electrical energy, from a d.c. supply, decomposes compounds, by considering the electrolysis of dilute hydrochloric acid to produce hydrogen and chlorine (explanations of the reactions at the electrodes are not required)

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

3.8 Describe the chemical test for hydrogen

3.9 Describe the chemical test for chlorine

3.10 Recall that chlorine can be obtained from sea water by electrolysis (explanations of the reactions at the electrodes are not required)

3.11 Describe chlorine as a toxic gas and that this leads to potential hazards associated with its large-scale manufacture

3.12 Describe the use of chlorine in the manufacture of bleach and of the polymer poly(chloroethene) (PVC)

3.13 Recall that water can be decomposed by electrolysis to form hydrogen and oxygen

3.14 Describe the chemical test for oxygen

Topic 4

Obtaining and using metals

4.1 Recall that:
- a most metals are extracted from ores found in the Earth's crust
- b unreactive metals are found in the Earth as the uncombined elements

4.2 Describe how most metals are extracted from their ores by:
- a heating with carbon, illustrated by iron
- b electrolysis, illustrated by aluminium

(knowledge of the blast furnace or the electrolytic cell for aluminium extraction are not required)

4.3 Explain why the method used to extract a metal is related to its position in the reactivity series and cost of the extraction process

4.4 *Investigate methods for extracting a metal from its ore*

4.5 Describe oxidation as the gain of oxygen and reduction as the loss of oxygen

4.6 Recall that the extraction of metals involves reduction of ores

4.7 Recall that the oxidation of metals results in corrosion

4.8 Demonstrate an understanding that a metal's resistance to oxidation is related to its position in the reactivity series

4.9 Discuss the advantages of recycling metals, including economic implications, and how recycling preserves both the environment and the supply of valuable raw materials

4.10 Describe the uses of metals in relation to their properties, including:
- a aluminium
- b copper
- c gold
- d steel

4.11 Use models to explain why converting pure metals into alloys often increases the strength of the product

4.12 Demonstrate an understanding that iron is alloyed with other metals to produce alloy steels with a higher strength and a greater resistance to corrosion

4.13 **Describe how alloying changes the properties of metals, including:**
- a **smart or shape memory alloys, including nitinol, an alloy of nickel and titanium**

Foundation and Higher

All students should have an understanding of the nature of alloys, but Higher tier students should know about specific alloys such as nitinol.

- b **gold alloys with higher strength, including fineness (parts per thousand) and carats to indicate the proportion of pure gold**

4.14 **Demonstrate an understanding that new materials are developed by chemists to fit new applications, such as the creation of new shape memory alloys for use, for example, in spectacle frames and as stents in damaged blood vessels**

Topic 5

Fuels

5.1 Describe hydrocarbons as compounds that contain carbon and hydrogen only

5.2 Describe crude oil as a complex mixture of hydrocarbons

5.3 Describe the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation (details of fractional distillation are not required)

5.4 Recall the name and uses of the following fractions:
- a gases, used in domestic heating and cooking
- b petrol, used as fuel for cars
- c kerosene, used as fuel for aircraft
- d diesel oil, used as fuel for some cars and trains
- e fuel oil, used as fuel for large ships and in some power stations
- f bitumen, used to surface roads and roofs

5.5 Describe that hydrocarbons in different fractions differ from each other in:
- a the number of carbon and hydrogen atoms their molecules contain
- b boiling points
- c ease of ignition
- d viscosity

5.6 Describe how the complete combustion of hydrocarbons:
- a involves the oxidation of the hydrocarbons
- b produces carbon dioxide and water
- c gives out energy

5.7 Describe the chemical test for carbon dioxide (using limewater)

5.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide

5.9 Describe how carbon monoxide behaves as a toxic gas

5.10 Demonstrate an understanding of the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels

Examiner's teaching tip

Note the sentence in brackets – students are required only to describe the process and not to explain how the products are formed.

5.11 Explain why impurities in some hydrocarbon fuels result in the production of sulfur dioxide

5.12 Demonstrate an understanding of some problems associated with acid rain caused when sulfur dioxide dissolves in rain water

5.13 Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, trap heat from the Sun and that this keeps the Earth warm

5.14 Demonstrate an understanding that the Earth's temperature varies and that human activity may influence this

5.15 Demonstrate an understanding that the proportion of carbon dioxide in the atmosphere varies due to human activity, and that chemists are investigating methods to control the amount of the gas in the atmosphere by:

a iron seeding of oceans

b converting carbon dioxide into hydrocarbons

5.16 Evaluate how far the correlation between global temperature and the proportion of carbon dioxide in the atmosphere provides evidence for climate change

5.17 Describe biofuels as being possible alternatives to fossil fuels

5.18 Recall that one example of a biofuel is ethanol obtained by processing sugar cane or sugar beet and that it can be used to reduce the demand for petrol

5.19 Evaluate the advantages and disadvantages of replacing fossil fuels with biofuels, including:

a the fact that biofuels are renewable

b that growing the crops to make biofuels requires land and may affect the availability of land for growing food

c the balance between the carbon dioxide removed from the atmosphere as these crops grow and the carbon dioxide produced when they are transported and burned

5.20 Demonstrate an understanding of the factors that make a good fuel, including:

a how easily it burns

b the amount of ash or smoke it produces

c the comparative amount of heat energy it produces (calculations involving conversion to joules are not required)

d how easy it is to store and transport

5.21 Recall that a simple fuel cell combines hydrogen and oxygen to form water and that this reaction releases energy

5.22 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars

5.23 Describe petrol, kerosene and diesel oil as non-renewable fossil fuels obtained from crude oil and methane as a non-renewable fossil fuel found in natural gas

Foundation and Higher

Higher Tier content is highlighted in bold

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

5.25 Recall that alkanes are saturated hydrocarbons, which are present in crude oil

5.26 Recall the formulae of the alkanes methane, ethane and propane, and draw the structures of these molecules to show how the atoms are bonded together (no further knowledge of bonding is required in this unit)

5.27 Recall that alkenes are unsaturated hydrocarbons

5.28 Recall the formulae of the alkenes ethene and propene, and draw the structures of their molecules to show how the atoms are bonded together (no further knowledge of bonding is required in this unit)

5.29 Describe how bromine water is used to distinguish between alkanes and alkenes

5.30 Describe how cracking involves the breaking down of larger saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes)

5.31 **Explain why cracking is necessary, including by using data on the composition of different crude oils and the demand for fractions in crude oil**

5.32 Describe the cracking of liquid paraffin in the laboratory

5.33 Recall that:

a many ethene molecules can combine together in a polymerisation reaction

b the polymer formed is called poly(ethene)

(conditions and mechanisms not required but **equations required**)

5.34 Describe how other polymers can be made by combining together other monomer molecules, to include poly(propene), poly(chloroethene) (PVC) and PTFE

5.35 Relate uses of the polymers poly(ethene), poly(propene), poly(chloroethene) (PVC) and PTFE to the properties of the compounds

5.36 Recall that most polymers are not biodegradable, that they persist in landfill sites and that many produce toxic products when burnt

5.37 Explain how some problems associated with the disposal of polymers can be overcome:

a by recycling

b by developing biodegradable polymers

Make the most of your Edexcel Enhanced Specifications Pack

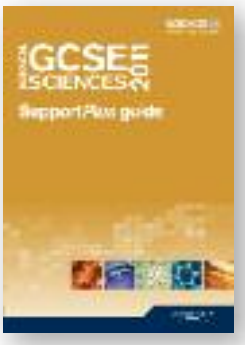
In addition to our five specifications, your Enhanced Specifications Pack includes our accredited sample assessment and sample controlled assessment materials. These too have been produced with annotated introductions to help you see how we've made our assessment clear to understand. We have also developed the following support materials, which provide valuable tools for your preparation, teaching and assessment of our exciting new specifications.

Getting started guide

An at-a-glance introduction to our specifications. This guide shows you how easy it is to move to Edexcel, detailing the support available to help you do so. It also offers guidance on teaching each unit, providing suggestions for managing assessment and support with preparing students for extended writing and mathematics.

Assessment guide

Developed to give you detailed support with managing assessment, the Assessment guide covers ways of scheduling and administering controlled assessment, including suggestions for making entries and choosing tiers. It provides information on Results*Plus*, our free results analysis service that provides unrivalled support with performance analysis, and includes a selection of exemplar answers to exam questions, with comments on how these should be assessed using our mark schemes.



SupportPlus guide

Providing detailed support with planning and implementation of our specifications, our Support*Plus* guide includes exemplar course plans, schemes of work and worksheets, all of which are ready-to-use, or available in editable format on our website.

GCSE & BTEC Links guide

This guide details the support we provide to make it easy for your students to move between GCSE and BTEC, and choose the learning pathway to which they are best suited.

Now turn to your copy of our accredited GCSE in Chemistry specification

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Accredited specification

Edexcel GCSE in Chemistry 2CH01

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Specification

To help students fulfil their potential, we have developed a new suite of GCSE qualifications for Science that:

- puts good science at the heart of teaching, learning and assessment
- is presented in clear and detailed specifications
- has examination papers designed and trialled to be accessible with appropriate stretch
- has a clear and achievable approach to new requirements for controlled assessment and practical work
- is designed to allow you to choose the best learning pathway for each student
- supports you with help available online, on the phone and locally.

You will see that this specification is extremely detailed. This is to:

- ensure that you have a clear idea about what might be assessed in an examination
- make it easy for you to plan your teaching
- make sure you don't have to cover material twice in successive units because the progression of ideas is clear.

www.edexcel.com/science2011

Our website will be regularly updated with a vast range of materials to support you with the delivery of our qualifications, including:

- our accredited specifications, sample assessment materials and sample controlled assessment materials
- free planning and teaching resources
- access to our Subject Advisor Service
- information on our published resources
- access to ResultsPlus, our FREE online results analysis and mocks analysis service
- information on events taking place in your area.

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GCSE in Chemistry

Specification

Edexcel GCSE in Chemistry (2CH01)

First teaching September 2011

A PEARSON COMPANY

Introduction

The Edexcel GCSE in Chemistry is designed for use in school and colleges. It is part of a suite of GCSE qualifications offered by Edexcel.

About this specification

Why choose Edexcel?

Every student can fulfil their potential

We are here to help you ensure that every student can fulfil their potential. At Key Stage 4 this is done by ensuring that they have the qualification they need to find work or progress to further learning.

To help students fulfil their potential, we have developed a new suite of GCSEs for Science that puts good science at the heart of teaching, learning and assessment, and:

- is based on an extremely clear and detailed specification
- has exam papers designed and trialled to be accessible and with appropriate stretch
- has a clear and achievable approach to new requirements for controlled assessment and practical work
- is designed to allow you to choose the best learning pathway for each student
- supports you with help available online, on the phone and locally.

An extremely clear and detailed specification

You will see that the specification is extremely detailed. This is to:

- ensure that you have a clear idea about what might be assessed in an exam
- make it easy for you to plan
- make sure you don't have to cover material twice in successive units because the progression of ideas is clear.

Exam papers designed and trialled to be accessible and with appropriate stretch

The new GCSEs for 2011 bring with them new regulatory requirements to test students using a variety of question types. The types we have included are:

- objective questions
- short answer questions
- longer answer questions, testing quality of written communication.

This represents an opportunity to ensure the exam papers remain accessible to students with a wide range of abilities while also giving them an opportunity to excel.
In response to this opportunity, using research undertaken by our Assessment Design team and in consultation with teachers, we have developed exam papers that are:

- accessible – early questions will generate confidence in students
- clear – the language is carefully checked and simple rules are followed for consistency

- able to stretch the students aiming for higher grades – longer answer questions are carefully written to ensure more able students know what they need to do to access all the marks and to ensure students aiming for lower grades can gain some marks
- consistent – to ensure that students are familiar with the paper style. This includes producing Sample Assessment Materials using the same quality control processes as live papers.

An achievable approach to new requirements for controlled assessment and practical investigations

We have designed the controlled assessment and theory content to ensure that the controlled assessment:

- is easy to plan
- is straightforward to mark
- follows a structure that helps test students' actual investigative skills
- is based on students' own practical work and collection of secondary evidence – as required by Ofqual subject criteria.

To help with planning and to develop skills, we have embedded a small number of practical investigations in the theory units. The benefits are twofold:

- development of knowledge and skills can happen simultaneously, thus maximising teaching time.
- a mix of theory and practical learning is more likely to lead to secure acquisition of knowledge and skills.

Knowledge of these practical investigations and the ability to interpret the data that can result from them can be assessed in the examination papers. The best way to ensure this is to undertake the practical investigations.

Controlled assessment – Planning, Observations and Conclusions (POC)

To allow students to experience what a full investigation is like, within the limitations of a real school environment, the controlled assessments have been split into three parts – Planning, Observations and Conclusions. Marks from each can be submitted from separate tasks or from the same task. Whole task responses, from which marks have been submitted, should be retained for moderation.

For each controlled assessment we will produce specific marking support to help you apply the generic assessment criteria. All controlled assessments are marked to these generic assessment criteria regardless of subject. This means that you can apply generic assessment criteria to award marks where a student gives an answer that you see is correct, but falls outside the specific guidance for that controlled assessment.

Designed to allow you to choose the best learning pathway for each student

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students.

There's a great deal of shared content between BTEC Applied Science and our new GCSE Science suite, as both are based on the Key Stage 4 Programme of Study. We've used this overlap to your advantage by creating highly flexible KS4 Science learning pathways. The volume of shared content means you can take your time to choose the progression route that best meets your students' needs and most fits their learning approach.

