International General Certificate
of Secondary Education

Syllabus

CHEMISTRY 0620

For examination in June and November 2010

Chemistry

Syllabus code: 0620

CONTENTS

Notes

Attention is drawn to alterations in the syllabus by black vertical lines on either side of the text.

Conventions (e.g. signs, symbols, terminology and nomenclature)
Syllabuses and question papers will conform with generally accepted international practice.
In particular, attention is drawn to the following documents, published in the UK, which will be used as guidelines.

(a) Reports produced by the Association for Science Education (ASE):
SI Units, Signs, Symbols and Abbreviations (1981)
Chemical Nomenclature, Symbols and Terminology for use in School Science (1985)
Signs, Symbols and Systematics: The ASE Companion to 16-19 Science (2000).

(b) Report produced by the Institute of Biology (in association with the ASE):
Biological Nomenclature, Recommendations on Terms, Units and Symbols (1997).

It is intended that, in order to avoid difficulties arising out of the use of l for the symbol for litre, usage of dm^3 in place of l or litre will be made.

Exclusions

This syllabus must not be offered in the same session with any of the following syllabuses:

0652 Physical Science
0653 Combined Science
0654 Co-ordinated Sciences (Double Award)
5070 Chemistry
5124 Science (Physics, Chemistry)
5126 Science (Chemistry, Biology)
5129 Combined Science
5130 Additional Combined Science

INTRODUCTION

International General Certificate of Secondary Education (IGCSE) syllabuses are designed as two-year courses for examination at age 16-plus.

All IGCSE syllabuses follow a general pattern. The main sections are:

Aims

Assessment Objectives

Assessment

Curriculum Content.

The IGCSE subjects have been categorised into groups, subjects within each group having similar Aims and Assessment Objectives.

Chemistry falls into Group III, Science, of the International Certificate of Education (ICE).

AIMS

The aims of the syllabus are the same for all students. The aims are set out below and describe the educational purposes of a course in Chemistry for the IGCSE examination. They are not listed in order of priority.

The aims are to:

1. provide through well-designed studies of experimental and practical science a worthwhile educational experience for all students whether or not they go on to study science beyond this level and, in particular, to enable them to acquire sufficient understanding and knowledge to
   - 1.1 become confident citizens in a technological world, able to take or develop an informed interest in matters of scientific import;
   - 1.2 recognise the usefulness, and limitations, of scientific method and appreciate its applicability in other disciplines and in everyday life;
   - 1.3 be suitably prepared for studies beyond the IGCSE level in pure sciences, in applied sciences or in science-dependent vocational courses.
2. develop abilities and skills that
   - 2.1 are relevant to the study and practice of Chemistry;
   - 2.2 are useful in everyday life;
   - 2.3 encourage efficient and safe practice;
   - 2.4 encourage effective communication.
3. develop attitudes relevant to Chemistry such as
   - 3.1 concern for accuracy and precision;
   - 3.2 objectivity;
   - 3.3 integrity;
   - 3.4 enquiry;
   - 3.5 initiative;
   - 3.6 inventiveness.
4. Stimulate interest in, and care for, the environment.

5. promote an awareness that

   5.1 scientific theories and methods have developed, and continue to do so, as a result of co-operative activities of groups and individuals;

   5.2 the study and practice of science are subject to social, economic, technological, ethical and cultural influences and limitations;

   5.3 the applications of science may be both beneficial and detrimental to the individual, the community and the environment;

   5.4 science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal.

ASSESSMENT OBJECTIVES

The three assessment objectives in Chemistry are

A Knowledge with understanding

B Handling information and solving problems

C Experimental skills and investigations

A description of each assessment objective follows.

A KNOWLEDGE WITH UNDERSTANDING

Students should be able to demonstrate knowledge and understanding in relation to

1. scientific phenomena, facts, laws, definitions, concepts and theories;
2. scientific vocabulary, terminology and conventions (including symbols, quantities and units);
3. scientific instruments and apparatus, including techniques of operation and aspects of safety;
4. scientific quantities and their determination;
5. scientific and technological applications with their social, economic and environmental implications.

The Curriculum Content defines the factual material that candidates may be required to recall and explain. Questions testing this will often begin with one of the following words: *define, state, describe, explain* or *outline*. (See the Glossary of Terms.)

B HANDLING INFORMATION AND PROBLEM SOLVING

Students should be able, in words or using other written forms of presentation (i.e. symbolic, graphical and numerical), to

1. locate, select, organise and present information from a variety of sources,
2. translate information from one form to another,
3. manipulate numerical and other data,
4. use information to identify patterns, report trends and draw inferences,
5. present reasoned explanations for phenomena, patterns and relationships,
6. make predictions and hypotheses,
7. solve problems, including some of a quantitative nature.

These skills cannot be precisely specified in the Curriculum Content because questions testing such skills are often based on information which is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, deductive manner to a novel situation. Questions testing these skills will often begin with one of the following words: *predict, suggest, calculate* or *determine*. (See the Glossary of Terms.)

C EXPERIMENTAL SKILLS AND INVESTIGATIONS

Students should be able to

1. use techniques, apparatus and materials (including the following of a sequence of instructions where appropriate),
2. make and record observations, measurements and estimates,
3. interpret and evaluate experimental observations and data,
4. plan and carry out investigations, evaluate methods and suggest possible improvements (including the selection of techniques, apparatus and materials).

SPECIFICATION GRID

The approximate weightings allocated to each of the assessment objectives are set out in the table below.

