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IGCSE

Chemistry

Teacher's guide

Edexcel IGCSE in Chemistry (4CH0)

First examination 2011

Issue 2

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This teacher's guide is Issue 2. Key changes are sidelined. We will inform centres of any changes to this issue. The latest issue can be found on the Edexcel website: www.edexcel.com

Acknowledgements

This guide has been produced by Edexcel on the basis of consultation with teachers, examiners, consultants and other interested parties. Edexcel would like to thank all those who contributed their time and expertise to its development.

Authorised by Roger Beard
Prepared by Phil Myers

Introduction

The Edexcel International General Certificate of Secondary Education (IGCSE) in Chemistry is designed for schools and colleges. It is part of a suite of IGCSE qualifications offered by Edexcel.

About this guide

This guide is for teachers who are delivering, or planning to deliver, the Edexcel IGCSE in Chemistry qualification. The guide supports you in delivering the course content and explains how to raise the achievement of your students. The guide:

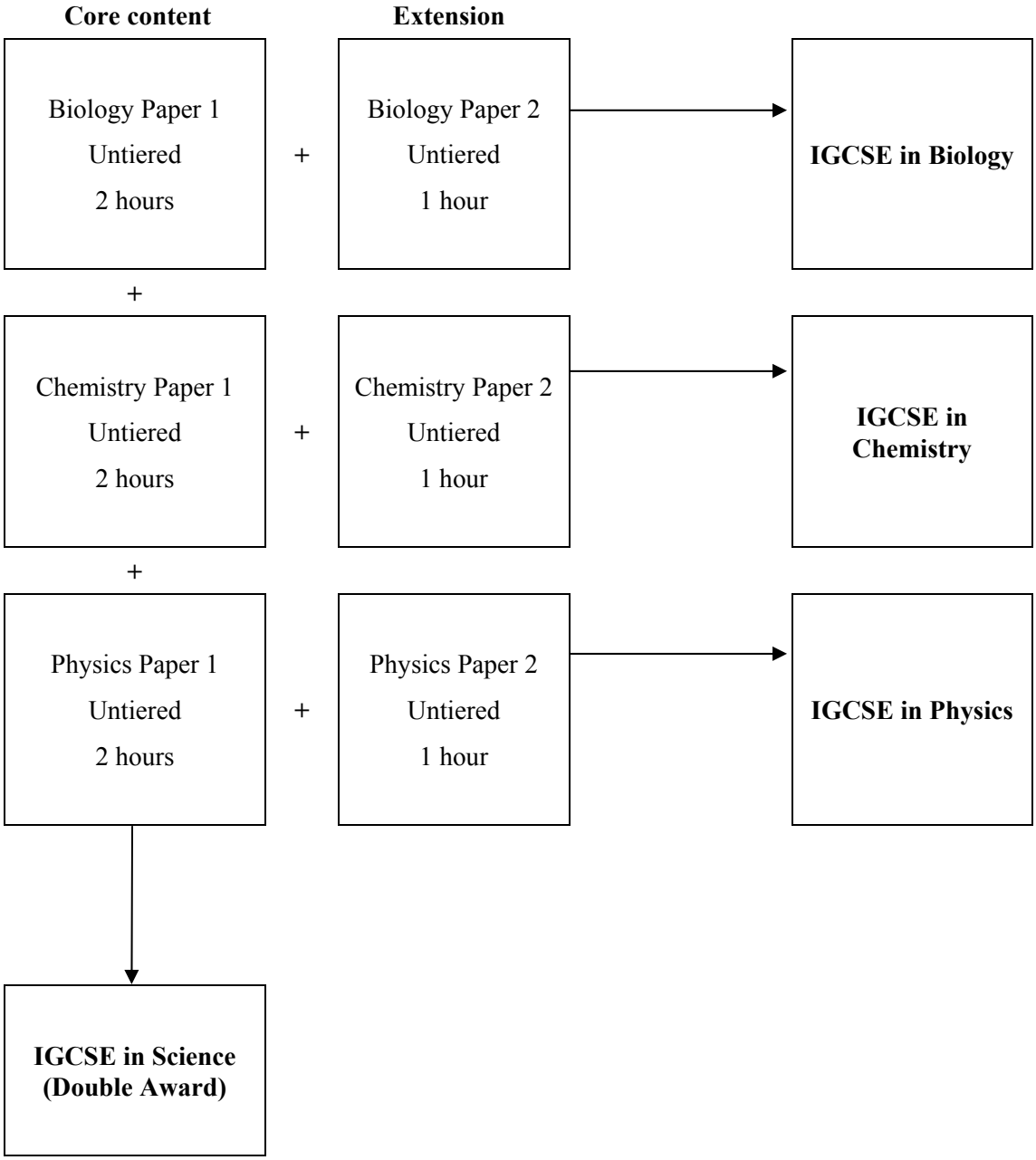
- gives essential information on the changes between this qualification and the existing Edexcel and other international qualifications in the subject
- provides details of Assessment Objectives (AO) and criteria
- includes a list of command words that are directly linked to the Assessment Objectives
- gives you an example course planner
- provides experimental and investigative work that should be incorporated into teaching
- offers you suggestions for a range of textbooks and other resources.