We'll provide you with high-quality guidance and comprehensive teaching schemes, enabling you to identify the best pathway for your students. You can use the schemes to set work

that provides evidence that meets BTEC criteria and also forms a valuable part of your GCSE teaching. This will help you to:

- see if a student works best with the BTEC approach or the GCSE approach
- delay the decision on moving students completely to BTEC or GCSE, or allow them the option of gaining both a GCSE and a BTEC qualification – depending on whether they become more interested in following a vocational or academic route
- have evidence gathered towards BTEC assignments for any students that move to a full BTEC course
- ensure you can cover GCSE teaching in the time available even if you are allowing students to try the BTEC approach early on in your Key Stage 4 teaching
- introduce some of the motivational aspects of the BTEC approach to all your students.

Supporting you with help available online, on the phone and locally

We recognise that the changing nature of teaching, with less time to travel to training, the need to continually review whether the expectations of students, parents and the community are being met, and a greater number of qualifications to offer means that you need more support available more quickly than ever before.

To help you we have committed to delivering expert support locally, online and at the end of the phone.

- We will be running free Launch, Getting Started and Getting Ready to Teach events.
- There will be online events at 4pm so you don't have to miss teaching.
- We will be working with your LA to provide you with the information and support you need. Look out for cluster groups and briefings in your area.
- If you have individual needs, you can call us to find out if an advisor can speak to you or visit you to discuss how to meet those needs.
- Our Science Subject Advisor team is on the end of the phone to help you with both subject-related and administrative queries.
- Our website is being radically updated. Visit www.edexcel.com/Science/ to find:
    - free teaching resources
    - a Y9 starter programme to help you with transition
    - free information on teaching GCSEs in Science with BTEC
    - a free mocks resource
    - our ResultsPlus Mock Analysis Service – get an early feel for how your students are coping with the new exam styles
    - our Subject Advisor webpage and Ask the Expert services – proven to help you.

Contents

Specification at a glance

Units

The suite of GCSEs in Science qualifications are a nested set of qualifications:

GCSE in Science ➜	B1 25%	C1 25%	P1 25%	Science controlled assessment (SCA) 25%
GCSE in Additional Science ➜	B2 25%	C2 25%	P2 25%	Additional Science controlled assessment (ASCA) 25%
	B3 25%	C3 25%	P3 25%	
	Biology controlled assessment (BCA) 25%	Chemistry controlled assessment (CCA) 25%	Physics controlled assessment (PCA) 25%	
	GCSE in Biology ↑	**GCSE in Chemistry ↑**	**GCSE in Physics ↑**	

Details of each unit are given on the following pages.

The Edexcel GCSE in Chemistry comprises four units:

- Units C1, C2, C3 and CCA

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students should have completed.

All externally assessed units will be assessed by tiered examinations. Students will need to be entered for a specific tier at the time of entry.

Unit C1: Chemistry in our world	***Unit code: 5CH1F/5CH1H**
• Externally assessed • Availability: November, March and June • First assessment: November 2011	**25% of the total GCSE**
Overview of content This unit is split into five compulsory topics: • The Earth's sea and atmosphere • Materials from the Earth • Acids • Obtaining and using metals • Fuels	
Overview of assessment • This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.	

Unit C2: Discovering chemistry	*Unit code: 5CH2F/5CH2H
• Externally assessed • Availability: November, March and June • First assessment: June 2012	**25% of the total GCSE**

Overview of content

This unit is split into six compulsory topics:

- Atomic structure and the periodic table
- Ionic compounds and analysis
- Covalent compounds and separation techniques
- Groups in the periodic table
- Chemical reactions
- Quantitative chemistry

Overview of assessment

- This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions.
- The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Unit C3: Chemistry in action	*Unit code: 5CH3F/5CH3H
• Externally assessed • Availability: November, March and June • First assessment: June 2013	**25% of the total GCSE**

Overview of content

This unit is split into five compulsory topics:

- Qualitative analysis
- Quantitative analysis
- Electrolytic processes
- Gases, equilibria and ammonia
- Organic chemistry

Overview of assessment

- This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions.
- The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Unit CCA: Chemistry controlled assessment	***Unit code: 5CH04**
• Internally assessed • Available for moderation: November and June • First assessment: June 2013	**25% of the total GCSE**
Overview of content • For this unit students will complete one or more controlled assessment tasks related to Unit C2 or C3 content. • Each task consists of **three** parts. Part A is planning activity, Part B is an observation, collecting primary and secondary evidence. Part C consists of conclusions related to the primary and secondary evidence collected in Part B.	
Overview of assessment • This unit is internally assessed under controlled conditions. • There will be two tasks available each year – one task from C2 and one task from C3. • Each task has a shelf life of one year. • The tasks will be available to teachers one year in advance. • Each task has three parts – Part A: Planning, Part B: Observations and Part C: Conclusions. • The total number of marks available for the three parts is 50. • Students must attempt all three parts of a task. • If they attempt both tasks, then the best marks from Part A, B and C should be submitted for the unit.	

*See *Appendix 1* for a description of this code and all other codes relevant to this qualification.

External assessments (examination papers)

Our overriding priority with exam papers is to ensure that:

- every student can show what they know, understand and are able to do
- every teacher knows what they must teach.

To do this we have produced a very detailed specification so that you and your students understand exactly what a student needs to know, understand and be able to do. To help you use this detailed specification, we have split it into topics.

Secondly, we have carried out extensive work, using science experts in our Assessment Design team and working closely with our senior examiners, to develop an exam paper style that can be consistently delivered and will be familiar to students. It includes three types of question part:

1. objective questions – used only where this will provide credible evidence of knowledge and skills
2. structured short answers – for maths, How Science Works or theory
3. longer answers worth six marks – to help provide stretch and challenge.

Papers are designed to allow students likely to get lower grades to achieve, while ensuring that some questions provide the stretch required to differentiate between students. Even the six mark question parts are designed with this aim.

Every question is designed to have an accessible starting point and then become more challenging. In addition, the paper itself is slightly ramped in difficulty. This maximises the opportunity for students to demonstrate their knowledge, understanding and skills in the exam.

Controlled assessment tasks (internal assessments)

Practical investigations in the theory units – the simplest way to plan controlled assessment

The criteria for GCSEs in Science indicate that an investigative approach to internal assessment is required. The best way to develop investigative skills is to embed practicals in your teaching of theory. The benefits are twofold:

- development of knowledge and skills can happen together, thus saving time that can then be used by you in other aspects of your teaching.
- a mix of theory and practical learning is more likely to lead to secure acquisition of knowledge and skills.

We have extended the benefit of this approach, if you choose to use it, by defining a small number of practicals in the theory units of the specification. Knowledge of these practical investigations, and the ability to interpret the data that can result, is required for exams.

Planning, Observations and Conclusions (POCs)

To allow students to experience what a full investigation is like, within the limitations of a real school environment, the controlled assessment task has been split into three parts, Part A – Planning, Part B – Observations and Part C – Conclusions. Students are required to attempt all three parts of the task. However, students can do two tasks. The best part marks from across both tasks can be submitted for the unit.

There is a set of assessment criteria within this specification. This assessment criteria is generic across the controlled assessment tasks for the GCSEs in Additional Science, Biology, Chemistry and Physics. Edexcel will give additional guidance on the application of the generic assessment criteria in support documentation.

A Qualification content

Key subject aims

GCSE in Chemistry

This GCSE in Chemistry encourages students to be inspired, motivated and challenged by following a broad, coherent, practical, satisfying and worthwhile course of study. It encourages students to develop their curiosity about the material and physical worlds and provides insight into and experience of how science works. It enables students to engage with chemistry in their everyday lives and to make informed choices about further study in chemistry and related disciplines, and career choices.

Knowledge and understanding

This Edexcel GCSE in Chemistry qualification requires students to demonstrate knowledge and understanding of:

- chemistry as an evidence-based discipline
- the collaborative nature of science as a subject discipline and the way new scientific knowledge is validated
- how scientific understanding and theories develop and the limitations of science
- how and why decisions about science and technology are made
- the ethical implications of chemistry and its applications
- the importance of scale in terms of time, size and space in chemistry
- the importance of working accurately and safely
- hazard identification and risk assessment
- risk factors and risk assessment in the context of potential benefit
- the use of modelling, including mathematical modelling, to explain aspects of chemistry
- the chemical properties of elements related to their atomic structure and their position in the periodic table
- the chemical properties of elements and compounds in terms of structure and bonding, including metallic, ionic and covalent bonds, and forces between molecules
- how the properties of materials, including elements and compounds, can be explained by their chemistry

- how the properties of materials determine their uses
- how, in chemical reactions, atoms are rearranged to make new products with different properties and no atoms are lost or made
- patterns in the chemical reactions between substances
- chemical reactions, including reduction and oxidation, neutralisation, electrolysis and polymerisation reactions
- how conditions and quantities can be used to control the rate of chemical reactions
- the energy changes that take place during chemical reactions
- chemical analysis using detection and separation techniques
- the quantitative interpretation of chemical formulae and equations including percentage yield
- how the surface of the Earth and its atmosphere have changed since its origin and are still changing
- the Earth's crust, sea and atmosphere, and living organisms, as the ultimate sources from which all useful materials are obtained or synthesised
- the production, use and disposal of materials, and how an understanding of chemistry helps to reduce the resulting impacts on the environment.

Skills

This Edexcel GCSE in Chemistry provides students with the opportunity to develop the ability to:

- develop hypotheses and plan practical ways to test them including risk assessment; manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data including the use of appropriate technology to draw evidence-based conclusions; review methodology to assess fitness for purpose, and review hypotheses in light of outcomes
- use scientific theories, models and evidence to develop hypotheses, arguments and explanations; develop and use models to explain systems, processes and abstract ideas
- communicate scientific information using scientific, technical and mathematical language, conventions and symbols
- represent chemical reactions by word equations, simple balanced equations and ionic equations where appropriate.

How Science Works

The GCSE in Chemistry requires the students to develop the skills, knowledge and understanding of *How Science Works*, described as follows:

Data, evidence, theories and explanations

1. the collection and analysis of scientific data
2. the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories
3. many phenomena can be explained by developing and using scientific theories, models and ideas
4. there are some questions that science cannot currently answer and some that science cannot address

Practical and enquiry skills

5. planning to test a scientific idea, answer a scientific question or solve a scientific problem
6. collecting data from primary or secondary sources, including the use of ICT sources and tools
7. working accurately and safely, individually and with others, when collecting first-hand data
8. evaluating methods of data collection and considering their validity and reliability as evidence

Communication skills

9. recalling, analysing, interpreting, applying and questioning scientific information or ideas
10. using both qualitative and quantitative approaches
11. presenting information, developing an argument and drawing a conclusion, and using scientific, technical and mathematical language, conventions and symbols, and ICT tools

Applications and implications of science

12. the use of contemporary science and technological developments and their benefits, drawbacks and risks
13. how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions
14. how uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.

Mathematical skills

Students should be able to:

1. understand number size and scale, and the quantitative relationship between units
2. understand when and how to use estimation
3. carry out calculations involving +, − , ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers
4. provide answers to calculations to an appropriate number of significant figures
5. understand and use the symbols =, <, >, ~
6. understand and use direct proportion and simple ratios
7. calculate arithmetic means
8. understand and use common measures and simple compound measures such as speed
9. plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms), selecting appropriate scales for the axes
10. substitute numerical values into simple formulae and equations using appropriate units
11. translate information between graphical and numeric form
12. extract and interpret information from charts, graphs and tables
13. understand the idea of probability
14. calculate area, perimeters and volumes of simple shapes

In addition, higher tier students should be able to:

15. interpret, order and calculate with numbers written in standard form
16. carry out calculations involving negative powers (only −1 for rate)
17. change the subject of an equation
18. understand and use inverse proportion
19. understand and use percentiles and deciles.

List of unit contents

Unit C1: Chemistry in our world

Overview

Content and How Science Works overview

Chemistry is everywhere. Indeed, we live and breathe as a result of essential and highly successful chemical reactions. Every substance in the world is a chemical substance: everything we use, everything we eat, everything we need to survive. Whether they are naturally occurring or man-made, all substances have their origin in the Earth and its atmosphere.

In Unit C1 students study five topics that will build a knowledge and understanding of some simple chemistry around them and equip them to make informed, critical comments on what appears in the media, helping them to become knowledgeable members of society, capable of making responsible decisions in areas involving chemistry.

Work on the Earth's early atmosphere provides opportunities to use models and theories to explain observed data. The importance of collecting data to develop new theories is illustrated by the data scientists have used to show how human activities have changed the composition of the atmosphere and also caused acid rain. Students will look at how new materials are developed to suit new applications, especially in the field of shape-memory alloys. They will also consider issues such as those that arise when humans use raw materials from the Earth; and how chemists can take non-useful substances and obtain useful materials from them. Students will also model decomposition, cracking and polymerisation reactions using the rearrangement of atoms, and model the structures of alkanes and alkenes.

Practical work throughout the unit will give students opportunities to work quantitatively, to assess and manage risks by interpreting hazard symbols and to plan practical ways to answer scientific questions and test hypotheses. Students will critically evaluate evidence, suggest reasons for inconsistencies in the data collected and ways to improve precision or reproducibility of results.

Students will be shown how to represent chemical reactions using word equations and balanced equations, using state symbols. They will have opportunities to work quantitatively in verifying conservation of mass, in balancing equations and in measuring pH during neutralisation reactions.

Throughout the unit students will see the significance of the application of chemistry to issues of global significance, such as removing acidic gases from power-station chimneys and reducing the proportion of carbon dioxide in the atmosphere. They have the opportunity to evaluate the advantages, disadvantages and risks of quarrying, extracting metals from ores, using crude oil, developing biofuels and using polymers, and to consider how decisions such as whether or not to recycle metals are taken.

In Topic 1 students will gain an overview of how the Earth and its atmosphere have evolved. They will begin to understand that human activity can have an impact on these by affecting the composition of the atmosphere.