Assessment Objective	Weighting
A Knowledge with understanding	50% (not more than 25% recall)
B Handling information and solving problems	30%
C Experimental skills and investigations	20%

WEIGHTING OF ASSESSMENT OBJECTIVES

The relationship between the assessment objectives and the scheme of assessment is set out in the table below.

	Paper 1 (marks)	Paper 2 or 3 (marks)	Paper 4, 5 or 6 (marks)	Whole assessment (%)
AO1: Knowledge with understanding	25-30	48-52	0	47-54
AO2: Handling, applying and evaluating information	10-15	27-32	0	26-33
AO3: Experimental and investigative skills	0	0	40	20

ASSESSMENT

All candidates must enter for three Papers. These will be Paper 1, **one** from either Paper 2 or Paper 3, and **one** from Papers 4, 5 or 6.

Candidates who have only studied the Core curriculum or who are expected to achieve a grade D or below should normally be entered for Paper 2. Candidates who have studied the Extended curriculum and who are expected to achieve a grade C or above should be entered for Paper 3.

All candidates must take a practical paper, chosen from Paper 4 (Coursework), or Paper 5 (Practical Test), or Paper 6 (Alternative to Practical).

<table>
<tr><td>Core curriculum
Grades C to G available</td><td>Extended curriculum
Grades A* to G available</td></tr>
<tr><td colspan="2">Paper 1 (45 minutes)
Compulsory A multiple-choice paper consisting of forty items of the four-choice type.
The questions will be based on the Core curriculum, will be of a difficulty appropriate to grades C to G, and will test skills mainly in Assessment Objectives A and B.
This paper will be weighted at 30% of the final total available marks.</td></tr>
<tr><td>Either:
Paper 2 (1 hour 15 minutes)
Core theory paper consisting of 80 marks of short-answer and structured questions.
The questions will be of a difficulty appropriate to grades C to G and will test skills mainly in Assessment Objectives A and B.
The questions will be based on the Core curriculum.
This Paper will be weighted at 50% of the final total available marks.</td><td>Or:
Paper 3 (1 hour 15 minutes)
Extended theory paper consisting of 80 marks of short-answer and structured questions.
The questions will be of a difficulty appropriate to the higher grades and will test skills mainly in Assessment Objectives A and B.
A quarter of the marks available will be based on Core material and the remainder on the Supplement.
This Paper will be weighted at 50% of the final total available marks.</td></tr>
<tr><td colspan="2">Practical Assessment
Compulsory The purpose of this component is to test appropriate skills in Assessment Objective C. Candidates will not be required to use knowledge outside the Core curriculum. For further information, see the section Assessment Criteria for Practicals.
Candidates must be entered for one of the following:
Either: Paper 4 Coursework (school-based assessment of practical skills)*
Or: Paper 5 Practical Test (1 hour 15 minutes), with questions covering experimental and observational skills.
Or: Paper 6 Alternative to Practical (1 hour). This is a written paper designed to test familiarity with laboratory based procedures.
The practical assessment will be weighted at 20% of the final total available marks.</td></tr>
</table>

*Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates. CIE offers schools in-service training in the form of occasional face-to-face courses held in countries where there is a need, and also through the IGCSE Coursework Training Handbook, available from CIE Publications.

CURRICULUM CONTENT

Students can follow either the Core curriculum only or they may follow the Extended curriculum which includes both the Core and the Supplement. Students aiming for grades A* to C must follow the Extended curriculum.

It is important that, throughout this course, attention should be drawn to:

(i) the finite life of the world's resources and hence the need for recycling and conservation;

(ii) economic considerations in the chemical industry, such as the availability and cost of raw materials and energy;

(iii) the importance of chemicals in industry and in everyday life.

TOPIC	CORE	SUPPLEMENT
	All students should be able to:	*In addition to what is required for the Core, students following the Extended curriculum should be able to:*
1. The particulate nature of matter	-describe the states of matter and explain their interconversion in terms of the kinetic particle theory -describe and explain diffusion -describe evidence for the movement of particles in gases and liquids (A treatment of Brownian motion is *not* required.)	-describe dependence of rate of diffusion on molecular mass (treated qualitatively)
2. Experimental techniques		
2.1 Measurement	-name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders	
2.2 (a) Criteria of purity	-describe paper chromatography -interpret simple chromatograms -identify substances and assess their purity from melting point and boiling point information -understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs	-interpret simple chromatograms, including the use of R_f values -outline how chromatography techniques can be applied to colourless substances by exposing chromatograms to substances called locating agents (Knowledge of *specific* locating agents is *not* required.)
(b) Methods of purification	-describe methods of purification by the use of a suitable solvent, filtration, crystallisation, distillation (including use of fractionating column). (Refer to the fractional distillation of crude oil (section 14.2) and products of fermentation (section 14.6)) -suggest suitable purification techniques, given information about the substances involved	
3. Atoms, elements and compounds		
3.1 Atomic structure and the Periodic Table	-state the relative charges and approximate relative masses of protons, neutrons and electrons -define *proton number* and *nucleon number* -use proton number and the simple structure of atoms to explain the basis of the Periodic Table (see section 9), with special reference to the elements of proton number 1 to 20	