Contents

Why choose this qualification?

The Edexcel International General Certificate in Secondary Education (IGCSE) in Chemistry is designed for use in schools and colleges. It is part of the IGCSE suite of science qualifications offered by Edexcel. The course offers the opportunity for students to experience chemistry within the context of their general education. The course provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level Chemistry.

The relationship between assessment and the qualifications available is shown below.



Go to www.edexcel.com/igcse2009 for more information about this IGCSE and related resources.

Support from Edexcel

We are dedicated to giving you exceptional customer service. Details of our main support services are given below. They will all help you to keep up to date with IGCSE 2009.

Website

Our dedicated microsite www.edexcel.com/igcse2009 is where you will find the resources and information you need to successfully deliver IGCSE qualifications. To stay ahead of all the latest developments visit the microsite and sign up for our email alerts.

Ask Edexcel

Ask Edexcel is our free, comprehensive online enquiry service. Use Ask Edexcel to get the answer to your queries about the administration of all Edexcel qualifications. To ask a question please go to www.edexcel.com/ask and fill out the online form.

Ask the Expert

This free service puts teachers in direct contact with over 200 senior examiners, moderators and external verifiers who will respond to subject-specific queries about IGCSE 2009 and other Edexcel qualifications.

You can contact our experts via email or by completing our online form. Go to www.edexcel.com/asktheexpert for contact details.

Regional offices

If you have any queries about the IGCSE 2009 qualifications, or if you are interested in offering other Edexcel qualifications your Regional Development Manager can help you. Go to www.edexcel.com/international for details of our regional offices.

Head Office — London

If you have a question about IGCSE 2009 and are not sure who to ask, email us on IGCSE2009@edexcel.com or call our Customer Services Team on +44 (0) 1204770696.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination is available. Go to www.edexcel.com for details.

Section A: Qualification content

Information for Edexcel centres

As our focus has been to retain the features of our successful legacy IGCSE in Chemistry (4335) qualification, we've made as few changes as possible. The changes we have made are listed below.

- Action verbs in the specification have been revised to be more appropriate.
- Sections on the Group 2 elements of the periodic table, and *transition metals: iron and copper* have been removed.
- Tests for cations using ammonia have been removed.
- The section on ethanol has been removed from the core and is in IGCSE Chemistry only.
- Emboldened content is in IGCSE Chemistry only.
- Tiers have been removed.
- Investigative skills are embedded throughout.

Comparison of the content from the Cambridge International Examinations (CIE) IGCSE in chemistry (0620) to this qualification

Adapting from teaching the Cambridge International Examinations (CIE) course is simplified, as much of the content of the CIE and Edexcel specifications is common. Resources that are suitable for the CIE IGCSE will, therefore, also cover most of the Edexcel IGCSE. The additional content of the Edexcel course (particularly the quantitative work) will be covered by many of the textbooks available at this level. Schools currently teaching the CIE IGCSE should be able to continue with the same schemes of work as long as they are modified to reflect the changes in content.

The inclusion of topics such as *dynamic equilibria, energy changes, properties related to structure and the mole concept* ensures that the Edexcel IGCSE can form a solid base from which students can go on to study chemistry at GCE level.

The table below shows how the content of the legacy CIE IGCSE in Chemistry qualification (0620) maps to this qualification.