In Topic 2 they will gain an elementary appreciation of different types of rock and how each is formed. Using limestone as an example, they will begin to appreciate that scientists have to balance factors when using the Earth's resources. They will also look at the chemistry of limestone and appreciate the wide uses to which it is put.

In Topic 3 students will see how acids can react to give useful products and how reactions of acids can solve some everyday problems. They will begin to appreciate how manufacturing supplies our world with useful products from land and sea.

In Topic 4 students will find out how metals are extracted from their ores and consider how metals are used. They will also learn the importance of humans moving to a more sustainable use of Earth's resources, and how recycling metals contributes by preserving ores. Students will also consider how chemists develop new alloys to fit new applications and how alloys have different properties from their component metals.

Topic 5 illustrates the usefulness of crude oil as a rich source of some of the substances we need in everyday life. Students will learn that these substances improve our lives but also cause problems, such as the effects of human activity on the environment, which we cannot ignore. Again, a responsible and sustainable approach to our use of the planet is considered by studying alternatives to fossil fuels.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark, tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop an understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations that exemplify the scientific process and may appear in the written examination for this unit:

1.7 *Investigate the proportion of oxygen in the atmosphere*

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

3.3 *Investigate the effectiveness of different indigestion remedies*

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

4.4 *Investigate methods for extracting a metal from its ore*

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

The following are further suggestions for practical work within this unit:

- *Investigate the presence of water vapour and carbon dioxide in the atmosphere*
- *Investigate the volume of air used up and products formed when candles are burned*
- *Investigate the effect of cooling rate on crystal sizes by melting crystals of salol and cooling them on hot and cold microscope slides; or by crystallisation of a saturated solution*
- *Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid*
- *Investigate mass changes before and after reactions eg copper sulfate and sodium chloride*
- *Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates*
- *Carry out tests for hydrogen, chlorine and oxygen*
- Carry out electrolysis of sea water/acidified water
- *Investigate the rusting of iron*

- *Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides*
- *Make an alloy or investigate the properties of alloys*
- *Investigate the properties of a metal, such as electrical conductivity*
- *Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions*
- *Investigate the products produced from the complete combustion of a hydrocarbon*
- *Test for unsaturation using bromine water*
- *Investigate the cracking of paraffin oil*

The controlled assessment task (CAT) for the GCSE in Chemistry will be taken from any of these practical investigations (specification points and further suggested practical work). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Recall the formulae of elements and simple compounds in the unit

0.2 Represent chemical reactions by word equations **and simple balanced equations**

0.3 **Write balanced chemical equations including the use of state symbols (s), (l), (g) and (aq) for a wide range of reactions in this unit**

0.4 Assess practical work for risks and suggest suitable precautions for a range of practical scenarios for reactions in this unit

0.5 Demonstrate an understanding that hazard symbols used on containers:

a indicate the dangers associated with the contents

b inform people about safe working procedures with these substances in the laboratory

Topic 1

The Earth's sea and atmosphere

1.1 Recall that the gases produced by volcanic activity formed the Earth's early atmosphere

1.2 Recall that the early atmosphere contained:

a little or no oxygen

b a large amount of carbon dioxide

c water vapour and small amounts of other gases

1.3 Explain why there are different sources of information about the development of the atmosphere which makes it difficult to be precise about the evolution of the atmosphere

1.4 Describe how condensation of water vapour formed oceans

1.5 Describe how the amount of carbon dioxide in the atmosphere was reduced by:

a the dissolution of carbon dioxide into the oceans

b the later incorporation of this dissolved carbon dioxide into marine organisms which eventually formed carbonate rocks

1.6 Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased

1.7 *Investigate the proportion of oxygen in the atmosphere*

1.8 Describe the current composition of the atmosphere and interpret data sources showing this information

1.9 Demonstrate an understanding of how small changes in the atmosphere occur through:
   a volcanic activity
   b human activity, including the burning of fossil fuels, farming and deforestation

Topic 2

Materials from the Earth

2.1 Describe that igneous rocks, such as granite, are:
   a formed by the solidification of magma or lava
   b made of crystals whose size depends on the rate of cooling

2.2 Describe chalk and limestone as examples of sedimentary rocks

2.3 Describe how sedimentary rocks are formed by the compaction of layers of sediment over a very long time period

2.4 Recall that sedimentary rocks:
   a may contain fossils
   b are susceptible to erosion

2.5 Describe marble as an example of a metamorphic rock

2.6 Describe the formation of metamorphic rocks by the action of heat and/or pressure, including the formation of marble from chalk or limestone

2.7 Recall that limestone, chalk and marble exist in the Earth's crust and that they are all natural forms of calcium carbonate

2.8 Demonstrate an understanding of the balance between the demand for limestone and the economic, environmental and social effects of quarrying it

2.9 Demonstrate an understanding of the commercial need for quarrying calcium carbonate on a large scale, as a raw material, for the formation of glass, cement and concrete

2.10 Describe the thermal decomposition of calcium carbonate into calcium oxide and carbon dioxide

2.11 *Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate*

2.12 Describe the ease of thermal decomposition of different metal carbonates

2.13 Demonstrate an understanding that:
   a atoms are the smallest particles of an element that can take part in chemical reactions
   b during chemical reactions, atoms are neither created nor destroyed
   c during chemical reactions, atoms are rearranged to make new products with different properties from the reactants

2.14 Describe the effect of water on calcium oxide

2.15 Describe how calcium hydroxide dissolves in water to form a solution, known as limewater

2.16 Demonstrate an understanding that the total mass before and after a reaction in a sealed container is unchanged, as shown practically by a precipitation reaction

2.17 Explain how calcium oxide, calcium hydroxide and calcium carbonate can be used to neutralise soil acidity

2.18 Explain how calcium carbonate can be used to remove acidic gases from coal-fired power station chimneys, reducing harmful emissions and helping to reduce acid rain

Topic 3

Acids

3.1 Recall that hydrochloric acid is produced in the stomach to:

a help digestion

b kill bacteria

3.2 Describe indigestion remedies as containing substances that neutralise excess stomach acid

3.3 *Investigate the effectiveness of different indigestion remedies*

3.4 Recall that acids are neutralised by:

a metal oxides

b metal hydroxides

c metal carbonates

to produce salts (no details of salt preparation techniques or ions are required)

3.5 Recall that:

a hydrochloric acid produces chloride salts

b nitric acid produces nitrate salts

c sulfuric acid produces sulfate salts

3.6 Describe electrolysis as a process in which electrical energy, from a d.c. supply, decomposes compounds, by considering the electrolysis of dilute hydrochloric acid to produce hydrogen and chlorine (explanations of the reactions at the electrodes are not required)

3.7 *Investigate the electrolysis of dilute hydrochloric acid*

3.8 Describe the chemical test for hydrogen

3.9 Describe the chemical test for chlorine

3.10 Recall that chlorine can be obtained from sea water by electrolysis (explanations of the reactions at the electrodes are not required)

3.11 Describe chlorine as a toxic gas and that this leads to potential hazards associated with its large-scale manufacture

3.12 Describe the use of chlorine in the manufacture of bleach and of the polymer poly(chloroethene) (PVC)

3.13 Recall that water can be decomposed by electrolysis to form hydrogen and oxygen

3.14 Describe the chemical test for oxygen

Topic 4

Obtaining and using metals

4.1 Recall that:

a most metals are extracted from ores found in the Earth's crust

b unreactive metals are found in the Earth as the uncombined elements

4.2 Describe how most metals are extracted from their ores by:

a heating with carbon, illustrated by iron

b electrolysis, illustrated by aluminium

(knowledge of the blast furnace or the electrolytic cell for aluminium extraction are not required)

4.3 Explain why the method used to extract a metal is related to its position in the reactivity series and cost of the extraction process

4.4 *Investigate methods for extracting a metal from its ore*

4.5 Describe oxidation as the gain of oxygen and reduction as the loss of oxygen

4.6 Recall that the extraction of metals involves reduction of ores

4.7 Recall that the oxidation of metals results in corrosion

4.8 Demonstrate an understanding that a metal's resistance to oxidation is related to its position in the reactivity series

4.9 Discuss the advantages of recycling metals, including economic implications, and how recycling preserves both the environment and the supply of valuable raw materials

4.10 Describe the uses of metals in relation to their properties, including:

a aluminium

b copper

c gold

d steel

4.11 Use models to explain why converting pure metals into alloys often increases the strength of the product

4.12 Demonstrate an understanding that iron is alloyed with other metals to produce alloy steels with a higher strength and a greater resistance to corrosion

4.13 **Describe how alloying changes the properties of metals, including:**

a **smart or shape memory alloys, including nitinol, an alloy of nickel and titanium**

b **gold alloys with higher strength, including fineness (parts per thousand) and carats to indicate the proportion of pure gold**

4.14 **Demonstrate an understanding that new materials are developed by chemists to fit new applications, such as the creation of new shape memory alloys for use, for example, in spectacle frames and as stents in damaged blood vessels**

Topic 5

Fuels

5.1 Describe hydrocarbons as compounds that contain carbon and hydrogen only

5.2 Describe crude oil as a complex mixture of hydrocarbons

5.3 Describe the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation (details of fractional distillation are not required)

5.4 Recall the name and uses of the following fractions:

a gases, used in domestic heating and cooking

b petrol, used as fuel for cars

c kerosene, used as fuel for aircraft

d diesel oil, used as fuel for some cars and trains

e fuel oil, used as fuel for large ships and in some power stations

f bitumen, used to surface roads and roofs

5.5 Describe that hydrocarbons in different fractions differ from each other in:

a the number of carbon and hydrogen atoms their molecules contain

b boiling points

c ease of ignition

d viscosity

5.6 Describe how the complete combustion of hydrocarbons:

a involves the oxidation of the hydrocarbons

b produces carbon dioxide and water

c gives out energy

5.7 Describe the chemical test for carbon dioxide (using limewater)

5.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide

5.9 Describe how carbon monoxide behaves as a toxic gas

5.10 Demonstrate an understanding of the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels

5.11 Explain why impurities in some hydrocarbon fuels result in the production of sulfur dioxide

5.12 Demonstrate an understanding of some problems associated with acid rain caused when sulfur dioxide dissolves in rain water

5.13 Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, trap heat from the Sun and that this keeps the Earth warm

5.14 Demonstrate an understanding that the Earth's temperature varies and that human activity may influence this

5.15 Demonstrate an understanding that the proportion of carbon dioxide in the atmosphere varies due to human activity, and that chemists are investigating methods to control the amount of the gas in the atmosphere by:

a iron seeding of oceans

b converting carbon dioxide into hydrocarbons

5.16 Evaluate how far the correlation between global temperature and the proportion of carbon dioxide in the atmosphere provides evidence for climate change

5.17 Describe biofuels as being possible alternatives to fossil fuels

5.18 Recall that one example of a biofuel is ethanol obtained by processing sugar cane or sugar beet and that it can be used to reduce the demand for petrol

5.19 Evaluate the advantages and disadvantages of replacing fossil fuels with biofuels, including:

a the fact that biofuels are renewable

b that growing the crops to make biofuels requires land and may affect the availability of land for growing food

c the balance between the carbon dioxide removed from the atmosphere as these crops grow and the carbon dioxide produced when they are transported and burned

5.20 Demonstrate an understanding of the factors that make a good fuel, including:

a how easily it burns

b the amount of ash or smoke it produces

c the comparative amount of heat energy it produces (calculations involving conversion to joules are not required)

d how easy it is to store and transport

5.21 Recall that a simple fuel cell combines hydrogen and oxygen to form water and that this reaction releases energy

5.22 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars

5.23 Describe petrol, kerosene and diesel oil as non-renewable fossil fuels obtained from crude oil and methane as a non-renewable fossil fuel found in natural gas

5.24 *Compare the temperature rise produced when the same volume of water is heated by different fuels*

5.25 Recall that alkanes are saturated hydrocarbons, which are present in crude oil

5.26 Recall the formulae of the alkanes methane, ethane and propane, and draw the structures of these molecules to show how the atoms are bonded together (no further knowledge of bonding is required in this unit)

5.27 Recall that alkenes are unsaturated hydrocarbons

5.28 Recall the formulae of the alkenes ethene and propene, and draw the structures of their molecules to show how the atoms are bonded together (no further knowledge of bonding is required in this unit)

5.29 Describe how bromine water is used to distinguish between alkanes and alkenes

5.30 Describe how cracking involves the breaking down of larger saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes)

5.31 **Explain why cracking is necessary, including by using data on the composition of different crude oils and the demand for fractions in crude oil**

5.32 Describe the cracking of liquid paraffin in the laboratory

5.33 Recall that:

a many ethene molecules can combine together in a polymerisation reaction

b the polymer formed is called poly(ethene)

(conditions and mechanisms not required but **equations required**)

5.34 Describe how other polymers can be made by combining together other monomer molecules, to include poly(propene), poly(chloroethene) (PVC) and PTFE

5.35 Relate uses of the polymers poly(ethene), poly(propene), poly(chloroethene) (PVC) and PTFE to the properties of the compounds

5.36 Recall that most polymers are not biodegradable, that they persist in landfill sites and that many produce toxic products when burnt

5.37 Explain how some problems associated with the disposal of polymers can be overcome:

a by recycling

b by developing biodegradable polymers

Unit C2: Discovering chemistry

Overview

Content and How Science Works overview

Everything in the world, including us, is made of atoms. There are just over 100 different elements and most of these elements exist as more than one type of atom. These atoms can combine together to form a huge number of different compounds. An understanding of how the atoms are bonded together helps us to explain the properties of these compounds and to predict how new compounds may behave.