TOPIC	CORE	SUPPLEMENT
	-define *isotopes* -state the two types of isotopes as being radioactive and non-radioactive -state one medical and one industrial use of radioactive isotopes -describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of valency electrons (The ideas of the distribution of electrons in s and p orbitals and in d block elements are *not* required. Note that a copy of the Periodic Table, as shown on the Data Sheet, will be available in Papers 1, 2 and 3)	
3.2 Bonding: the structure of matter	-describe the differences between elements, mixtures and compounds, and between metals and non-metals -describe an alloy, such as brass, as a mixture of a metal with other elements	
(a) Ions and ionic bonds	-describe the formation of ions by electron loss or gain -describe the formation of ionic bonds between elements from Groups I and VII	
(b) Molecules and covalent bonds	-describe the formation of single covalent bonds in H_2, Cl_2, H_2O, CH_4 and HCl as the sharing of pairs of electrons leading to the noble gas configuration -describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds	-describe the formation of ionic bonds between metallic and non-metallic elements -describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions
(c) Macromolecules	-describe the giant covalent structures of graphite and diamond -relate their structures to the use of graphite as a lubricant and of diamond in cutting	-describe the electron arrangement in more complex covalent molecules such as N_2, C_2H_4, CH_3OH and CO_2 -describe the macromolecular structure of silicon(IV) oxide (silicon dioxide)
(d) Metallic bonding		-describe the similarity in properties between diamond and silicon(IV) oxide, related to their structures -describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use this to describe the electrical conductivity and malleability of metals
4. Stoichiometry	-use the symbols of the elements and write the formulae of simple compounds -deduce the formula of a simple compound from the relative numbers of atoms present -deduce the formula of a simple compound from a model or a diagrammatic representation -construct word equations and simple balanced chemical equations -define *relative atomic mass*, A_r	-determine the formula of an ionic compound from the charges on the ions present -construct equations with state symbols, including ionic equations -deduce the balanced equation for a chemical reaction, given relevant information

TOPIC	CORE	SUPPLEMENT
	-define *relative molecular mass*, M_r, as the sum of the relative atomic masses (*relative formula mass* or M_r will be used for ionic compounds) (Calculations involving reacting masses in simple proportions may be set. Calculations will *not* involve the mole concept.)	
4.1 The mole concept		-define the *mole* and the *Avogadro constant* -use the molar gas volume, taken as 24 dm^3 at room temperature and pressure -calculate stoichiometric reacting masses and volumes of gases and solutions, solution concentrations expressed in g/dm^3 and mol/dm^3. (Calculations involving the idea of limiting reactants may be set. Questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will *not* be set.) -calculate empirical formulae and molecular formulae -calculate % yield and % purity
5. Electricity and chemistry	-describe the electrode products in the electrolysis of: molten lead(II) bromide concentrated hydrochloric acid concentrated aqueous sodium chloride between inert electrodes (platinum or carbon) -state the general principle that metals or hydrogen are formed at the negative electrode (cathode), and that non-metals (other than hydrogen) are formed at the positive electrode (anode) -predict the products of the electrolysis of a specified binary compound in the molten state -describe the electroplating of metals -name the uses of electroplating -describe the reasons for the use of copper and (steel-cored) aluminium in cables, and why plastics and ceramics are used as insulators	-relate the products of electrolysis to the electrolyte and electrodes used, exemplified by the specific examples in the Core together with aqueous copper(II) sulfate using carbon electrodes and using copper electrodes (as used in the refining of copper) -describe electrolysis in terms of the ions present and reactions at the electrodes in the examples given -predict the products of electrolysis of a specified halide in dilute or concentrated aqueous solution -describe, in outline, the manufacture of (i) aluminium from pure aluminium oxide in molten cryolite (ii) chlorine and sodium hydroxide from concentrated aqueous sodium chloride (Starting materials and essential conditions should be given but not technical details or diagrams.)
6. Chemical changes		
6.1 Energetics of a reaction	-describe the meaning of *exothermic* and *endothermic* reactions	-describe bond breaking as endothermic and bond forming as exothermic

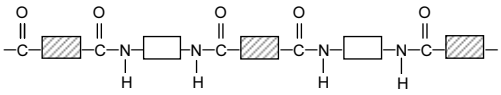
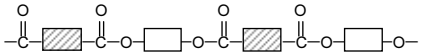
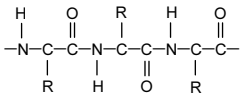
TOPIC	CORE	SUPPLEMENT
6.2 Production of energy	-describe the production of heat energy by burning fuels -describe hydrogen as a fuel -describe radioactive isotopes, such as ^{235}U, as a source of energy	-describe the production of electrical energy from simple cells, i.e. two electrodes in an electrolyte. (This should be linked with the reactivity series in section 10.2 and redox in section 7.3.) -describe the use of hydrogen as a potential fuel reacting with oxygen to generate electricity in a fuel cell (details of the construction and operation of a fuel cell are not required)
7. Chemical reactions		
7.1 Speed of reaction	-describe the effect of concentration, particle size, catalysts (including enzymes) and temperature on the speeds of reactions -describe a practical method for investigating the speed of a reaction involving gas evolution -describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. mines)	-devise a suitable method for investigating the effect of a given variable on the speed of a reaction -interpret data obtained from experiments concerned with speed of reaction -describe and explain the effects of temperature and concentration in terms of collisions between reacting particles -describe the effect of light on the speed of reactions -describe the use of silver salts in photography as a process of reduction of silver ions to silver; and photosynthesis as the reaction between carbon dioxide and water in the presence of chlorophyll and sunlight (energy) to produce glucose
7.2 Reversible reactions	-describe the idea that some chemical reactions can be reversed by changing the reaction conditions (Limited to the effects of heat on hydrated salts. Concept of equilibrium is *not* required.)	-predict the effect of changing the conditions (temperature and pressure) on other reversible reactions -concept of equilibrium
7.3 Redox	-define *oxidation* and *reduction* in terms of oxygen loss/gain. (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII), dichromate(VI).)	-define *redox* in terms of electron transfer -identify redox reactions by changes in oxidation state and by the colour changes involved when using acidified potassium manganate(VII), and potassium iodide. (Recall of equations involving $KMnO_4$ is *not* required.)
8. Acids, bases and salts		
8.1 The characteristic properties of acids and bases	-describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus -describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus -describe neutrality and relative acidity and alkalinity in terms of pH (whole numbers only) measured using Universal Indicator paper -describe and explain the importance of controlling acidity in soil	-define *acids* and *bases* in terms of proton transfer, limited to aqueous solutions -describe the meaning of weak and strong acids and bases
8.2 Types of oxides	-classify oxides as either acidic or basic, related to metallic and non-metallic character	-further classify other oxides as neutral or amphoteric