Legacy CIE content (0620)	This qualification content reference	Comment	
		Deleted content	Additional content
1 – Particulate nature of matter	1.1; 1.2; 1.3; 1.4		
2 – Experimental techniques	1.7		
3 – Atoms, elements and compounds	1.8; 1.9; 1.10; 1.11; 1.12; 1.13; 1.14 1.5; 1.6; 1.27; 1.29; 1.30; 1.31; 1.32; 1.33; **1.34**; **1.35**; **1.36**; 1.37; 1.38; 1.39; 1.40; 1.41; 1.42; **1.43**; **1.44**; 1.45; 1.46	No knowledge of radioactivity is required	Calculation of A_r, explanations of properties related to structure
4 – Stoichiometry	1.20; 1.21 **1.17**; 1.18; 1.19; 1.15; 1.16; 1.22; 1.23; 1.24; **1.25**; 1.26;	Percentage purity	Mole concept included in both Chemistry (4CH0) and Double Award Science (4SC0)
5 – Electricity and chemistry	1.47; 1.48; 1.49; 1.50; 1.51; 1.52; 1.53; 1.54; **1.55**; **1.56**; 5.2; 5.3; **5.28**; **5.29**; **5.30**;	Reactive electrodes; electroplating	The Faraday; use of Q=It
6 – Chemical changes	4.10; 4.11; **4.12**; 4.13; 4.14; 4.15; **4.16**	Electrochemical cells, nuclear power	Calculation of ΔH; energy level diagrams
7 – Chemical reactions	4.17; 4.18; 4.19; 4.20; 4.21 4.22; 4.23; 4.24; 4.25 1.28; 2.33; 2.34	Enzymes, the effect of light on rate – silver salts in photography and photosynthesis, $KMnO_4$ in redox reactions.	Activation energy and reaction profiles, concept of dynamic equilibrium is required.
8 – Acids, bases and salts	4.1; 4.2; 4.3; 4.4; 4.5; 2.26 2.19; 2.3 4.6; 4.7; 4.8; 4.9 2.38; 2.39; 2.40	Weak and strong in terms of ionisation; soil acidity; amphoteric oxides identification of Al^{3+}; Zn^{2+}; the use of $NH_3(aq)$ with metal ions; the use of $Pb(NO_3)_2$ for iodide	Titrations flame tests Br^- and I^- using $AgNO_3(aq)$

Legacy CIE content (0620)	This qualification content reference	Comment	
		Deleted content	Additional content
9 – Periodic table	2.1; 2.2; 2.4; 2.5; 2.6; 2.7; **2.8**; 2.9; 2.10; 2.11; 2.12; 2.13; 2.14; 2.15	Transition elements; uses of noble gases	Explanation of reactivity trend in group 1; hydrogen chloride dissolved in both water and methylbenzene
10 — Metals	**1.46**; 2.30; 2.31; 2.32; 5.1; 5.4; 5.5	Thermal decomposition of hydroxides and nitrates; apparent unreactivity of aluminium; zinc extraction; uses of copper; steels	
11 – Air and water	2.27; 2.28; 2.29; 2.16; 2.17; 2.18; 2.20; 2.21; 2.22; 2.23; 2.24; 2.25; 2.35; 2.36; 2.37; 5.11; 5.21; 5.22; 5.23; 5.24	Water supply; lead from cars; catalytic converters in cars; uses of oxygen; fractional distillation of air; the need for fertilisers	Laboratory preparation; properties and uses of CO_2
12 – Sulphur	**5.25**; **5.26**; **5.27**	Sources of sulphur; uses of sulphur dioxide	
13 – Carbonates	2.21	Lime manufacture and uses	Limited to thermal decomposition of metal carbonates (such as $CuCO_3$)
14 – Organic chemistry	3.1; 3.2; 3.3; 3.4; 3.5; 3.6; 3.7; 3.8; **3.9**; **3.10**; **3.11**; **3.12;** 5.6; 5.7; 5.8; 5.9; 5.10; 5.12; 5.13; 5.14; 5.15; 5.16; **5.17**; **5.18**; **5.19**; **5.20**	Coal ethanoic acid esters polyesters natural macromolecules	Dehydration of ethanol.

Numbers in **bold** relate to specification statements that are examined only in Paper 2.

Section B: Assessment

This section describes the nature of assessment for this qualification, including the logistics of examinations and what you can expect from the Edexcel examination papers.

Assessment overview

The table below gives an overview of the assessment.

We recommend that you make this information available to students to help ensure they are fully prepared and know exactly what to expect in each assessment.