The purpose of this unit is to give students a more extensive understanding of chemistry by introducing them to some important basic ideas. In particular, they will appreciate how chemistry has progressed through a series of discoveries and advances in understanding.

Practical work in this unit will give students opportunities to plan practical ways to answer scientific questions; devise appropriate methods for the collection of numerical and other data; assess and manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data; draw evidence-based conclusions; and evaluate methods of data collection and the quality of the resulting data.

Work on the structure of atoms, the periodic table and the formation of ionic, covalent and metallic bonds provides opportunities to use models to explain ideas and processes, and to communicate scientific information using scientific conventions and symbols, including diagrams of electronic configurations and balanced chemical equations.

Students will have the opportunity to work quantitatively when studying relative formula masses, percentage compositions and percentage yields.

Work on the periodic table, flame tests and the discovery of noble gases provides opportunities to look at how scientific ideas have changed over time and some ways in which chemists can make new discoveries. Students can also consider how new scientific ideas are validated.

Students have the opportunity to consider the advantages, disadvantages and risks of the applications of some of the substances studied, including the use of barium sulfate in 'barium meals', the use of chromatography by food chemists and forensic scientists, and the uses of noble gases. They will look at the reasons why reactions do not always give the theoretical yield, and how the chemical industry can contribute to sustainability by improving yields and utilising waste products.

In Topic 1 students will gain a thorough knowledge and understanding of the structure of atoms, which will enable them to understand the arrangement of elements in the periodic table and the terms atomic number, mass number and relative atomic mass.

An understanding of the formation and nature of ionic bonds, gained in Topic 2, will enable students to understand the properties of these compounds and their usefulness in making salts. Students will begin to appreciate that, in solutions, the ions present behave independently. This will enable students to grasp the basis of simple qualitative analysis, carry out some reactions and consider some applications.

An understanding of the formation and nature of covalent bonds, gained in Topic 3, will enable students to understand the properties of these compounds and see the distinction between covalent compounds consisting of simple molecules and those consisting of giant molecules. Students will also look at some important separation techniques, such as fractional distillation and paper chromatography.

In Topic 4 students study three groups of the periodic table: a group of metals (group 1), a group of non-metals (group 7) and the noble gases (group 0). They will gain an elementary knowledge of the structure of metals which, together with the knowledge gained in Topics 2 and 3, will enable them to differentiate four types of substances by their bonding and properties and therefore to make predictions about substances not familiar to them.

Topic 5 gives students an understanding of two general aspects of chemical reactions: the heat energy changes that accompany reactions and the rates of reactions. They can understand how industrial chemists try to make products quickly and efficiently by controlling reaction conditions.

In Topic 6 students learn how to determine empirical formulae through practical experiments and how to use formulae and equations to determine the amounts of substances involved in reactions. Finally, students should understand why practical yields are always lower than calculated yields.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark tiered written examination, containing six questions.

The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop an understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practicals which exemplify the scientific process and may appear in the written examination for this unit:

1.7 *Investigate the proportion of oxygen in the atmosphere*

2.12 *Prepare an insoluble salt by precipitation*

3.4 *Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)*

4.12 *Investigate displacement reactions of halogens reacting with halide ions in solution*

5.1 *Measure temperature changes accompanying some of the following types of change:*

a *salts dissolving in water*

b *neutralisation reactions*

c *displacement reactions*

d *precipitation reactions*

5.7 *Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips*

6.3 *Determine the empirical formula of a simple compound, such as magnesium oxide*

The following are further suggestions for practical work within this unit:

- *Investigate the properties of a group of elements eg Group 2*
- *Investigate the properties of typical ionic compounds*
- *Test predictions of whether a precipitate forms when soluble salts are combined*
- *Carry out a series of ion tests to identify unknown compounds*
- *Build models of simple covalent molecules*
- *Investigate the typical properties of simple and giant covalent compounds*
- *Use paper chromatography to separate inks, food dyes, etc*
- *Investigate the properties of metals*
- *Carry out an activity to show that transition metal salts have a variety of colours*
- *Investigate heat energy changes in neutralisation and/or displacement reactions*
- *Investigate the rate of reactions, such as magnesium and hydrochloric acid, or sodium thiosulfate and hydrochloric acid*

- *Investigate the effect of potential catalysts on the rate of decomposition of hydrogen peroxide*
- *Determine the formula of copper oxide by reduction of the oxide to copper*
- *Determine the formula of a hydrated salt such as barium chloride or copper sulfate by heating to drive off water of crystallisation*
- *Prepare a substance and calculate the % yield given the theoretical yield*

The Controlled Assessment Task (CAT) for the GCSE in Chemistry will be taken from any of these practicals (specification points and further suggested practicals). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Recall the formulae of elements and simple compounds in the unit

0.2 Represent chemical reactions by word equations and simple balanced equations

0.3 Write balanced chemical equations including the use of state symbols (s), (l), (g) and (aq) for a wide range of reactions in this unit

0.4 Assess practical work for risks and suggest suitable precautions for a range of practical scenarios for reactions in this unit

0.5 Demonstrate an understanding that hazard symbols used on containers:

a indicate the dangers associated with the contents

b inform people about safe-working procedures with these substances in the laboratory

Topic 1

Atomic structure and the periodic table

1.1 Explain how Mendeleev:

a arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds

b used his table to predict the existence and properties of some elements not then discovered

1.2 Classify elements as metals or non-metals according to their position in the periodic table

1.3 Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells (energy levels)

1.4 Demonstrate an understanding that the nucleus of an atom is very small compared to the overall size of the atom

1.5 Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element

1.6 Recall the relative charge and relative mass of:

a a proton

b a neutron

c an electron

1.7 Demonstrate an understanding that atoms contain equal numbers of protons and electrons

1.8 Explain the meaning of the terms:
   a atomic number
   b mass number
   c relative atomic mass

1.9 Describe the arrangement of elements in the periodic table such that:
   a elements are arranged in order of increasing atomic number, in rows called periods
   b elements with similar properties are placed in the same vertical column, called groups

1.10 **Demonstrate an understanding that the existence of isotopes results in some relative atomic masses not being whole numbers**

1.11 **Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes**

1.12 Apply rules about the filling of electron shells (energy levels) to predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form 2.8.1

1.13 Describe the connection between the number of outer electrons and the position of an element in the periodic table

Topic 2

Ionic compounds and analysis

2.1 Demonstrate an understanding that atoms of different elements can combine to form compounds by the formation of new chemical bonds

2.2 Describe how ionic bonds are formed by the transfer of electrons to produce cations and anions

2.3 Describe an ion as an atom or group of atoms with a positive or negative charge

2.4 Describe the formation of sodium ions, Na^+, and chloride ions, Cl^-, and hence the formation of ions in other ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7

2.5 Demonstrate an understanding of the use of the endings –ide and –ate in the names of compounds

2.6 Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions

2.7 **Describe the structure of ionic compounds as a lattice structure:**
   a **consisting of a regular arrangement of ions**
   b **held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions**

2.8 Describe **and explain** the properties of ionic substances including sodium chloride and magnesium oxide, limited to:

a melting points and boiling points

b whether they conduct electricity as solids, when molten and in aqueous solution

2.9 Recall the general rules which describe the solubility of common types of substances in water:

a all common sodium, potassium and ammonium salts are soluble

b all nitrates are soluble

c common chlorides are soluble except those of silver and lead

d common sulfates are soluble except those of lead, barium and calcium

e common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium

2.10 Demonstrate an understanding that insoluble salts can be formed as precipitates by the reaction of suitable reagents in solution

2.11 Demonstrate an understanding of the method needed to prepare a pure, dry sample of an insoluble salt

2.12 *Prepare an insoluble salt by precipitation*

2.13 Use solubility rules to predict whether a precipitate is formed when named solutions are mixed together and to name the precipitate

2.14 Recall that the insoluble salt, barium sulfate, is given as a 'barium meal' to X-ray patients because:

a it is opaque to X-rays

b it is safe to use as, although barium salts are toxic, its insolubility prevents it entering the blood

2.15 Describe tests to show the following ions are present in solids or solutions:

a Na^+, K^+, Ca^{2+}, Cu^{2+} using flame tests

b CO_3^{2-} using dilute acid and identifying the carbon dioxide evolved

c SO_4^{2-} using dilute hydrochloric acid and barium chloride solution

d Cl^- using dilute nitric acid and silver nitrate solution

2.16 Recall that chemists use spectroscopy (a type of flame test) to detect the presence of very small amounts of elements and that this led to the discovery of new elements, including rubidium and caesium

Topic 3

Covalent compounds and separation techniques

3.1 Describe a covalent bond as a pair of electrons shared between two atoms

3.2 Recall that covalent bonding results in the formation of molecules

3.3 Explain the formation of simple molecular, covalent substances using dot and cross diagrams, including:

a hydrogen

b hydrogen chloride

c water

d methane

e **oxygen**

f **carbon dioxide**

3.4 *Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulphate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)*

3.5 Describe the properties of typical simple molecular, covalent compounds, limited to:

a low melting points and boiling points, in terms of weak forces between molecules

b poor conduction of electricity

3.6 Demonstrate an understanding of the differences between the properties of simple molecular, covalent substances and those of giant molecular, covalent substances, including diamond and graphite

3.7 **Explain why, although they are both forms of carbon and giant molecular substances, graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools**

3.8 Describe the separation of two immiscible liquids using a separating funnel

3.9 Describe the separation of mixtures of miscible liquids by fractional distillation, by referring to the fractional distillation of liquid air to produce nitrogen and oxygen

3.10 Describe how paper chromatography can be used to separate and identify components of mixtures, including colouring agents in foodstuffs

3.11 Evaluate the information provided by paper chromatograms, including the calculation of R_f values, in a variety of contexts, such as the food industry and forensic science

Topic 4

Groups in the periodic table

4.1 Classify elements as alkali metals (group 1), halogens (group 7), noble gases (group 0) and transition metals based on their position in the periodic table

4.2 Describe the structure of metals as a regular arrangement of positive ions surrounded by a sea of delocalised electrons

4.3 Describe and explain the properties of metals, limited to malleability and the ability to conduct electricity

4.4 Recall that most metals are transition metals and that their typical properties include:

a high melting point

b the formation of coloured compounds

4.5 Demonstrate an understanding that elements and compounds can be classified as:

a ionic

b simple molecular covalent

c giant molecular covalent

d metallic

and that each type of substance has different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)

4.6 Describe alkali metals as:

a soft metals

b metals with comparatively low melting points

4.7 Describe the reactions of lithium, sodium and potassium with water to form hydroxides which are alkaline, and hydrogen gas

4.8 Describe the pattern in reactivity of the alkali metals lithium, sodium and potassium with water, use this pattern to predict the reactivity of other alkali metals **and explain the pattern**

4.9 Recall the colours and physical states of the halogens at room temperature

4.10 Describe the reaction of halogens with metals to form metal halides

4.11 Recall that halogens react with hydrogen to produce hydrogen halides which dissolve in water to form acidic solutions

4.12 *Investigate displacement reactions of halogens reacting with halide ions in solution*

4.13 Describe the relative reactivity of the halogens as shown by their displacement reactions with halide ions in aqueous solution

4.14 Describe the noble gases as chemically inert, compared with the other elements, and demonstrate an understanding that this lack of reactivity can be explained by the electronic arrangements in their atoms

4.15 Demonstrate an understanding that the discovery of the noble gases was due to chemists:

a noticing that the density of nitrogen made in a reaction differed from that of nitrogen obtained from air

b developing a hypothesis about the composition of the air

c performing experiments to test this hypothesis and show the presence of the noble gases

4.16 Relate the uses of the noble gases to their properties, including:

a inertness (including providing an inert atmosphere for welding and in filament lamps)

b low density (including filling balloons)

c non-flammability

4.17 Use the pattern in a physical property of the noble gases, such as boiling point or density, to estimate an unknown value for another member of the group

Topic 5

Chemical reactions

5.1 *Measure temperature changes accompanying some of the following types of change:*

a *salts dissolving in water*

b *neutralisation reactions*

c *displacement reactions*

d *precipitation reactions*

5.2 Define an exothermic change or reaction as one in which heat energy is given out, including combustion reactions or explosions

5.3 Define an endothermic change or reaction as one in which heat energy is taken in, including photosynthesis or dissolving ammonium nitrate in water

5.4 Describe the breaking of bonds as endothermic and the making of bonds as exothermic

5.5 Demonstrate an understanding that the overall heat energy change for a reaction is:

a exothermic if more heat energy is released making bonds in the products than is required to break bonds in the reactants

b endothermic if less heat energy is released making bonds in the products than is required to break bonds in the reactants

5.6 **Draw and interpret simple graphical representations of energy changes occurring in chemical reactions (no knowledge of activation energy is required)**

5.7 *Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips*

5.8 Recall that the rates of chemical reactions vary from very fast, explosive reactions to very slow reactions

5.9 Describe the effect of changes in temperature, concentration and surface area of a solid on the rate of reaction

5.10 Describe how reactions can occur when particles collide **and explain how rates of reaction are increased by increasing the frequency and/or energy of collisions**

5.11 **Demonstrate an understanding that not all collisions lead to a reaction, especially if particles collide with low energy**

5.12 Recall the effect of a catalyst on the rate of reaction

5.13 Demonstrate an understanding that catalytic converters in cars:

a have a high surface area to increase the rate of reaction of carbon monoxide and unburnt fuel from exhaust gases with oxygen from the air to produce carbon dioxide and water

b work best at high temperatures

Topic 6

Quantitative chemistry

6.1 Calculate relative formula mass given relative atomic masses

6.2 Calculate the formulae of simple compounds from reacting masses and understand that these are empirical formulae

6.3 *Determine the empirical formula of a simple compound, such as magnesium oxide*

6.4 Calculate the percentage composition by mass of a compound from its formula and the relative atomic masses of its constituent elements

6.5 **Use balanced equations to calculate masses of reactants and products**

6.6 Recall that the yield of a reaction is the mass of product obtained in the reaction

6.7 Demonstrate an understanding that the actual yield of a reaction is usually less than the yield calculated using the chemical equation (theoretical yield)

6.8 Calculate the percentage yield of a reaction from the actual yield and the theoretical yield

6.9 Demonstrate an understanding of the reasons why reactions do not give the theoretical yield due to factors, including:

a incomplete reactions

b practical losses during the preparation

c competing, unwanted reactions

6.10 Demonstrate an understanding that many reactions produce waste products which:

a are not commercially useful

b can present economic, environmental and social problems for disposal

6.11 **Demonstrate an understanding that chemists in industry work to find the economically most favourable reactions where:**

a **the percentage yield is high**

b **all the products of the reaction are commercially useful**

c **the reaction occurs at a suitable speed**

Unit C3: Chemistry in action

Overview

Content and How Science Works overview

One of the attractive features of chemistry is that a knowledge and understanding of the basic ideas reduces the amount of learning required and provides the satisfaction of making successful predictions because the knowledge and understanding can be applied in a wide variety of ways in the laboratory and in industry.