TOPIC	CORE	SUPPLEMENT
8.3 Preparation of salts	-describe the preparation, separation and purification of salts as examples of some of the techniques specified in section 2.2(b) and the reactions specified in section 8.1	-describe the preparation of insoluble salts by precipitation -suggest a method of making a given salt from suitable starting material, given appropriate information
8.4 Identification of ions and gases	-describe the following tests to identify: *aqueous cations:* aluminium, ammonium, calcium, copper(II), iron(II), iron(III) and zinc (using aqueous sodium hydroxide and aqueous ammonia as appropriate). (Formulae of complex ions are *not* required.) *anions:* carbonate (by reaction with dilute acid and then limewater), chloride (by reaction under acidic conditions with aqueous silver nitrate), iodide (by reaction under acidic conditions with aqueous silver nitrate), nitrate (by reduction with aluminium), sulfate (by reaction under acidic conditions with aqueous barium ions) *gases:* ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using lighted splint), oxygen (using a glowing splint).	
9. The Periodic Table	Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements	
9.1 Periodic trends	-describe the change from metallic to non-metallic character across a period	-describe the relationship between Group number, number of valency electrons and metallic/non-metallic character
9.2 Group properties	-describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and reaction with water -predict the properties of other elements in Group I, given data, where appropriate -describe chlorine, bromine and iodine in Group VII as a collection of diatomic non-metals showing a trend in colour, state and their reaction with other halide ions -predict the properties of other elements in Group VII, given data, where appropriate	-identify trends in other Groups given information about the elements concerned
9.3 Transition elements	-describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts	
9.4 Noble gases	-describe the noble gases as being unreactive -describe the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps; helium for filling balloons	

TOPIC	CORE	SUPPLEMENT
10. Metals		
10.1 Properties of metals	-describe the general physical and chemical properties of metals -explain why metals are often used in the form of alloys -identify representations of alloys from diagrams of structure	
10.2 Reactivity series	-place in order of reactivity, potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen), and copper, by reference to the reactions, if any, of the metals with water or steam dilute hydrochloric acid and the reduction of their oxides with carbon	-describe the reactivity series as related to the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with the aqueous ions, the oxides, of the other listed metals
		-describe the action of heat on the hydroxides and nitrates of the listed metals -account for the apparent unreactivity of aluminium in terms of the oxide layer which adheres to the metal
	-deduce an order of reactivity from a given set of experimental results	
10.3 a) Extraction of metals	-describe the ease in obtaining metals from their ores by relating the elements to the reactivity series	-describe in outline, the extraction of zinc from zinc blende
	-name the main ore of aluminium as bauxite (see section 5)	
	-describe the essential reactions in the extraction of iron from hematite	
	-describe the conversion of iron into steel using basic oxides and oxygen	
b) Uses of metals	-name the uses of aluminium: in the manufacture of aircraft because of its strength and low density; in food containers because of its resistance to corrosion	-name the uses of zinc for galvanising and for making brass
	-describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys	-name the uses of copper related to its properties (electrical wiring and in cooking utensils)
	-name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)	
11. Air and water	-describe a chemical test for water	
	-describe, in outline, the purification of the water supply in terms of filtration and chlorination	
	-name some of the uses of water in industry and in the home	
	-describe the composition of clean air as being approximately 79% nitrogen, 20% oxygen and the remainder as being a mixture of noble gases, water vapour and carbon dioxide	
	-name the common pollutants in the air as being carbon monoxide, sulfur dioxide, oxides of nitrogen and lead compounds	

TOPIC	CORE	SUPPLEMENT
	-state the source of each of these pollutants: -carbon monoxide from the incomplete combustion of carbon-containing substances -sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to 'acid rain' – see section 13)	
	-oxides of nitrogen from car exhausts	-describe and explain the presence of oxides of nitrogen in car exhausts and their catalytic removal
	-state the adverse effect of common pollutants on buildings and on health	-describe the separation of oxygen and nitrogen from liquid air by fractional distillation
	-describe methods of rust prevention, specifically paint and other coatings to exclude oxygen	-describe sacrificial protection in terms of the reactivity series of metals and galvanising as a method of rust prevention
	-describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers	-describe the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air
	-describe the displacement of ammonia from its salts	
	-state that carbon dioxide and methane are greenhouse gases and may contribute to climate change	
	-describe the formation of carbon dioxide: as a product of complete combustion of carbon-containing substances as a product of respiration as a product of the reaction between an acid and a carbonate	-describe the carbon cycle in simple terms, to include the processes of combustion, respiration and photosynthesis
	-state the sources of methane, including decomposition of vegetation and waste gases from digestion in animals	
12. Sulfur		-name some sources of sulfur -name the use of sulfur in the manufacture of sulfuric acid -name the uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper; as a food preservative (by killing bacteria) -describe the manufacture of sulfuric acid by the Contact process, including essential conditions -describe the properties of dilute sulfuric acid as a typical acid
13. Carbonates	-describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of the chemical reactions involved -name some uses of lime and slaked lime as in treating acidic soil and neutralising acidic industrial waste products, e.g. flue gas desulfurisation -name the uses of calcium carbonate in the manufacture of iron and of cement	