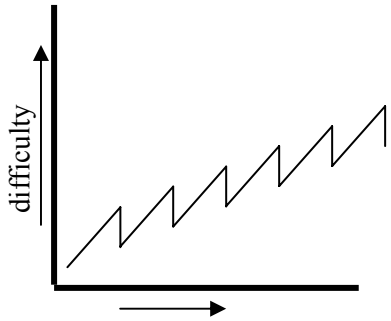
Paper	Percentage	Marks	Time	Availability
Chemistry Paper 1	$66\frac{2}{3}$	120	2 hours	January and June examination series First assessment June 2011
Paper	**Percentage**	**Marks**	**Time**	**Availability**
Chemistry Paper 2	$33\frac{1}{3}$	60	1 hour	January and June examination series First assessment June 2011

Assessment Objectives and weightings

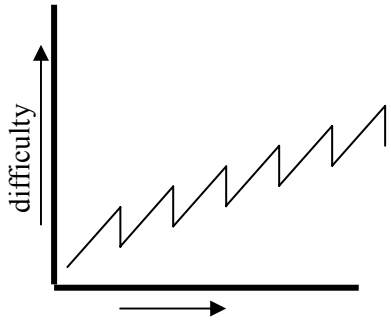
	% in IGCSE
A01: Knowledge and understanding	45-55%
A02: Application of knowledge and understanding, analysis and evaluation	25-35%
A03: Investigative skills	20%
TOTAL	**100%**

Assessment summary

Paper 1	Description	Knowledge and skills

Chemistry Paper 1	• The time allowed for the examination is 2 hours. There are 120 marks available.
	• The paper has one section. All questions are compulsory – there is no choice of questions. All questions will be structured.
	• As you progress through a question it will become more difficult. As you progress through the paper the questions will also generally increase in difficulty.
	 
	
	progress through paper
	This means that the end of one question will often be more difficult than the start of the next question. Do not stop working just because you get stuck on one question.
	• This paper covers the full range of grades from G to A*.
	• All parts of the specification content <u>except</u> those printed in **bold** are covered.
	• Although all questions will be of the structured type, you can expect to find some questions requiring longer answers towards the end of the paper.
	• You should take into the examination:
	  • **a black** pen
	  • a pencil (for graphs)
	  • a rule
	  • an eraser
	  • a calculator.
		All three Assessment Objectives are covered. The breakdown of marks available is:
		AO1: 45%-55% (54 to 66 marks)
		AO2: 25%-35% (30 to 42 marks)
		AO3: 20% (24 marks).
		For AO1 you will be required to recall and show understanding of facts, terminology, principles, concepts and practical techniques. You will need to draw on your knowledge to show an understanding of the applications and implications of chemistry. You will need to make use of and present information logically and using appropriate vocabulary. No more than 50 per cent of the AO1 marks will be for direct recall.
		For AO2 you will be required to explain phenomena and interpret data based on you knowledge of chemistry. This may involve unfamiliar contexts and you should be able to use your knowledge and apply it to work out the answer. You will be required to carry out calculations; in calculations it is important that you show clearly all the steps of your working.
		For AO3 you will not be expected to need factual recall of chemistry. You will need to show that you are familiar with laboratory apparatus and its use, including the reading of scales. You may be asked to plan experimental procedures, to record results in table and/or to plot them on a graph and draw straight lines or curves of best fit. You will need to be able to offer explanations for results and to be able to spot anomalous results and suggest explanations for them. You are expected to be able to evaluate data obtained from experiments and experimental methods and to suggest improvements.
		To obtain a high mark you will need to be able to recall the factual content of the specification and apply those facts to novel situations. You will also need to be familiar with laboratory work and the way in which science is conducted in a practical situation.

Paper 2	Description	Knowledge and skills

Chemistry Paper 2	• The time allowed for the examination is 1 hour. There are 60 marks available.
	• The paper consists of one section. All questions are compulsory – there is no choice of questions. All questions will be structured.
	• As you progress through a question it will become more difficult. As you progress through the paper the questions will generally increase in difficulty.
	 
	
	progress through paper
	This means that the end of one question will often be more difficult than the start of the next question. Do not stop working just because you get stuck on one question.
	• This paper targets grades from E to A*.
	• All parts of the specification (those in **bold** and those <u>not</u> in bold) are covered.
	• Although all questions will be of the structured type, you can expect to find some questions requiring longer answers towards the end of the paper.
	• You should take into the examination:
	  • **a black** pen
	  • a pencil (for graphs)
	  • a rule
	  • an eraser
	  • a calculator.
		All three Assessment Objectives are covered. The breakdown of marks available is:
		AO1: 45%-55% (27 to 33 marks)
		AO2: 25%-35% (15 to 21 marks)
		AO3: 20% (12 marks).
		For AO1 you will be required to recall and show understanding of facts, terminology, principles, concepts and practical techniques. You will need to draw on your knowledge to show an understanding of the applications and implications of chemistry. You will need to make use of and present information logically and using appropriate vocabulary. No more than 50 per cent of the AO1 marks will be for direct recall.
		For AO2 you will be required to explain phenomena and interpret data based on you knowledge of chemistry. This may involve unfamiliar contexts and you should be able to use your knowledge and apply it to work out the answer. You will be required to carry out calculations; in calculations it is important that you show clearly all the steps of your working.
		For AO3 you will not be expected to need factual recall of chemistry. You will need to show that you are familiar with laboratory apparatus and its use, including the reading of scales. You may be asked to plan experimental procedures, to record results in table and/or to plot them on a graph and draw straight lines or curves of best fit. You will need to be able to offer explanations for results and to be able to spot anomalous results and suggest explanations for them. You are expected to be able to evaluate data obtained from experiments and experimental methods and to suggest improvements.
		To obtain a high mark you will need to be able to recall the factual content of the specification and apply those facts to novel situations. You will also need to be familiar with laboratory work and the way in which science is conducted in a practical situation.