The purpose of this unit is to provide students with opportunities to apply what they have learnt in C1 and C2. This consolidates their knowledge and understanding before commencing an AS / A level course, or gives them the satisfaction of feeling that they have achieved something worthwhile in their GCSE chemistry course. They will realise that they can study and understand qualitative and quantitative inorganic analysis, electrolysis, equilibrium and organic chemistry, seeing the importance and relevance of what they have learned for industrial as well as for laboratory processes.

Practical work in this unit will give students opportunities to plan practical ways to answer scientific questions; devise appropriate methods for the collection of numerical and other data; assess and manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data; draw evidence-based conclusions; and evaluate methods of data collection and the quality of the resulting data.

Work on electrolysis, reversible reactions and dynamic equilibrium, and the structures of molecules in homologous series, provides students with opportunities to use models to explain ideas and processes, and to communicate scientific information using scientific conventions and symbols.

Students will have the opportunity to work quantitatively when carrying out mole calculations and working with volumes of gases, and when writing balanced chemical equations and half equations.

Work on ion tests and the quantitative testing of water allows students to consider the role chemistry plays in providing safe drinking water. Studying the uses of sodium, the purification of copper, the use of electroplating, the manufacture of fertiliser and the production of ethanol, vinegar, esters and soap shows students the importance of the chemical industry in providing useful materials.

Students have the opportunity to consider the advantages, disadvantages and risks of the applications of some of the substances studied, including problems caused by hard water, the over-use of fertilisers, the social effects of alcoholic drinks and the uses of esters. They will consider the economic factors involved in choosing reaction conditions for the Haber process and in choosing the method used to produce ethanol. They will also consider issues of sustainability, such as the need to recycle some materials.

In Topic 1, building on their work in C2, candidates will extend their knowledge of tests for ions to enable them to identify unknown salts, and will see how qualitative analysis has relevance to chemists working in fields such as forensic science.

In Topic 2 students will learn that amounts of substances are expressed in moles and, having carried out titrations, will do calculations to determine concentrations of dissolved substances. They will also learn how to prepare soluble salts and understand that using an excess of a reactant is practically convenient but that simple titration has to be used when the reactant is soluble. They will also see how the presence of some dissolved salts can cause water to be hard and to appreciate the problems this raises.

Having learnt that electrolysis results in the decomposition of aqueous solutions of salts, students can use their knowledge of ions in Topic 3 to understand and make predictions about such processes and to write half equations for the reactions occurring at the electrodes. Purification of copper and electroplating demonstrate the relevance, in industry, of what they have learnt.

In Topic 4 the introduction of molar volume and of Avogadro's law enables students to do quantitative work related to volumes of gases. They are then able to consider dynamic equilibria and how changing conditions affects equilibrium yield and rate of attainment of equilibrium. This will lead them to focus on the Haber process and the manufacture of fertilisers.

In Topic 5 students will widen their knowledge of organic chemistry and begin to understand the beauty of organic chemistry, where a little knowledge can go a long way. They will study ethanol, ethanoic acid and ethyl ethanoate leading, through the concept of homologous series, to the series of alcohols, carboxylic acids and esters. An appreciation that oils and fats are esters leads to the production of soaps.

Assessment overview

This unit is externally assessed, through a one hour, 60 mark tiered written examination, containing six questions.

The examination will contain a mixture of questions styles, including objective questions, short answer questions and extended writing questions.

Practical investigations in this unit

Within this unit, students will develop understanding of the process of scientific investigations, including that investigations:

- use hypotheses which are tested
- require assessment and management of risks
- require the collection, presentation, analysis and interpretation of primary and secondary evidence including the use of appropriate technology
- should include a review of methodology to assess fitness for purpose
- should include a review of hypotheses in the light of outcomes.

The following specification points are practical investigations which exemplify the scientific process and may appear in the written examination for this unit:

1.4 *Identify the ions in unknown salts, using the tests above and in unit C2, specification point 2.15*

2.6 *Evaporate a solution to dryness to determine the mass of solute in a given mass of solution*

2.14 *Carry out an acid-base titration to prepare a salt from a soluble base*

3.8 *Electrolyse sodium chloride solution*

3.12 *Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes*

5.2 *Prepare a solution of ethanol by fermentation*

The following are further suggestions for practical work within this unit:

- *Investigate the properties of a group of elements eg Group 2*
- *Describe an experiment to test the hardness of samples of water by shaking the sample with soap solution*
- *Investigate methods for removing hardness in water*
- *Carry out titrations reaction to find an unknown concentration of an acid or alkali in solution*
- *Investigate the migration of ions in eg potassium manganate (VII) solution*
- *Investigate the products of electrolysis of solutions of salts*
- *Electroplate a metal object*
- *Determine the volume of one mole of hydrogen gas by using the reaction of magnesium with hydrochloric acid*
- *Determine the molar volume by measuring the volume and mass of a gas using a heavier gas (eg carbon dioxide)*
- *Investigate simple reversible reactions, such as the decomposition of ammonium chloride*
- *Dehydration of ethanol*
- *Oxidation of ethanol*
- *Reactions of ethanoic acid*
- *Describe an experiment to prepare an ester on a test tube scale*
- *Manufacture of soap*

The Controlled Assessment Task (CAT) for the GCSE in Chemistry will be taken from any of these practicals (specification points and further suggested practicals). This task will change every year, so future CATs will be chosen from this list.

Detailed unit content

In this specification bold text refers to higher tier only content. Italic text refers to practical investigations, which students are required to demonstrate an understanding of.

Throughout the unit

0.1 Recall the formulae of elements and simple compounds in the unit

0.2 Represent chemical reactions by word equations and simple balanced equations

0.3 Write balanced chemical equations including the use of state symbols (s), (l), (g) and (aq) for a wide range of reactions in this unit

0.4 Write balanced ionic equations for a wide range of reactions in this unit and those in unit C2, specification point 2.15

0.5 Assess practical work for risks and suggest suitable precautions for a range of practical scenarios for reactions in this unit

0.6 Demonstrate an understanding that hazard symbols used on containers:

a indicate the dangers associated with the contents

b inform people about safe-working procedures with these substances in the laboratory

Topic 1

Qualitative analysis

1.1 Demonstrate an understanding that analysis may be qualitative or quantitative

1.2 Explain why the test for any ion must be unique

1.3 Describe tests to show the presence of the following ions in solids or solutions as appropriate:

a Al^{3+}, Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+} using sodium hydroxide solution

b NH_4^+ using sodium hydroxide solution, warming and testing for the ammonia gas produced

c Cl^-, Br^-, I^- using dilute nitric acid and silver nitrate solution

1.4 *Identify the ions in unknown salts, using the tests above and in unit C2, specification point 2.15*

1.5 Demonstrate an understanding that these tests form the basis for testing by chemists:

a working in the water industry to check the purity of drinking water

b for the presence of substances in the blood

Topic 2

Quantitative analysis

2.1 Calculate the concentration of solutions in g dm^{-3}

2.2 Demonstrate an understanding that some areas of the country have dissolved calcium or magnesium ions in their tap water and that the presence of these ions makes the water hard

2.3 Describe problems caused by hard water, including:

a it does not easily form a lather with soap

b it reacts with soap to form a precipitate ("scum"), which causes soap to be wasted

2.4 Describe hard water as either temporary or permanent, and describe how boiling removes temporary hardness but not permanent hardness

2.5 Explain how hard water can be softened by removing the dissolved calcium and/or magnesium ions and that this can be done by:

a boiling (for temporary hard water only)

b using an ion exchange resin

2.6 *Evaporate a solution to dryness to determine the mass of solute in a given mass of solution*

2.7 **Demonstrate an understanding that the amount of a substance can be measured in grams, numbers of particles or number of moles of particles**

2.8 **Convert masses of substances into moles of particles of the substance and vice versa**

2.9 **Convert concentration in g dm^{-3} into mol dm^{-3} and vice versa**

2.10 Demonstrate an understanding that if soluble salts are prepared from an acid and an insoluble reactant:

a excess of the reactant can be added to ensure that all the acid is used up

b the excess reactant can be removed by filtration

c the solution remaining is only salt and water

2.11 Demonstrate an understanding that if soluble salts are prepared from an acid and a soluble reactant:

a titration must be used to determine the exact amount of the soluble reactant that reacts with an acid

b the acid and the soluble reactant can then be mixed in the correct proportions

c the solution remaining after reaction is only salt and water

2.12 Describe an acid-base titration as a neutralisation reaction where hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the base

2.13 Describe how to carry out simple acid-base titrations using burette, pipette and suitable acid-base indicators

2.14 *Carry out an acid-base titration to prepare a salt from a soluble base*

2.15 **Carry out simple calculations using the results of titrations to calculate an unknown concentration of a solution or an unknown volume of solution required.**

Topic 3

Electrolytic processes

3.1 Explain that electrolytes are ionic substances in the molten state or dissolved in water

3.2 Describe the movement of ions during electrolysis, such that:

a positively charged cations migrate to the negatively charged cathode

b negatively charged anions migrate to the positively charged anode

3.3 Demonstrate an understanding that oxidation can involve the loss of electrons and reduction can involve the gain of electrons

3.4 Demonstrate an understanding that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions

3.5 **Write half equations for reactions occurring at the anode and cathode in examples of electrolysis reactions in this unit**

3.6 Describe the manufacture of sodium by the electrolysis of molten sodium chloride (details of the electrolytic cell are not required)

3.7 Recall that sodium can be used in street lamps and as a coolant in some nuclear reactors

3.8 *Electrolyse sodium chloride solution*

3.9 Explain the formation of the products in the electrolysis of sodium chloride solution

3.10 Describe how the electrolysis of aqueous solutions can give products from ions in water, rather than from ions of the dissolved solid

3.11 Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including:

a copper chloride solution

b copper sulfate solution

c sodium sulfate solution

d molten lead bromide

3.12 *Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes*

3.13 Describe the purification of copper by electrolysis using a pure copper cathode and an impure copper anode

3.14 Explain how electroplating can be used to improve the appearance and/or the resistance to corrosion of metal objects

Topic 4

Gases, equilibria and ammonia

4.1 **Demonstrate an understanding that one mole of any gas occupies 24 dm^3 at room temperature and atmospheric pressure and that this is known as the molar volume of the gas**

4.2 **Use molar volume and balanced equations in calculations involving the masses of solids and volumes of gases**

4.3 **Use Avogadro's law to calculate volumes of gases involved in gaseous reactions, given the relevant equations**

4.4 Recall that nitrogenous fertilisers are manufactured from ammonia and that they promote plant growth

4.5 Demonstrate an understanding of the environmental consequences of the over-use of fertilisers, including excessive plant growth in rivers and lakes

4.6 Recall that chemical reactions are reversible and that the Haber process uses a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) to form ammonia

4.7 **Demonstrate an understanding of the concept of dynamic equilibrium**

4.8 **Explain how the position of a dynamic equilibrium is affected by changes in:**

a **temperature**

b **pressure**

4.9 **Demonstrate an understanding of the consequential effects of these changes on the rate of attainment of equilibrium and of the need to use a catalyst**

4.10 **Describe how, in industrial reactions such as the Haber process, the temperature, pressure and catalyst used produce an acceptable yield in an acceptable time**

Topic 5

Organic chemistry

5.1 Describe how ethanol is produced during the fermentation of carbohydrates, including:

a that the fermentation mixture is kept warm and under anaerobic conditions

b that yeast provides an enzyme for this reaction

5.2 *Prepare a solution of ethanol by fermentation*

5.3 Recall that different percentages of ethanol are present in various drinks

5.4 Demonstrate an understanding of the social issues and possible harmful effects of ethanol in alcoholic drinks

5.5 Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture

5.6 **Recall how ethanol can also be manufactured by reacting ethene (from cracking of crude oil fractions) with steam**

5.7 **Evaluate the factors which are relevant to the choice of method used in the manufacture of ethanol, including:**

a **the relative availability of sugar cane or sugar beet and crude oil**

b **the quality of the final product and whether it needs further processing**

5.8 **Recall that the dehydration of ethanol results in the formation of ethene**

5.9 Define homologous series as a series of compounds which:

a have the same general formula

b show a gradual variation in physical properties as exemplified by their boiling points

c have similar chemical properties

5.10 Recall the names, formulae and structures of members of the following homologous series:

a alkanes, up to 4 carbons atoms per molecule

b alkenes, up to 3 carbons atoms per molecule

c **alcohols, up to 3 carbons atoms per molecule**

d **carboxylic acids, up to 3 carbon atoms per molecule**

(no treatment of isomers is required in any of these series)

5.11 Demonstrate an understanding that ethanol can be oxidised to form ethanoic acid and that this reaction occurs in open bottles of wine and in the production of ethanoic acid in vinegar

5.12 Describe the use of vinegar as a flavouring and as a preservative

5.13 Demonstrate an understanding that ethanoic acid is a typical acid, including:

a its reaction with metals

b its reaction with bases and carbonates to form salts (ethanoates)

c its typical effect on indicators

5.14 Describe the reaction of ethanol with ethanoic acid to produce an ester, ethyl ethanoate and water **including writing an equation for this reaction using molecular and structural formulae**

5.15 Describe uses of:

a esters as flavourings and perfumes, as they are pleasant-smelling

b polyesters as fibres to make fabric and as plastics for making bottles (no consideration of the formation of polyester is required)

5.16 Demonstrate an understanding that polyesters can be recycled to form fleece that is used to make clothing

5.17 Recall that oils and fats are esters

5.18 Describe the breaking down of oils and fats, by boiling with concentrated alkali solution, to produce soaps, which are sodium or potassium salts of long carbon chain carboxylic acids

5.19 **Demonstrate an understanding of how a soap removes dirt or grease, including:**

a **that part of the soap anion is hydrophobic and dissolves in dirt or grease**

b **that the other part is hydrophilic and dissolves in water**

5.20 **Demonstrate an understanding that liquid oils can be converted to solid fats by catalytic hydrogenation which removes the C═C unsaturation and that this process is used to manufacture margarine**

Unit CCA: Chemistry controlled assessment

Overview

Content and How Science Works overview

The controlled assessment is designed to enable students to engage with the scientific process through setting a hypothesis relevant to a given set of variables and then planning an investigation, observing, recording and presenting outcomes and conclusions.