TOPIC	CORE	SUPPLEMENT
14. Organic Chemistry		
14.1 Names of compounds	-name, and draw the structures of methane, ethane, ethanol, ethanoic acid and the products of the reactions stated in sections 14.4-14.6 -state the type of compound present given a chemical name, ending in *-ane, -ene, -ol,* or *-oic acid*, or a molecular structure	-name, and draw the structures of the unbranched alkanes, alkenes (not *cis-trans*), alcohols and acids containing up to four carbon atoms per molecule
14.2 Fuels	-name the fuels coal, natural gas and petroleum -name methane as the main constituent of natural gas -describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation -name the uses of the fractions as: refinery gas for bottled gas for heating and cooking; gasoline fraction for fuel (petrol) in cars; naphtha fraction for making chemicals; kerosene/paraffin fraction for jet fuel; diesel oil/gas oil for fuel in diesel engines; fuel oil fraction for fuel for ships and home heating systems; lubricating fraction for lubricants, waxes and polishes; bitumen for making roads	
14.3 Homologous series	-describe the concept of homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group	-describe the general characteristics of an homologous series -describe and identify structural isomerism
14.4 Alkanes	-describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning -describe the bonding in alkanes	-describe substitution reactions of alkanes with chlorine
14.5 Alkenes	-describe the manufacture of alkenes and of hydrogen by cracking -distinguish between saturated and unsaturated hydrocarbons from molecular structures by reaction with aqueous bromine -describe the formation of poly(ethene) as an example of addition polymerisation of monomer units	-describe the properties of alkenes in terms of addition reactions with bromine, hydrogen and steam
14.6 Alcohols	-describe the formation of ethanol by fermentation and by the catalytic addition of steam to ethene -describe the properties of ethanol in terms of burning -name the uses of ethanol as a solvent and as a fuel	
14.7 Acids		-describe the formation of ethanoic acid by the oxidation of ethanol by fermentation and with acidified potassium manganate(VII) -describe ethanoic acid as a typical weak acid -describe the reaction of ethanoic acid with ethanol to give an ester (ethyl ethanoate)

TOPIC	CORE	SUPPLEMENT
14.8 Macromolecules		-describe macromolecules in terms of large molecules built up from small units (monomers), different macromolecules having different units and/or different linkages
(a) Synthetic polymers		-name some typical uses of plastics and of man-made fibres -describe the pollution problems caused by non-biodegradable plastics -deduce the structure of the polymer product from a given alkene and vice versa -describe the formation of nylon (a polyamide) and *Terylene* (a polyester) by condensation polymerisation, the structure of nylon being represented as:  and the structure of *Terylene* as:  (Details of manufacture and mechanisms of these polymerisations are *not* required.)
(b) Natural macromolecules		-name proteins, fats and carbohydrates as the main constituents of food -describe proteins as possessing the same (amide) linkages as nylon but with different units -describe the structure of proteins as:  -describe the hydrolysis of proteins to amino acids (structures and names *not* required) -describe fats as esters possessing the same linkage as *Terylene* but with different units -describe soap as a product of hydrolysis of fats -describe complex carbohydrates in terms of a large number of sugar units, considered as HO–□–OH , joined together by condensation polymerisation, e.g. –O–□–O–□–O–□–O– -describe the acid hydrolysis of complex carbohydrates (e.g. starch) to give simple sugars -describe the fermentation of simple sugars to produce ethanol (and carbon dioxide) (Candidates will *not* be expected to give the molecular formulae of sugars.) -describe, in outline, the usefulness of chromatography in separating and identifying the product of hydrolysis of carbohydrates and proteins

ASSESSMENT CRITERIA FOR PRACTICALS

PRACTICAL ASSESSMENT – PAPER 4 OR 5 OR 6

Scientific subjects are, by their nature, experimental. It is accordingly important that an assessment of a student's knowledge and understanding of Chemistry should contain a component relating to practical work and experimental skills (as identified by Assessment Objective C). In order to accommodate, within IGCSE, differing circumstances – such as the availability of resources – three different means of assessing Assessment Objective C objectives are provided, namely school-based assessment, a formal practical test, or a written alternative-to-practical paper, as outlined in the Scheme of Assessment.

Paper 4, Coursework (School-based assessment of practical skills)

Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates.

CIE offers schools in-service training in the form of courses held at intervals in Cambridge and elsewhere, and also via distance training manuals.

Paper 5, Practical Test

Candidates may be asked to carry out exercises involving:

- simple quantitative experiments involving the measurement of volumes;
- speeds of reaction;
- measurement of temperature based on a thermometer with 1 °C graduations;
- problems of an investigatory nature, possibly including suitable organic compounds;
- simple paper chromatography;
- filtration;
- identification of ions and gases as specified in the Core curriculum (the question papers will include notes on qualitative analysis for the use of candidates in the examination.

Candidates will not be required to carry out weighing for the practical test.