Command words

Terms used within the papers include the following.

- **Balance** – chemistry questions may require students to balance an equation
- **Calculate** – students may be asked to perform calculations
- **Compare** – students should offer similarities and differences between the items being compared. This should not be answered by writing two quite separate paragraphs that deal separately with the two items
- **Describe** – students should offer a response that includes the fundamental facts about the item or process for which the description is requested
- **Design** – students may be asked to design an experiment
- **Explain** – students should offer a response that utilises the underlying principles and concepts involved
- **Name** – students should offer the name of the object or process in question. They should not describe or explain it
- **Plot/draw/complete/measure** – students may be asked questions requiring them to plot data, draw diagrams, complete tables or measure drawn apparatus
- **State/identify** – students should offer a concise response with no explanation unless this is additionally requested
- **Suggest** – students will be expected to offer a logical response, not based on recall of knowledge, but on application of the principles and concepts gained during the course. This may be related to new situations or may relate to familiar situations in which there is no single correct response

Using the mark scheme

The mark scheme gives the responses we expect from students. Indicative answers are given but during the standardisation of examiners process the mark scheme is updated and expanded to cover unexpected, correct student responses.

Section C: Planning and teaching

The specification content is divided into **five** areas:

1 Principles of Chemistry

2 Chemistry of the Elements

3 Organic Chemistry

4 Physical Chemistry

5 Chemistry in Society.

In putting together a delivery strategy you need to consider a number of parameters when deciding the best way to teach the specification.

Parameter	Details
Sequence	Students need knowledge and understanding of some topics in order to tackle others successfully. Topics must be taught in a way that enables the content of one to build on and extend the content of another.
Continuity	A good course should flow. Where possible, the teacher should establish links between different areas of the specification, allowing students to appreciate the general nature of many underlying concepts and how topics relate to each other.
Difficulty	It is the nature of any subject that students find some topics easier to understand than others. It would be extremely off-putting to start a course with a topic that is generally perceived to be difficult. The effect would be to demotivate students and, once interest in the subject is lost, it is difficult to re-establish. A good course should start with the easier topics, leaving the more difficult topics until student interest and confidence have grown.
Variety	The specification allows you to address the topics in a way that maintains students' interest. A good course will provide a continuous variety of content rather than focus on particular areas of the specification for long periods of time.
Balance	It is important that the amount of time spent studying the different areas of the specification reflects the amount of content. There is no benefit in spending an excessive amount of
Practicalities	A centre might not have sufficient resources for the teacher to deliver the course exactly in the way that they would like. For example, perhaps owing to a shortage of equipment, what should really be an individual student-based practical session might have to become a class demonstration by the teacher. This is clearly less than ideal, but a good demonstration may provide a better lesson than a badly-equipped practical session.

The following page shows one possible timetable for teaching the chemistry course content over five terms. The boundaries between some topics are not as clear cut as the table would imply, and some degree of overlap is both inevitable and desirable. In terms of the amount of work to be undertaken each term, you must consider the specification content and other issues such as how much practical work will be undertaken.

Course planner

Section	Year 1 – Term 1	Suggested practical work
Principles of Chemistry	1b – Atoms 1c – Atomic structure 1f – Ionic compounds 1g – Covalent substances 1a – States of matter	Diffusion of gases and in solutions Diffusion of $NH_3(g)$ and HCl(g) Physical properties of substances compared to structure and bonding
Chemistry of the Elements	2a – The periodic table	N/A
Organic Chemistry	N/A	N/A
Physical Chemistry	N/A	N/A
Chemistry in Society	N/A	N/A