The student task will consist of three parts:

Part A – Planning

Part B – Observations

Part C – Conclusions

The tasks, provided by Edexcel, will relate to the following units in this specification:

C2 – Discovering chemistry

C3 – Chemistry in action

Students must NOT submit a controlled assessment task for C1 for this qualification.

The quality of written communication will be important in all reports produced as how students present, order and explain their work links directly to how well it is understood by the reader.

Assessment overview

- This unit is internally assessed under controlled conditions.
- There will be two tasks available each year – one task from C2 and one task from C3.
- Each task has a shelf life of one year.
- The tasks will be available to teachers one year in advance.
- Each task has three parts – Part A: Planning, Part B: Observations and Part C: Conclusions.
- The total number of marks available for the three parts is 50.
- Students must attempt all three parts of a task.
- If they attempt both tasks, then the best marks from Part A, B and C should be submitted for the unit.

Detailed unit content

Delivery of the controlled assessment

Skills

Students should demonstrate the ability to carry out the following skills when completing a task:

a develop a hypothesis and plan practical ways to test it including risk assessment

b manage risks when carrying out practical work

c collect, process, analyse and interpret primary and secondary evidence including the use of appropriate technology to draw evidence-based conclusions

d review methodology to assess fitness for purpose, and review the hypothesis in light of outcomes.

Parts of the controlled assessment tasks

Part A – Planning (20 marks)

Includes choosing equipment, hypothesis, controls needed for the task, evidence/observations and range, identification and management of risk.

Part B – Observations (6 marks)

Includes primary and secondary evidence collection and recording.

Part C – Conclusions (24 marks)

Includes processing and presentation of evidence, quality of evidence, conclusions based on evidence, evaluation of method, evaluation of conclusion.

Student support

Where students produce a plan that is unworkable or dangerous, it is permitted for teachers to provide students with a plan, provided it is clear that students will not receive Part A marks for this plan.

Levels of control

Internal assessment under controlled conditions has levels of control for task setting, task taking and task marking. These must be adhered to when students are completing their controlled assessment tasks.

Summary of levels of control

Area	Level of control
Part A – Planning	Limited
Part B – Observations	Limited
Part C – Conclusions	High

Task setting

High level of control

A high level of control means that tasks will be set by Edexcel and centres will choose from a list of tasks, from the other units in this qualification.

The tasks will change every year, in accordance with the Ofqual regulations for GCSE Science. Teachers must take care when using these tasks to ensure that students are completing the correct task for a particular year. The front sheet of each task will show the dates for which it is valid.

When will the tasks be available?

They will be available on the Edexcel website for teachers to download a year ahead of their first assessment opportunity. Teachers can view all the task sheets available before deciding which task the students will complete.

When should the tasks be made available to students?

The task sheets for this controlled assessment are confidential and must not be shown to students before they start the tasks. Task sheets should not be shown to students until the start of the task planning stage of the controlled assessment.

Do all my students have to do the same task?

It is acceptable for all the students in a class to complete the same task. However, the same task does not have to be chosen for all students and they can work on a mixture of different tasks from C2 and C3.

The tasks will change every year, in accordance with the Ofqual regulations for GCSE Science. Teachers must take care when using these tasks to ensure that students are completing the correct task for a particular year. The front sheet of each task will show the dates for which it is valid.

Task taking

a Research and data collection – limited level of control

Research and data collection, including practical work, will be carried out under limited control. This means that students may work collaboratively when collecting data from practical activities.

Students may carry out any secondary research whilst not being directly supervised by a teacher, for example in a library or at home. The secondary research can include extracts from books and websites.

b Analysis, conclusions and evaluation of findings – high level of control

The analysis, conclusions and evaluation will be produced by students under high levels of control. This means that students must carry out this part of the write-up individually, under the supervision of a teacher.

The production of the final report will usually take place over several lessons, so the students' materials must be collected in at the end of the lesson and handed back at the beginning of the next one. Students' final reports must be produced individually.

Communication with students during the controlled assessment

Feedback can be given to students during the controlled assessment, but this must be general rather than specific feedback. Teachers may give students general feedback on:

- the equipment chosen
- the controls for the task
- data to be collected or observations to be made
- risks involved with the task
- techniques for processing data/observations
- skills involved in the conclusions and evaluation.

Students should receive a copy of the assessment criteria so that they are aware of what they need to do to access the full range of marks.

Suggested timings of each area

The suggested timings for each part of the controlled assessment task are as follows:

Part A – Planning	1 hour
Part B – Observations	1 hour
Part C – Conclusions	1 hour

Total of 3 hours

For this controlled assessment unit, it is expected that students should be given approximately 6 hours of time specifically on preparing for tasks. By using the practicals noted in the theory units, this can be achieved as part of your normal teaching.

Task marking

Task marking – medium level of control

A medium level of control means that the marking of the tasks will be carried out by teachers and moderated by Edexcel.

Marking procedure

Teachers should use the assessment criteria to mark the tasks and use the *Controlled Assessment Record Sheet* (Appendix 5) to record the marks. Edexcel will give additional guidance of the application of the generic marking criteria in support documentation.

It is good practice for teachers to annotate students' work to show how the marks have been allocated for each section.

Submitting marks

Students must attempt all three parts of any task they do.

Final marks for each section of the student's work should be recorded on the *Controlled Assessment Record Sheet* in Appendix 5.

They don't need to submit all marks from a task but can submit the best marks from any of the tasks they have attempted.

If a mark is submitted from a task, the student response to all three parts must be marked and retained by the centre for moderation.

Each CAT may be submitted for moderation in either May (for a June session) or October (for a November session).

Health and safety

Students must observe safe practice when they are carrying out practical work. It is the responsibility of centres to carry out risk assessments for all practical work that they undertake with their students.

In this internal assessment teachers will have limited control when students are collecting their data, but it should be carried out under full supervision for health and safety reasons. The limited control means that students can work collaboratively to collect their data.

Assessment criteria

Part A - Planning

Element	Marks		Criteria
Equipment	2	0 marks	Gives no relevant detail
		1–2 marks	a) Chooses most relevant resources/equipment b) Explains reasons for choices and choices are fully relevant to method

Element	Marks		Criteria
Controls (If variables are to be controlled, criteria a1 and b1 will be used. If there are no variables to control, criteria a2 and b2 will be used. The specific criteria needed will be in the controlled assessment task.)	6	0 marks	Gives no relevant controls
		1–2 marks	a1) Identifies one appropriate variable to control b1) Describes how this variable can be controlled OR a2) Identifies one appropriate way to control the task b2) Describes this way of controlling the task
		3–4 marks	a1) Identifies some relevant variables to control b1) Gives an appropriate description of how to control these variables OR a2) Identifies some relevant ways to control the task to produce meaningful results b2) Describes how these ways control the task
		5–6 marks	a1) Identifies a range of variables appropriate to control b1) Gives an appropriate explanation of how to control these variables OR a2) Provides a comprehensive list of relevant ways to control the task to produce meaningful results b2) Explains how these ways control the task

Element	Marks		Criteria
Hypothesis	4	0 marks	Provides no relevant hypothesis
		1–2 marks	a) Provides a hypothesis that is appropriate for most of the task b) Partially justifies the hypothesis
		3–4 marks	a) Provides a hypothesis that is appropriate for the full scope of the task, based on relevant scientific ideas b) Justifies the hypothesis fully using relevant scientific ideas
Risks	4	0 marks	No relevant detail given
		1–2 marks	a) Identifies a relevant risk which is specific to the task b) Suggests measure(s) to manage the risk
		3–4 marks	a) Identifies most of the relevant risks which are specific to the task b) Method reflects how risks need to be managed
Overall plan	4	0 marks	Gives no relevant method
		1–2 marks	a) Method is logically ordered to produce results b) Chooses range of data/observations that would test the hypothesis
		3–4 marks	a) Method is logically ordered to produce results and includes an explanation of why it would test the hypothesis b) Chooses range of data/observations that would test the hypothesis and explains why the range was chosen
Total marks	**20**		

Part B - Observations

Element	Marks		Criteria
Primary evidence and recording	4	0 marks	Collects no primary evidence
		1 mark	Records some data/observations that are appropriate for the topic
		2 marks	Collects a suitable range of data/observations and records some appropriately (depends on the practical)
		3 marks	Collects a suitable range of data/observations and records all appropriately (depends on the practical)
		4 marks	Collects a suitable range of data/observations and records all appropriately (depends on the practical) and records further/repeat data
Secondary evidence	2	0 marks	Collects no secondary evidence
		1 mark	Collects and records secondary evidence relevant to the hypothesis in a way appropriate for the topic
		2 marks	Collects and records secondary evidence relevant to the hypothesis in a way appropriate for the topic. Comments on the quality of the sources of secondary evidence
Total marks	**6**		

Part C - Conclusions

Element	Marks		Criteria
Processing evidence	4	0 marks	Evidence is not processed
		1–2 marks	a) Attempts to process all collected evidence, using appropriate mathematical skills b) Attempts to present the processed evidence in a way appropriate for the topic
		3–4 marks	a) Processes all collected evidence in a way that is appropriate to the task, using appropriate mathematical skills b) Presents processed evidence in a way that allows conclusions to be drawn
Quality of evidence	4	0 marks	Makes no comments on the quality of the evidence
		1–2 marks	a) Comments on the quality of the primary evidence, dealing with anomalies appropriately (if no anomalies in evidence candidates need to state this) b) Comments on the quality of the secondary evidence, dealing with anomalies appropriately (if no anomalies in evidence candidates need to state this)
		3–4 marks	a) Explains any adjustments to the evidence needed, or decision not to exclude evidence b) Takes account of anomalies in primary and secondary evidence when processing evidence (using all evidence if anomalies)

Element	Marks		Criteria
Conclusions based on evidence	6	0 marks	Makes no relevant conclusions
		1–2 marks	a) Provides a conclusion based on all collected evidence, but does not link it to the hypothesis b) Attempts to explain the conclusion using all collected evidence, including appropriate mathematical relationships
		3–4 marks	a) Provides a conclusion which refers to the hypothesis based on all collected evidence b) Explains the conclusion using the evidence, including appropriate mathematical relationships
		5–6 marks	a) Provides a conclusion which refers to the hypothesis based on all collected evidence and relevant scientific ideas b) Explains the conclusion using relevant scientific ideas and all collected evidence, including appropriate mathematical relationships
Evaluation of conclusion	4	0 marks	Makes no relevant evaluation
		1–2 marks	a) Evaluates conclusion based on all collected evidence b) Suggests how all collected evidence can be improved to provide stronger support for the conclusion
		3–4 marks	a) Evaluates conclusion based on all collected evidence and relevant scientific ideas b) Suggests how all collected evidence can be improved and extended to provide stronger support for the conclusion

Element	Marks		Criteria
Evaluation of method	6	0 marks	Makes no relevant evaluation
		1–2 marks	a) Identifies a strength or weakness in the method b) Suggests how to improve method and justifies comments made
		3–4 marks	a) Describes strengths or weaknesses in the method and reasons for any anomalies b) Suggests how to improve method and justifies comments made relating to the quality of the evidence collected (including reasons for anomalies)
		5–6 marks	a) Describes strengths and weaknesses in the method and relates them to the hypothesis, and reasons for any anomalies b) Suggests how to improve method, justifying comments made relating to the hypothesis and how better quality evidence could be produced (including reasons for any anomalies)
Total marks	**24**		

B Assessment

Assessment summary

Unit C1 is externally assessed by a one hour examination

Unit C2 is externally assessed by a one hour examination

Unit C3 is externally assessed by a one hour examination

Unit CCA is an internally assessed unit

Summary of table of assessment

Unit C1: Chemistry in our world	Unit code: 5CH1F/5CH1H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: November, March and June. • First assessment: November 2011.	

Unit C2: Discovering chemistry	Unit code: 5CH2F/5CH2H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: November, March and June. • First assessment: June 2012.	