Apparatus List

This list given below has been drawn up in order to give guidance to schools concerning the apparatus that is expected to be generally available for examination purposes. The list is not intended to be exhaustive: in particular, items (such as Bunsen burners, tripods) that are commonly regarded as standard equipment in a chemical laboratory are not included. The rate of allocation is "per candidate".

one burette, 50 cm^3
one pipette, 25 cm^3
a pipette filler
two conical flasks within the range 150 cm^3 to 250 cm^3
a measuring cylinder, 50 cm^3 or 25 cm^3
a filter funnel
a beaker, squat form with lip: 250 cm^3
a thermometer, –10 °C to + 110 °C at 1 °C
a polystyrene, or other plastic beaker of approximate capacity 150 cm^3
clocks (or wall-clock) to measure to an accuracy of about 1s (Where clocks are specified, candidates may use their own wristwatch if they prefer.)
wash bottle
test-tubes (some of which should be Pyrex or hard glass), approximately 125 mm x 16 mm
boiling tubes, approximately 150 mm x 25 mm
stirring rod

Paper 6, Alternative to Practical

This paper is designed to test candidates' familiarity with laboratory practical procedure.

Questions may be set requiring candidates to do the following:

- record readings from diagrams of apparatus;
- describe, explain or comment on experimental arrangements and techniques;
- complete tables of data;
- draw conclusions from information given;
- interpret and evaluate observations and experimental data;
- describe tests for gases and ions, and/or draw conclusions from such tests;
- plot graphs and/or interpret graphical information;
- identify sources of error and suggest possible improvements in procedures;
- suggest suitable techniques and apparatus for an investigation.

COURSEWORK (SCHOOL-BASED ASSESSMENT (PAPER 4))

The experimental skills and abilities C1 to C4 to be assessed are given below.

C1 Using and organising techniques, apparatus and materials

C2 Observing, measuring and recording

C3 Handling experimental observations and data

C4 Planning investigations

The four skills carry equal weighting.

All assessments must be based upon experimental work carried out by the candidates.

It is expected that the teaching and assessment of experimental skills and abilities will take place throughout the course.

Teachers must ensure that they can make available to CIE evidence of two assessments of each skill for each candidate. For skills C1 to C4 inclusive, information about the tasks set and how the marks were awarded will be required. In addition, for skills C2, C3 and C4, the candidate's written work will also be required.

The assessment scores finally recorded for each skill must represent the candidate's best performances.

For candidates who miss the assessment of a given skill through no fault of their own, for example because of illness, and who cannot be assessed **on another occasion**, CIE procedure for special consideration should be followed. However, candidates who for no good reason absent themselves from an assessment of a given skill should be given a mark of zero for that assessment.

Criteria for Assessment of Experimental Skills and Abilities

Each skill must be assessed on a six-point scale, level 6 being the highest level of achievement. Each of the skills is defined in terms of three levels of achievement at scores of 2, 4, and 6.

A score of 0 is available if there is no evidence of positive achievement for a skill.

For candidates who do not meet the criteria for a score of 2, a score of 1 is available if there is some evidence of positive achievement.

A score of 3 is available for candidates who go beyond the level defined for 2, but who do not meet fully the criteria for 4.

Similarly, a score of 5 is available for those who go beyond the level defined for 4, but do not meet fully the criteria for 6.

SKILL C1 USING AND ORGANISING TECHNIQUES, APPARATUS AND MATERIALS

1

2 - Follows written, diagrammatic or oral instructions to perform a single practical operation.
Uses familiar apparatus and materials adequately, needing reminders on points of safety.

3

4 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of step-by-step practical operations.
Uses familiar apparatus, materials and techniques adequately and safely.

5

6 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of practical operations where there may be a need to modify or adjust one step in the light of the effect of a previous step.
Uses familiar apparatus, materials and techniques safely, correctly and methodically.

SKILL C2 OBSERVING, MEASURING AND RECORDING

1

2 - Makes observations or readings given detailed instructions.
Records results in an appropriate manner given a detailed format.

3

4 - Makes relevant observations, measurements or estimates given an outline format or brief guidelines.
Records results in an appropriate manner given an outline format.

5

6 - Makes relevant observations, measurements or estimates to a degree of accuracy appropriate to the instruments or techniques used.
Records results in an appropriate manner given no format.

SKILL C3 HANDLING EXPERIMENTAL OBSERVATIONS AND DATA

1

2 - Processes results in an appropriate manner given a detailed format.
Draws an obvious qualitative conclusion from the results of an experiment.

3

4 - Processes results in an appropriate manner given an outline format.
Recognises and comments on anomalous results.
Draws qualitative conclusions which are consistent with obtained results and deduces patterns in data.

5

6 - Processes results in an appropriate manner given no format.
Deals appropriately with anomalous or inconsistent results.
Recognises and comments on possible sources of experimental error.
Expresses conclusions as generalisations or patterns where appropriate.

SKILL C4 PLANNING, CARRYING OUT AND EVALUATING INVESTIGATIONS

1

2 - Suggests a simple experimental strategy to investigate a given practical problem.
Attempts ‘trial and error’ modification in the light of the experimental work carried out.

3

4 - Specifies a sequence of activities to investigate a given practical problem.
In a situation where there are two variables, recognises the need to keep one of them constant while the other is being changed.
Comments critically on the original plan, and implements appropriate changes in the light of the experimental work carried out.

5

6 - Analyses a practical problem systematically and produces a logical plan for an investigation.
In a given situation, recognises that there are a number of variables and attempts to control them.
Evaluates chosen procedures, suggests/implements modifications where appropriate and shows a systematic approach in dealing with unexpected results.