Section	Year 1 – Term 2	Suggested practical work
Principles of Chemistry	1d – Relative molecular and molar volumes of gases	Determination of the volume of 1 mole of hydrogen
Chemistry of the Elements	2b – The Group 1 elements: lithium, sodium and potassium 2c – The Group 7 elements: chlorine, bromine and iodine	Group 1 metals with water Reaction of halogens with iron wool/'dutch metal' Dissolving hydrogen chloride in water and methylbenzene
Organic Chemistry	3a – Introduction 3b – Alkanes	Reaction of hexane with bromine in UV light Cracking long chain alkanes
Physical Chemistry	4a – Acids, alkalis and salts	The effect of acids and alkalis on a selection of indicators Reactions of acids with metals, metal carbonates and metal oxides Making crystals of a soluble salt using an insoluble metal oxide or metal carbonate Making crystals of a soluble salt by titration Precipitation reactions Making dry samples of insoluble salts
Chemistry in Society	5b – Crude oil	Fractional distillation of 'artificial crude oil'

Section	Year 1 – Term 3	Suggested practical work
Principles of Chemistry	1e – Chemical formulae and chemical equations	Determination of the formula of copper oxide by reduction. Acid/alkali titrations
Chemistry of the Elements	2d – Oxygen and Oxides	Determination of the oxygen content of the air Laboratory preparation of oxygen Burning elements in oxygen The thermal decomposition of copper (II) carbonate
Organic Chemistry	3c – Alkenes	Reaction of alkenes with bromine water
Physical Chemistry	4c – Rates of reaction	Effect of surface area on rate using marble chips and hydrochloric acid Effect of concentration on rate (metals/marble chips with acid; sodium thiosulphate with acid; clock reactions) Effect of temperature on rate (metals/marble chips with acid; sodium thiosulphate with acid; clock reactions) Catalytic decomposition of hydrogen peroxide
Chemistry in Society	5c – Synthetic polymers	Making poly(styrene) Nylon rope trick

Section	Year 2 – Term 1	Suggested practical work
Principles of Chemistry	N/A	N/A
Chemistry of the Elements	2e – Hydrogen and water 2f – Reactivity series	Displacement reactions of metals (solutions and thermite type) Reduction of metal oxides using carbon Cause and prevention of rusting
Organic Chemistry	3d – Ethanol	Dehydration of ethanol
Physical Chemistry	4d – Equilibria	Effect of heat on ammonium chloride
Chemistry in Society	5d – The industrial manufacture of chemicals	N/A

Section	Year 2 – Term 2	Suggested practical work
Principles of Chemistry	1i – Electrolysis 1h – Metallic crystals	Electrolysis of molten lead bromide Electrolysis of aqueous solutions
Chemistry of the Elements	2g – Tests for ions and gases	Anion and cation analysis
Organic Chemistry	N/A	N/A
Physical Chemistry	4b – Energetics	Endothermic reactions – sodium carbonate decahydrate with citric acid crystals Measurement of enthalpy change (displacement reactions; combustion)
Chemistry in Society	5a – Extraction and uses of metals	N/A

The ordering of the subject areas does not imply any hierarchy in content. You must organise each term based on a logical sequence for teaching the topics. For example, in the first term of Year 1 of the course a reasonable teaching order would be:

1 states of matter (hopefully it will be possible to build on the student's prior knowledge and learning)

2 atoms

3 atomic structure

4 the periodic table (relating position to atomic structure and electronic configuration)

5 ionic compounds (introduced as bonding between metal and non-metal with reference to position in the periodic table)

6 covalent compounds (introduced as bonding between non-metal and non-metal with reference to position in the periodic table).

Coverage of these topics in the first term lays down a suitable foundation for looking at chemical formulae and equations, and some of the groups of elements in the periodic table during the second term.

The introduction of covalent compounds in the first term means that alkanes and natural oil and gas can be covered more meaningfully than would otherwise be the case.

The content of the remaining terms should be considered in a logical sequence and how the topics relate to what has been previously taught and what will be taught in subsequent terms.

There is no definitive sequence to delivering the course; however, some are educationally better than others. It is up you to devise the route through the course content that they think will be most appropriate for you and for your students, based on the parameters described above. On the following page there is an example of a simplification of a successful teaching sequence. Fundamental content is covered early on so that it can be built on during the remainder of the course.

First year, first term

1a – States of matter

1b – Atoms

1c – Atomic structure

1f – Ionic compounds

1g – Covalent compounds

4a – Acids, alkalis and salts

1e – Chemical formulae and chemical equations (1.20 to 1.21)

2d – Oxygen and oxides

2e – Hydrogen and water.

First year, second term

2a – The Periodic Table

2b – The Group 1 elements

4d – Equilibria

5d – The industrial manufacture of chemicals

1d – Relative formula masses and molar volumes of gases

1e – Chemical formulae and chemical equations (1.22 to 1.26).