Unit C3: Chemistry in action	Unit code: 5CH3F/5CH3H
• This unit is assessed through a one hour, 60 mark, tiered written examination, containing six questions. • The examination will contain a mixture of question styles, including objective questions, short answer questions and extended writing questions. • Availability: November, March and June. • First assessment: June 2013.	

Unit CCA: Chemistry controlled assessment	Unit code: 5CH04

- This unit is internally assessed under controlled conditions.
- There will be two tasks available each year – one task from C2 and one task from C3.
- Each task has a shelf life of one year.
- The tasks will be available to teachers one year in advance.
- Each task has three parts - Part A: Planning, Part B: Observations and Part C: Conclusions.
- The total number of marks available for the three parts is 50.
- Students must attempt all three parts of a task.
- If they attempt both tasks, then the best marks from Part A, B and C should be submitted for the unit.
- Availability: November and June.
- First assessment: June 2013.

Assessment Objectives and weightings

		% in GCSE
AO1:	Recall, select and communicate their knowledge and understanding of chemistry	**33 – 39%**
AO2:	Apply skills, knowledge and understanding of science in practical and other contexts	**34 – 40%**
AO3:	Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence	**25.5 – 28.5%**
	TOTAL	**100%**

Relationship of Assessment Objectives to units

Unit	Assessment Objective			
	AO1	**AO2**	**AO3**	**Total for AO1, AO2 and AO3**
Unit C1: Chemistry in our world	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit C2: Discovering chemistry	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit C3: Chemistry in action	11 – 13%	7 – 9%	4.5 – 5.5%	25%
Unit CCA: Chemistry controlled assessment	0%	13%	12%	25%
Total for GCSE in Chemistry	**33 – 39%**	**34 – 40%**	**25.5 – 28.5%**	**100%**

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *Information Manual*; a copy is sent to all examinations officers. The information can also be found on Edexcel's website (www.edexcel.com).

There is a requirement that at least 40 per cent of the assessment must be taken in the examination series in which certification is requested. The final qualification grade will include assessment results which satisfy this terminal requirement.

All externally assessed units will be assessed by tiered examinations. Students will need to be entered for a specific tier at the time of entry.

Forbidden combinations and classification code

Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Students should be advised that, if they take two qualifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if students take two GCSE qualifications that have different classification codes but have significant overlap of content. Students who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE and Entry Level aims to enhance access to the qualifications for students with disabilities and other difficulties (as defined by the Disability Discrimination Act 1995 and the amendments to the Act) without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Edexcel website (www.edexcel.com) for:

- the JCQ policy Access Arrangements and Special Considerations, Regulations and Guidance Relating to Students who are Eligible for Adjustments in Examinations
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Disability Discrimination Act (DDA)

Please see the Edexcel website (www.edexcel.com) for information with regard to the Disability Discrimination Act.

Controlled assessment

In controlled assessments, control levels are set for three linked processes: task setting, task taking and task marking. The control levels (high, medium or limited are dependent on the subject) are set for each process so that the overall level of control secures validity and reliability, provides good manageability for all involved and allows teachers to authenticate the student work confidently.

The summary of the controlled conditions for this qualification is shown below.

Summary of conditions for controlled assessment

Levels of control

Internal assessment under controlled conditions has levels of control for task setting, task taking and task marking. These must be adhered to when students are completing their controlled assessment tasks.

Summary of levels of control

Area	Level of control
Part A – Planning	Limited
Part B – Observations	Limited
Part C – Conclusions	High

Task setting

High level of control

A high level of control means that tasks will be set by Edexcel and centres will choose from a list of tasks from the other units in this qualification.

When will the tasks be available?

They will be available on the Edexcel website for teachers to download a year ahead of their first assessment opportunity. Teachers can view all the task sheets available before deciding which task the students will complete.

When should the tasks be made available to students?

The task sheets for this controlled assessment are confidential and must not be shown to students before they start the tasks. Task sheets should not be shown to students until the start of the task planning stage of the controlled assessment.

Do all my students have to do the same task?

It is acceptable for all the students in a class to complete the same task. However, the same task does not have to be chosen for all students and they can work on a mixture of different tasks from C2 and C3.

The tasks will change every year, in accordance with the Ofqual regulations for GCSE Science. Teachers must take care when using these tasks to ensure that students are completing the correct task for a particular year. The front sheet of each task will show the dates for which it is valid.

Task taking

a Research and data collection – limited level of control

Research and data collection, including practical work, will be carried out under limited control. This means that students may work collaboratively when collecting data from practical activities.

Students may carry out any secondary research whilst not being directly supervised by a teacher, for example in a library or at home. The secondary research can include extracts from books and websites.

b Analysis, conclusions and evaluation of findings – high level of control

The analysis, conclusions and evaluation will be produced by students under high levels of control. This means that this part of the write-up must be carried out individually by the students, under the supervision of a teacher.

The production of the final report will usually take place over several lessons, so the students' materials must be collected in at the end of the lesson and handed back at the beginning of the next one. Students' final reports must be produced individually.

Task marking

Task marking – medium level of control

A medium level of control means that the marking of the tasks will be carried out by teachers and moderated by Edexcel.

Internal standardisation

Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.

Authentication

All students must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those that relate to sampled students must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any student unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.

Further information

For more information on annotation, authentication, mark submission and moderation procedures, please refer to the *Edexcel GCSEs in Science, Additional Science, Biology, Chemistry and Physics: Instructions and administrative documentation for internally assessed units* document, which is available on the Edexcel website.

For up-to-date advice on teacher involvement, please refer to the Joint Council for Qualifications (JCQ) *Instructions for conducting coursework/portfolio document* on the JCQ website (www.jcq.org.uk).

For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications (JCQ) *Suspected Malpractice in Examinations: Policies and Procedures and Instructions for conducting coursework/portfolio* document on the JCQ website (www.jcq.org.uk).

Assessing your students

The first assessment opportunity for Unit C1 of this qualification will take place in the November 2011 series and in each following March, June and November series for the lifetime of the qualification. The first assessment opportunity for Unit C2 will be in June 2012, Unit C3 will be in June 2013 and then in each following November, March and June series for the lifetime of the qualification. The first assessment opportunity for Unit CCA of this qualification will take place in the June 2013 series and in each following November and June series for the lifetime of the qualification.

Your student assessment opportunities

GCSE in Chemistry

Unit	Nov 2011	March 2012	June 2012	Nov 2012	March 2013	June 2013	Nov 2013	March 2014
Unit C1: Chemistry in our world	✓	✓	✓	✓	✓	✓	✓	✓
Unit C2: Discovering chemistry			✓	✓	✓	✓	✓	✓
Unit C3: Chemistry in action						✓	✓	✓
Unit CCA: Chemistry Controlled Assessment						✓	✓	

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The GCSE qualification will be graded and certificated on an eight-grade scale from A* to G. Individual unit results will be reported.

The first certification opportunity for the Edexcel GCSE in Chemistry will be in 2013.

Students whose level of achievement is below the minimum judged by Edexcel to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Unit results

The minimum uniform marks required for each grade for each unit:

All units

Unit grade	A*	A	B	C	D	E	F	G
Maximum uniform mark = 80	72	64	56	48	40	32	24	16

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–15.

Qualification results

The minimum uniform marks required for each grade:

GCSEs in Chemistry Cash-in code: 2CH01

Qualification grade	A*	A	B	C	D	E	F	G
Maximum uniform mark = 320	288	256	224	192	160	128	96	64

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–63.

Resitting of units

Students can resit a unit once (regardless of tier) before claiming certification for the qualification. For internally assessed units students will need to retake the entire assessment requirements for that unit.

At least 40 per cent of the assessment must be taken in the examination series in which certification is requested and the results from these assessments must be used. Therefore, any previous, banked results for the unit(s) that are being used to satisfy the terminal requirement cannot be used even if they are better than the results achieved in the terminal series.

Results of units held in Edexcel's unit bank have a shelf-life limited only by the shelf-life of this qualification and, subject to the terminal requirement, these unit results may be re-used after certification.

Language of assessment

Assessment of this qualification will be available in English only. Assessment materials will be published in English only and all work submitted for examination and moderation must be produced in English.

Quality of written communication

Students will be assessed on their ability to:

- write legibly, with accurate use of spelling, grammar and punctuation, in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate.

Stretch and challenge

Students can be stretched and challenged in units through the use of different assessment strategies, for example:

- using a variety of stems in questions – for example analyse, evaluate, discuss, compare, describe, explain
- ensuring connectivity between sections of questions
- a requirement for extended writing
- use of a wider range of question types to address different skills – for example open-ended questions, case studies, etc.

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications (JCQ) *Suspected Malpractice in Examinations: Policies and Procedures* document on the JCQ website (www.jcq.org.uk).

Student recruitment

Edexcel's access policy concerning recruitment to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Progression

- Students who successfully achieve this GCSE in Chemistry can progress onto a number of qualifications, such as the Level 3 GCE in Chemistry.
- Students could also progress onto an Edexcel BTEC Level 3 Applied Science qualification.
- Students could also progress into employment.

Grade descriptions

Chemistry

A	Students recall, select and communicate precise knowledge and detailed understanding of chemistry. They demonstrate a comprehensive understanding of the nature of chemistry, its laws, principles and applications, and the relationship between chemistry and society. They understand the relationships between scientific advances, their ethical implications and the benefits and risks associated with them. They use scientific and technical knowledge, terminology and conventions appropriately and consistently showing a detailed understanding of scale in terms of time, size and space. They apply appropriate skills, including mathematical, technical and observational skills, knowledge and understanding effectively in a wide range of practical and other contexts. They show a comprehensive understanding of the relationships between hypotheses, evidence, theories and explanations, and make effective use of models, including mathematical models, to explain abstract ideas, phenomena, events and processes. They use a wide range of appropriate methods, sources of information and data consistently, applying relevant skills to address scientific questions, solve problems and test hypotheses. Students analyse, interpret and critically evaluate a broad range of quantitative and qualitative data and information. They evaluate information systematically to develop arguments and explanations taking account of the limitations of the available evidence. They make reasoned judgements consistently and draw detailed, evidence-based conclusions.
C	Students recall, select and communicate secure knowledge and understanding of chemistry. They demonstrate understanding of the nature of chemistry, its laws, principles and applications, and the relationship between chemistry and society. They understand that scientific advances may have ethical implications, benefits and risks. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space. They apply appropriate skills, including mathematical, technical and observational skills, knowledge and understanding, in a range of practical and other contexts. They show understanding of the relationships between hypotheses, evidence, theories and explanations, and use models, including mathematical models, to describe abstract ideas, phenomena, events and processes. They use a range of appropriate methods, sources of information and data, applying their skills to address scientific questions, solve problems and test hypotheses. Students analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand the limitations of evidence and use evidence and information to develop arguments with supporting explanations. They draw conclusions based on the available evidence.

F	Students recall, select and communicate limited knowledge and understanding of chemistry. They recognise simple inter-relationships between chemistry and society. They show a limited understanding that scientific advances may have ethical implications, benefits and risks. They use limited scientific and technical knowledge, terminology and conventions, showing some understanding of scale in terms of time, size and space. They apply skills, including limited mathematical, technical and observational skills, knowledge and understanding, in practical and some other contexts. They recognise and use hypotheses, evidence and explanations, and can explain straightforward models of phenomena, events and processes. They use a limited range of methods, sources of information and data to address straightforward scientific questions, problems and hypotheses. Students interpret and evaluate limited quantitative and qualitative data and information from a narrow range of sources. They can draw elementary conclusions having collected limited evidence.

C Resources, support and training

Edexcel resources

Edexcel aims to provide the most comprehensive support for our qualifications.

Edexcel publications

You can order further copies of the specification, Sample Assessment Materials (SAMs) and Teacher's Guide documents from:

Edexcel Publications
Adamsway
Mansfield
Nottinghamshire NG18 4FN

Telephone: 01623 467 467
Fax: 01623 450 481
Email: publications@linney.com
Website: www.edexcel.com

Endorsed resources

Edexcel also endorses some additional materials written to support this qualification. Any resources bearing the Edexcel logo have been through a quality assurance process to ensure complete and accurate support for the specification. For up-to-date information about endorsed resources, please visit www.edexcel.com/endorsed.

Please note that while resources are checked at the time of publication, materials may be withdrawn from circulation and website locations may change.

Edexcel support services

Edexcel has a wide range of support services to help you implement this qualification successfully.

ResultsPlus – ResultsPlus is an application launched by Edexcel to help subject teachers, senior management teams and students by providing detailed analysis of examination performance. Reports that compare performance between subjects, classes, your centre and similar centres can be generated in just a few clicks. Skills maps that show performance according to the specification topic being tested are available for some subjects. For further information about which subjects will be analysed through ResultsPlus, and for information on how to access and use the service, please visit www.edexcel.com/resultsplus.

Ask the Expert – To make it easier for you to raise a query with us online, we have merged our **Ask Edexcel** and **Ask the Expert** services.

There is now one easy-to-use web query form that will allow you to ask any question about the delivery or teaching of Edexcel qualifications. You'll get a personal response, from one of our administrative or teaching experts, sent to the email address you provide.

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database, so you'll be able to find answers to many questions you might have by searching before you submit the question to us.

Examzone – The Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including re-marking, resitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses covering various aspects of the specification and examination will be arranged by Edexcel each year on a regional basis. Full details can be obtained from:

Training from Edexcel
Edexcel
One90 High Holborn
London WC1V 7BH

Telephone: 0844 576 0027
Email: trainingbookings@edexcel.com
Website: www.edexcel.com

D Appendices

Appendix 1: Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	1110
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The NQF code is known as a Qualification Number (QN). This is the code that features in the DfE Funding Schedule, Sections 96 and 97, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QN for the qualification in this publication is: GCSE in Chemistry – 600/0799/0
Unit codes	Each unit is assigned a unit code. This unit code is used as an entry code to indicate that a student wishes to take the assessment for that unit. Centres will need to use the entry codes only when entering students for their examination.	Unit C1 – 5CH1F/5CH1H Unit C2 – 5CH2F/5CH2H Unit C3 – 5CH3F/5CH3H Unit CCA – 5CH04
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's unit scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	GCSE in Chemistry – 2CH01
Entry codes	The entry codes are used to: • enter a student for the assessment of a unit • aggregate the student's unit scores to obtain the overall grade for the qualification.	Please refer to the *Edexcel Information Manual*, available on the Edexcel website.