Notes for guidance

The following notes are intended to provide teachers with information to help them to make valid and reliable assessments of the skills and abilities of their candidates.

The assessments should be based on the principle of positive achievement: candidates should be given opportunities to demonstrate what they understand and can do.

It is expected that candidates will have had opportunities to acquire a given skill before assessment takes place.

It is not expected that all of the practical work undertaken by a candidate will be assessed.

Assessments can be carried out at any time during the course. However, at whatever stage assessments are done, the standards applied must be those expected at the end of the course as exemplified in the criteria for the skills.

Assessment should normally be made by the person responsible for teaching the candidates.

It is recognised that a given practical test is unlikely to provide opportunities for all aspects of the criteria at a given level for a particular skill to be satisfied, for example, there may not be any anomalous results (Skill C3). However, by using a range of practical work, teachers should ensure that opportunities are provided for all aspects of the criteria to be satisfied during the course.

The educational value of extended experimental investigations is widely recognised. Where such investigations are used for assessment purposes, teachers should make sure that candidates have ample opportunity for displaying the skills and abilities required by the scheme of assessment.

It is not necessary for all candidates in a Centre, or in a teaching group within a Centre, to be assessed on exactly the same practical work, although teachers may well wish to make use of work that is undertaken by all of their candidates.

When an assessment is carried out on group work the teacher must ensure that the individual contribution of each candidate can be assessed.

Skill C1 may not generate a written product from the candidates. It will often be assessed by watching the candidates carrying out practical work.

Skills C2, C3 and C4 will usually generate a written product from the candidates. This product will provide evidence for moderation.

Raw scores for individual practical assessments should be recorded on the Individual Candidate Record Card. The final, internally moderated, total score should be recorded on the Coursework Assessment Summary Form. Examples of both forms are at the back of this syllabus.

Raw scores for individual practical assessments may be given to candidates as part of the normal feedback from the teacher. The final, internally moderated, total score, which is submitted to CIE, should not be given to the candidate.

Moderation

(a) Internal Moderation

When several teachers in a Centre are involved in internal assessments, arrangements must be made within the Centre for all candidates to be assessed to a common standard.

It is essential that within each Centre the marks for each skill assigned within different teaching groups (e.g. different classes) are moderated internally for the whole Centre entry. The Centre assessments will then be subject to external moderation.

(b) External Moderation

External moderation of internal assessment will be carried out by CIE.

The internally moderated marks for all candidates must be received at CIE by 30 April for the May/June examination and by 31 October for the November examination. These marks may be submitted either by using MS1 mark sheets or by using Cameo as described in the Handbook for Centres.

Once CIE has received the marks, CIE will select a sample of candidates whose work should be submitted for external moderation. CIE will communicate the list of candidates to the Centre, and the Centre should despatch the coursework of these candidates to CIE immediately. For each candidate on the list, every piece of work which has contributed to the final mark should be sent to CIE. Individual Candidate Record Cards and Coursework Assessment Summary Forms (copies of which may be found at the back of this syllabus booklet) must be enclosed with the coursework.

Further information about external moderation may be found in the Handbook for Centres and the Administrative Guide for Centres.

A further sample may be required. All records and supporting written work should be retained until after publication of results.

Centres may find it convenient to use loose-leaf A4 file paper for assessed written work. This is because samples will be sent through the post for moderation and postage bills are likely to be large if whole exercise books are sent. Authenticated photocopies of the sample required would be acceptable.

The individual pieces of work should not be stapled together. Each piece of work should be labelled with the skill being assessed, the Centre number and candidate name and number, title of the experiment, a copy of the mark scheme used, and the mark awarded. This information should be attached securely, mindful that adhesive labels tend to peel off some plastic surfaces.

GRADE DESCRIPTIONS

The scheme of assessment is intended to encourage positive achievement by all candidates.

A **Grade A** candidate must show mastery of the Core curriculum and the Extended curriculum.

A **Grade C** candidate must show mastery of the Core curriculum plus some ability to answer questions which are pitched at a higher level.

A **Grade F** candidate must show competence in answering questions based on the Core curriculum.

A **Grade A** candidate is likely to:

- relate facts to principles and theories and vice versa;
- state why particular techniques are preferred for a procedure or operation;
- select and collate information from a number of sources and present it in a clear logical form;
- solve problems in situations which may involve a wide range of variables;
- process data from a number of sources to identify any patterns or trends;
- generate a hypothesis to explain facts, or find facts to support a hypothesis.

A **Grade C** candidate is likely to:

- link facts to situations not specified in the syllabus;
- describe the correct procedure(s) for a multi-stage operation;
- select a range of information from a given source and present it in a clear logical form;
- identify patterns or trends in given information;
- solve a problem involving more than one step, but with a limited range of variables;
- generate a hypothesis to explain a given set of facts or data.

A **Grade F** candidate is likely to

- recall facts contained in the syllabus;
- indicate the correct procedure for a single operation;
- select and present a single piece of information from a given source;
- solve a problem involving one step, or more than one step if structured help is given;
- identify a pattern or trend where only minor manipulation of data is needed;
- recognise which of two given hypotheses explains a set of facts or data.

The Periodic Table of the Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 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	64 **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	**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** Tantalum 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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** actinium 89 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	163 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

Key

a
X
b

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

GLOSSARY OF TERMS USED IN SCIENCE PAPERS

It is hoped that the glossary (which is relevant only to Science subjects) will prove helpful to candidates as a guide, i.e. it is neither exhaustive nor definitive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Candidates should appreciate that the meaning of a term must depend, in part, on its context.