First year, third term

1h – Metallic crystals

2f – Reactivity series

5a – Extraction and uses of metals (5.1 to 5.2)

2g – Tests for ions and gases.

Second year, first term

4c – Rates of reaction

2c – The Group 7 elements

4b – Energetics

5b – Crude oil

3a – Organic introduction

3b – Alkanes.

Second year, second term

3c – Alkenes

5c – Synthetic polymers

3d – Ethanol

1i – Electrolysis

5a – Extraction and uses of metals (5.3 to 5.5).

Teaching ideas — experimental and investigative work

Experimental work is an integral part of the study of chemistry so it is appropriate that assessment of experimental and investigative skills should form approximately 20 per cent of the final assessment.

Just as this assessment is integrated into the theoretical content of both Papers 1 and 2, it should be integrated into the teaching of chemistry throughout this course and not treated as an add on.

It is strongly recommended that 20 per cent of the teaching time should be devoted to practical work carried out by the students themselves. However, there may be circumstances where it is possible for the work to be carried out in small groups or even by demonstration alone. Between 24 and 30 of the 120 marks in Paper 1 will be set as questions with a practical bias, along with approximately 12 of the 60 marks in Paper 2.

Many of the topics in the specification will be taught in a way that allows the facts to arise from practical work, rather than the practical work being used to demonstrate what the students have already been taught. This will allow development of scientific methods where theories can explain the observed facts and experimental work can test these theories.

In the examination, students will be expected to have experience of working in a laboratory. They should be able to:

- recognise and explain the use of common items of laboratory apparatus
- plan practical procedures
- use the idea of a fair test
- read scales to an appropriate degree of accuracy and perform simple mathematical operations (including finding the mean) on results obtained
- use correct units for values
- record results in tables and use data presented in a variety of formats
- draw and use bar charts
- plot and use graphs and draw straight lines and curves of best fit
- identify relationships from graphs
- comment on the reliability and accuracy of data
- draw conclusions and offer explanations
- identify anomalous results and explain how they may have arisen
- evaluate provided procedures and suggest improvements
- suggest further experimental work that may be required.

Training students in practical skills

While there is no requirement for students to conduct a full investigation from planning through to evaluation, all of the skills needed so to do form the basis of the assessment of AO3.

Students would benefit from being introduced to the concept of practical investigative work well before they begin the two-year examination course. Research evidence has shown that students take a considerable time to gain the confidence needed for higher-level investigative skills such as critical evaluation.

Many students will need considerable guidance in order to progress from simply carrying out a set of practical instructions provided by you, to the point where they are able to plan procedures for themselves, obtain and analyse results, and critically evaluate the outcome. However, the effort required will be well rewarded, as the student will more fully understand the principles and parameters upon which scientific method is based.

Students should be encouraged to participate in practical work wherever possible. The scheme is designed to encourage a wide variety of activities, including those based on the collection of first-hand evidence and those that depend on secondary evidence. (The term 'evidence' is used to mean observations, measurements or other data.)

The value of demonstration work must not be overlooked. Demonstrations are important in the teaching of good technique and they enable students to see for themselves experiments they cannot do due to restrictions imposed by resources or safety considerations.

Suggested practical activities

The following list of practical activities is neither compulsory nor exhaustive. Before any practical activity is undertaken a full risk assessment should be conducted. The suitability of a practical activity depends on available resources, group sizes and the ability level and prior experience of those concerned. The inclusion of any practical activity in the following list does not mean that it is suitable in all cases; they are merely suggestions that teachers may like to consider. Details of how to carry out these activities should be available in textbooks or on the internet.

Principles of Chemistry

- Diffusion of gases and in solutions
- Diffusion of NH3(g) and HCl(g)
- Physical properties of substances compared to structure and bonding
- Determination the formula of copper oxide by reduction
- Determination of the volume of one mole of hydrogen
- Acid/alkali titrations
- Electrolysis of molten lead bromide
- Electrolysis of aqueous solutions

Chemistry of the Elements

- Determination of the oxygen content of the air
- Laboratory preparation of oxygen
- Burning elements in oxygen
- Laboratory preparation of carbon dioxide
- The thermal decomposition of copper(II) carbonate
- Group 1 metals with water
- Displacement reactions of metals (solutions and thermite type)
- Reduction of metal oxides using carbon
- Cause and prevention of rusting
- Anion and cation analysis
- Reaction of halogens with iron wool/'Dutch metal'
- Dissolving hydrogen chloride in water and methylbenzene
- Endothermic reactions – sodium carbonate decahydrate with citric acid crystals
- Measurement of enthalpy change (displacement reactions; combustion)