Appendix 2: How Science Works mapping

How Science Works reference *(see page 10)*	Unit C1 specification reference
1	1.3, 1.7, 1.9, 2.11, 2.16, 3.3, 3.7, 4.4, 5.16, 5.24, 5.31
2	1.8, 3.3, 5.16, 5.24
3	1.1, 1.4, 1.5, 1.6, 1.9, 2.1, 2.3, 2.10, 2.13, 2.16, 4.3, 4.5, 4.8, 4.11, 5.3, 5.5, 5.16, 5.26, 5.28, 5.30, 5.34
4	1.3, 2.8, 5.16
5	1.7, 2.9, 2.11, 2.16, 3.3, 3.4, 3.7, 4.4, 5.24
6	1.7, 2.1, 2.9, 2.11, 2.14, 2.16, 2.17, 3.3, 3.4, 3.7, 3.8, 3.9, 3.14, 4.4, 4.9, 5.3, 5.6, 5.7, 5.20, 5.24, 5.29, 5.31
7	0.4, 0.5, 1.7, 2.9, 2.11, 2.14, 2.16, 3.3, 3.4, 3.7, 3.9, 4.4, 5.3, 5.7, 5.20, 5.24, 5.29, 5.32
8	1.7, 2.9, 2.11, 2.16, 2.17, 3.3, 3.4, 3.7, 4.4, 5.24
9	Throughout the unit
10	0.2, 0.3, 1.7, 2.16, 2.17, 3.3, 3.4, 3.7, 4.4, 4.10, 4.13, 5.16, 5.20, 5.24, 5.30, 5.31
11	0.1, 0.2, 0.3, 0.5, 1.7, 2.8, 2.11, 3.3, 3.7, 4.4, 5.16, 5.19, 5.24, 5.28, 5.36
12	2.8, 2.9, 2.17, 2.18, 3.2, 3.3, 3.11, 3.12, 4.2, 4.6, 4.7, 4.9, 4.10, 4.11, 4.12, 4.13, 4.14, 5.1, 5.3, 5.4, 5.10, 5.14, 5.15, 5.16, 5.17, 5.18, 5.19, 5.21, 5.22, 5.23, 5.30, 5.31, 5.35, 5.36, 5.37
13	1.9, 2.8, 2.9, 2.17, 4.9, 5.1, 5.14, 5.15, 5.16, 5.17, 5.18, 5.19, 5.22, 5.36, 5.37
14	1.9, 2.13, 5.14, 5.15, 5.16, 5.17, 5.37

How Science Works reference *(see page 10)*	Unit C2 specification reference
1	1.1, 2.12, 2.13, 2.15, 3.4, 3.10, 4.12, 4.15, 5.1, 5.7, 6.3
2	1.1, 1.2, 1.3, 1.9, 1.12, 2.12, 2.15, 3.4, 3.11, 4.8, 4.12, 4.15, 4.17, 5.1, 5.7, 6.3
3	1.3, 1.4, 1.5, 1.9, 1.10, 1.12, 1.13, 2.2, 2.7, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 4.2, 4.14, 4.15, 5.6, 5.10, 5.11
4	
5	2.12, 2.13, 3.4, 4.12, 4.15, 5.1, 5.7, 6.3
6	2.12, 3.4, 3.10, 3.11, 4.12, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5
7	0.4, 0.5, 2.11, 2.12, 3.4, 4.12, 5.1, 5.7, 6.3
8	2.12, 3.4, 4.12, 5.1, 5.7, 6.3
9	Throughout the unit
10	0.2, 0.3, 1.8, 1.10, 2.6, 2.9, 2.12, 3.4, 3.10, 4.4, 4.5, 4.12, 4.17, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8
11	0.1, 0.2, 0.3, 0.5, 1.12, 2.2, 2.4, 2.5, 2.8, 2.12, 3.3, 3.4, 4.12, 4.17, 5.1, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8
12	2.14, 2.16, 3.11, 4.15, 4.16, 5.13, 6.9, 6.10, 6.11
13	5.13, 6.9, 6.10, 6.11
14	1.1, 1.3, 1.10, 2.5, 2.15, 4.15

How Science Works reference *(see page 10)*	Unit C3 specification reference
1	1.3, 1.4, 2.6, 2.14, 3.8, 3.12, 5.2, 5.9
2	1.4, 2.6, 2.7, 2.14, 3.8, 3.12, 4.1, 5.9
3	2.4, 2.7, 3.2, 3.11, 4.7, 4.8, 4.9, 4.10, 5.10, 5.14, 5.17, 5.19
4	5.4
5	1.4, 2.6, 2.10, 2.11, 2.13, 2.14, 3.8, 3.12, 5.2
6	1.4, 2.1, 2.6, 2.14, 3.8, 3.12
7	0.5, 0.6, 1.4, 2.6, 2.14, 3.8, 3.12
8	1.4, 2.6, 2.14, 3.8, 3.12, 4.2, 5.2
9	Throughout the unit
10	0.2, 0.3, 0.4, 1.4, 2.1, 2.6, 2.7, 2.8, 2.9, 2.14, 2.15, 3.5, 3.8, 3.12, 4.1, 4.2, 4.3, 5.2
11	0.1, 0.2, 0.3, 0.4, 1.4, 2.1, 2.6, 2.7, 2.8, 2.9, 2.14, 2.15, 3.3, 3.4, 3.5, 3.8, 3.12, 4.1, 4.2, 4.3, 5.2, 5.10, 5.14, 5.17
12	1.5, 2.3, 2.5, 3.6, 3.7, 3.13, 3.14, 4.4, 4.5, 4.10, 5.4, 5.6, 5.7, 5.12, 5.15, 5.16, 5.18, 5.20
13	1.5, 4.5, 4.10, 5.4, 5.7, 5.16
14	2.7, 4.1, 4.5, 5.4, 5.10

Appendix 3: Mathematical skills mapping

Mathematical skills reference *(see page 11)*	Unit specification reference		
	C1	C2	C3
1	1.7, 2.11, 2.16, 3.3, 3.7, 5.5, 5.14, 5.15, 5.24	1.8, 1.9, 1.11, 2.4, 3.4, 5.1, 5.7, 6.1, 6.3	2.1, 2.6, 2.14, 2.15, 3.12, 4.1, 4.2, 4.3
2		1.4, 1.11, 4.17, 6.1, 6.3, 6.4, 6.8	2.1, 2.6, 2.8, 2.9, 2.15, 3.12
3		1.11, 4.17, 5.7, 6.1, 6.2, 6.3, 6.4, 6.5, 6.8	2.1, 2.8, 2.9, 2.14, 2.15, 4.2, 4.3
4		1.8, 1.10, 1.11, 6.8	2.1, 2.8, 2.9, 2.14, 2.15
5			
6	0.2, 0.3, 1.7, 2.11, 2.16, 3.3, 3.7, 5.24	0.2, 0.3, 1.8, 4.9, 5.7, 6.1, 6.3, 6.4	0.2, 0.3, 0.4, 3.5
7	1.7, 3.3, 3.7, 5.24	5.1, 5.7, 6.3	2.14, 2.15
8	1.7, 5.14, 5.15, 5.24	5.1, 5.7	2.1, 2.7, 2.14, 2.15, 3.12
9	3.3, 3.7, 5.24	3.4, 4.12, 5.1, 5.6, 5.7	3.12
10			2.1, 2.8, 2.9, 2.15, 3.12, 4.2, 4.3
11	1.7, 1.8, 3.3, 3.7, 5.14, 5.15, 5.16, 5.24	3.4, 4.12, 4.17, 5.1, 5.6, 5.7	3.12
12	1.7, 1.8, 3.3, 3.7, 5.14, 5.15, 5.16, 5.24, 5.31	1.8, 1.11, 3.4, 4.8, 4.12, 4.13, 4.17, 5.1, 5.7, 6.3	3.12
13			
14		1.4	
15	1.7	1.4	
16	1.7, 4.13	5.7	
17			2.1, 2.8, 2.9, 2.15, 3.12, 4.2, 4.3
18			
19			

Appendix 4: The periodic table of the elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantaium 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **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	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenicated						

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relevant atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Appendix 5: Controlled Assessment Record Sheet

Centre Name:	Centre Number:
Teacher Name:	Qualification Number:
Qualification Title:	Examination Series:
Candidate Name:	Candidate Number:

One mark is required for each of the areas shown in Part A, Part B and Part C. The marks can either be for Part A, Part B and Part C from the same task or from different tasks relating to Units C2/C3 for this GCSE. Centres must retain all parts of the task for moderation.

Part A – Planning			**Part B – Observations**			**Part C – Conclusions**		
Marks from	**C2 / C3** delete as appropriate		**Marks from**	**C2 / C3** delete as appropriate		**Marks from**	**C2 / C3** delete as appropriate	
Area	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**	**Area**	**Centre mark awarded**	**Max. mark**
Equipment		**2**	**Primary evidence and recording**		**4**	**Processing evidence**		**4**
Controls		**6**	**Secondary evidence**		**2**	**Quality of evidence**		**4**
Hypothesis		**4**						
Risks		**4**				**Conclusions based on evidence**		**6**
Overall plan		**4**				**Evaluation of conclusion**		**4**
						Evaluation of method		**6**
Total		**20**	**Total**		**6**	**Total**		**24**
Total for Unit CCA: Chemistry controlled assessment								

Declaration of authentication

I declare that the work submitted for assessment is my own work and has been carried out without assistance, other than that which is acceptable under the scheme of assessment.

Candidate signature _____

Teacher signature _____

Date final record sheet signed _____

By signing the above declaration, you agree to your controlled assessment task(s) being used to support Professional Development, Online Support and Training of both Centre-Assessors and Edexcel Moderators. If you have any concerns regarding this, please contact Science2011@edexcel.com.

Appendix 6 Certification, cash-in, transfer rules and entry code for transferring units

Certification and cash-in rules

Certification for the GCSE in Chemistry may be claimed in March, June or November, providing all of the contributing units have been entered and assessed and at least 40 per cent of the assessment has been taken in that examination series.

Students may also cash in for any of the other four science qualifications in the same examination series.

Externally assessed components

There is one unit code for any common external units.

The result of an external unit can only count towards one qualification. For example, if the result for 5CH1F (Unit 1 foundation tier) is used towards GCSE in Chemistry (2CH01), this same unit result cannot be used towards GCSE in Science (2SC01), or vice versa.

Transfer rules

If a student wishes to claim certification for GCSE in Chemistry **and** GCSE in Additional Science then the student must take the relevant external units for the two qualifications.

For the internal unit, a student's result from GCSE in Chemistry to GCSE in Additional Science and vice versa may be transferred providing the work submitted meets the requirements for the appropriate qualification.

A transfer can only be made once a centre can confirm this. If the requirement is not met for the second qualification then the student will need to do a new controlled assessment task.

Example 1: transferring the Chemistry internal unit result to Additional Science

If a student wishes to use the unit result from Unit CCA in the GCSE Chemistry qualification (2CH01) towards Unit ASCA of the GCSE in Additional Science qualification (2SA01), then this is acceptable but only if the CCA unit result uses marks **only** from the C2 controlled assessment. If the CCA unit result uses any marks from C3, then the result **cannot** be transferred to GCSE in Additional Science, Unit ASCA.

Example 2: transferring an Additional Science unit result to Chemistry

If a student wishes to use the unit result from Unit ASCA in the GCSE Additional Science qualification (2SA01) towards Unit CCA of the GCSE in Chemistry qualification (2CH01), then this is acceptable but only if the ASCA unit result uses marks **only** from the C2 controlled

assessment. If the ASCA unit result uses any marks from B2 and/or P2, then the result **cannot** be transferred to GCSE in Chemistry, Unit CCA.

Transfer of a unit result

When a transfer is being requested for a unit result the following must be done by the Centre

- make the correct entry code
- provide evidence to Edexcel that the controlled assessment fulfils the requirements for the other qualification.

Evidence to support transfer of a unit result

Centres are advised to check before requesting a transfer that they have a copy of the record sheet of the original work. Although entries will be accepted for a transfer, if it is found that a centre has not provided a copy of the record sheet then the transfer request will **not** be granted.

If a centre requests the transfer of a controlled assessment unit result, the centre will need to provide a hardcopy or a scanned copy of the original record sheet to Edexcel to show that the work fulfils the rules for the second qualification.

The deadline for submission of this evidence is the same as the deadline for submission of controlled assessment work.

Please send a hardcopy of the record sheet to:

Edexcel
Lowton House
Lowton Way
Hellaby
Rotherham
South Yorkshire
S66 8SS

Or email a scanned copy to: Science2011@edexcel.com

Entry codes for transferring units

The following entry codes should be used when transferring the unit results for the internal controlled assessed unit.

Entry code	When it should be used
5SA0T/01	When the unit result for a separate science is transferred towards a qualification in GCSE in Additional Science (2SA01)
5BI0T/01 5CH0T/01 5PH0T/01	When the unit result for 5SA04 is transferred towards a qualification in GCSE in Biology (2BI01), GCSE in Chemistry (2CH01) or GCSE in Physics (2PH01)

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Contact us

If you have questions regarding any aspect of this specification, please contact our Science Subject Advisor, Stephen Nugus, or the Science team.

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