Organic Chemistry

- Fractional distillation of 'artificial crude oil'
- Reaction of hexane with bromine in uv light
- Reaction of alkenes with bromine water
- Dehydration of ethanol

Physical Chemistry

- The effect of acids and alkalis on a selection of indicators
- Reactions of acids with metals, metal carbonate and metal oxides
- Making crystals of a soluble salt using an insoluble metal oxide or metal carbonate
- Making crystals of a soluble salt by titration
- Precipitation reactions
- Making dry samples of insoluble salts
- The effect of heat on ammonium chloride
- The effect of surface area on rate using marble chips and hydrochloric acid
- The effect of concentration on rate (metals/marble chips with acid; thiosulfate with acid; clock reactions)
- The effect of temperature on rate (metals/marble chips with acid; sodium thiosulfate with acid; clock reactions)
- Catalytic decomposition of hydrogen peroxide

Chemistry in Society

- Making polystyrene
- Cracking long chain alkanes
- Nylon rope trick.

Resources

Please note that while resources are correct at the time of publication, they may be updated or withdrawn from circulation. Website addresses may change at any time.

Textbooks

The following textbooks are recommended for this course.

Clark J — *Longman Chemistry for IGCSE* (Longman, 2005) ISBN 1405802081

Goodman S — *IGCSE Chemistry for Edexcel* (Collins, 2006) ISBN 000775549X

The following may also be useful.

Chemical Nomenclature, Symbols and Terminology for use in school science (ASE 1985) ISBN 0863570135

The Essential Chemical Industry (The Chemical Industry Education Centre (CIEC)) ISBN 185342577X

International Practical Science Guide (ASE 2006) ISBN 9780863574115

Safeguards in the School Laboratory (ASE 2006) ISBN 9780863574085

Websites

Classic chemistry demonstrations (Royal Society of Chemistry) – available from the RSC
www.rsc.org/education/teachers/learnnet/classic.htm

Classic chemistry experiments (RSC) – available from the RSC
www.rsc.org/education/teachers/learnnet/classic_exp.htm

Practical experiments (RSC)
www.practicalchemistry.org/

You will also find useful information on the following websites.

www.abpischools.org.uk	Association of British Pharmaceutical Industry (resources for schools)
www.alupro.org.uk	Aluminium Packaging Recycling Organisation
www.bbc.co.uk/schools/gcsebitesize/	BBC Bitesize revision
www.bbc.co.uk/science	BBC Science
www.biochemistry.org	Biochemistry Society
www.bbsrc.ac.uk	Biotechnology and Biological Research Council
www.bpes.com	BP Amoco Educational Service
www.the-ba.net/the-ba/	British Association for the Advancement of Science
www.bl.uk	British Library
www.bpf.co.uk	British Plastics Federation
www.cat.org.uk	Centre of Alternative Technology
www.chemdex.org	Chemdex
www.ciec.org.uk/	Chemical Industry Education Centre (CIEC)
www.chemsoc.org	Chemical Society Network
www.esso.co.uk	Esso
www.foe.co.uk	Friends of the Earth
www.whynotchemeng.com/Splashpage/	Institute of Chemical Engineers
www.ioe.ac.uk	Institute of Education (London)
www.rsc.org/Chemsoc/GCN/index.htm	Green Chemistry Network
www.lgc.co.uk	Laboratory of the Government Chemist
www.rsc.org/education/teachers/learnnet/	Learnnet
www.liv.ac.uk/Chemistry/Links/	Links for Chemists
www.new-media.co.uk	Multimedia – Key Concepts in Science
www.newscientist.com	*New Scientist*
www.philipallan.co.uk	Philip Allan updates/*Chemistry Review*
www.practicalchemistry.org/	Practical chemistry website
www.chem1.com/chemed/	Resources for chemistry educators
www.rsc.org	Royal Society of Chemistry
www.schoolscience.org.uk	School science
www.sep.org.uk	Science Enhancement Programme
www.sciencemuseum.org.uk	Science Museum
www.shell.co.uk	Shell
beta.soci.org/	Society of Chemical Industry
www.periodicvideos.com	University of Nottingham
www.ChemWeb.com	Website for chemists

Other useful information

Schools may find membership of one or more of the following organisations useful.

- The Association for Science Education (www.ase.org.uk)
- CLEAPSS (www.cleapss.org.uk)
- SSERC (www.sserc.org.uk)

Appendix

Appendix 1 – Periodic table

THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
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
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	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
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Indium 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

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