1. *Define* (the term(s)...) is intended literally, only a formal statement or equivalent paraphrase being required.
2. *What do you understand by/What is meant by* (the term (s)...) normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.
3. *State* implies a concise answer with little or no supporting argument (e.g. a numerical answer that can readily be obtained 'by inspection').
4. *List* requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified this should not be exceeded.
5. *Explain* may imply reasoning or some reference to theory, depending on the context.
6. *Describe* requires the candidate to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

   In other contexts, *describe* should be interpreted more generally (i.e. the candidate has greater discretion about the nature and the organisation of the material to be included in the answer). *Describe and explain* may be coupled, as may *state and explain*.
7. *Discuss* requires the candidate to give a critical account of the points involved in the topic.
8. *Outline* implies brevity (i.e. restricting the answer to giving essentials).
9. *Predict* implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

   Predict also implies a concise answer with no supporting statement required.
10. *Deduce* is used in a similar way to *predict* except that some supporting statement is required, e.g. reference to a law or principle, or the necessary reasoning is to be included in the answer.
11. *Suggest* is used in two main contexts, i.e. either to imply that there is no unique answer (e.g. in Chemistry, two or more substances may satisfy the given conditions describing an 'unknown'), or to imply that candidates are expected to apply their general knowledge of the subject to a 'novel' situation, one that may be formally 'not in the syllabus' – many data response and problem solving questions are of this type.
12. *Find* is a general term that may variously be interpreted as *calculate, measure, determine*, etc.
13. *Calculate* is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
14. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument (e.g. length, using a rule, or mass, using a balance).
15. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula e.g. relative molecular mass.
16. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned, making such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.
17. *Sketch*, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct, **but** candidates should be aware that, depending on the context, some quantitative aspects may be looked for (e.g. passing through the origin, having an intercept).

    In diagrams, *sketch* implies that simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

MATHEMATICAL REQUIREMENTS

Calculators may be used in all parts of the examination.

Candidates should be able to:

1. add, subtract, multiply and divide;
2. use averages, decimals, fractions, percentages, ratios and reciprocals;
3. recognise and use standard notation;
4. use direct and inverse proportion;
5. use positive, whole number indices;
6. draw charts and graphs from given data;
7. interpret charts and graphs;
8. select suitable scales and axes for graphs;
9. make approximate evaluations of numerical expressions;
10. recognise and use the relationship between length, surface area and volume and their units on metric scales;
11. use usual mathematical instruments (ruler, compasses, protractor, set square);
12. understand the meaning of angle, curve, circle, radius, diameter, square, parallelogram, rectangle and diagonal;
13. solve equations of the form $x = yz$ for any one term when the other two are known.

RESOURCE LIST

The following books have been endorsed by CIE for use with this syllabus. They have been through an independent quality assurance process and match the syllabus content closely.

Harwood, R	*Chemistry* (Edition 2, 2003) Cambridge University Press ISBN 0 5215 3093 8 http://www.cambridge.org/education/international This book is also available from Cambridge University Press in a Low Priced Edition (ISBN 0 5216 6662 7) from their local distributors in Africa, The Caribbean, Bangladesh, India, Nepal, Pakistan and Sri Lanka.
Berry, R	*IGCSE Study Guide for Chemistry* (2005) Hodder Murray ISBN 0 7195 7902 3 http://www.hodderheadline.co.uk

Teachers may also find reference to the following books helpful. These are suitable for use with this syllabus. Content of the books does not necessarily match the CIE syllabus closely and examples may be British in focus.

Clegg, A	*Chemistry for IGCSE* Heinemann ISBN 0 4359 6675 8 http://www.heinemann.co.uk
Earl, B & Wilford, L D R	*Chemistry* John Murray, Hodder Murray ISBN 0 7195 5303 2 http://johnmurray.co.uk
Hill, G	*Chemistry Counts* Hodder and Stoughton, ISBN 0 3406 3934 2 http://www.hodderheadline.co.uk
Lewis & Waller	*Thinking Chemistry* (GCSE Edition) Oxford University Press ISBN 0 1991 4257 2 http://www.oup.co.uk

These titles represent some of the texts available at the time of printing this booklet. Teachers are encouraged to choose texts for class use which they feel will be of interest to their students and will support their own teaching style.

SCIENCES
Experiment Form

IGCSE

Please read the instructions printed overleaf.

Centre Number						Centre Name	
Syllabus Code		**0**	**6**	**2**	**0**	Syllabus Title	**Chemistry**
Component Number		**0**		**4**		Component Title	**Coursework**
June/November	**2**	**0**	**1**	**0**			

Experiment Number	Experiment	Skill(s) Assessed

INSTRUCTIONS FOR COMPLETING SCIENCES EXPERIMENT FORM

1. Complete the information at the head of the form.
2. Use a separate form for each Syllabus.
3. Give a brief description of each of the experiments your students performed for assessment in the IGCSE Science Syllabus indicated. Use additional sheets as necessary.
4. Copies of the experiment forms and the corresponding worksheets/instructions and marking schemes will be required for each assessed task sampled, for each of Skills C1 to C4 inclusive.

SCIENCES
Individual Candidate Record Card
IGCSE 2010

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number						Centre Name					June/November	**2**	**0**	**1**	**0**
Candidate Number						Candidate Name					Teaching Group/Set				
Syllabus Code	**0**	**6**	**2**	**0**		Syllabus Title	**CHEMISTRY**	Component Number	**0**	**4**	Component Title	**COURSEWORK**			

Date of Assessment	Experiment Number from Sciences Experiment Form	Assess at least twice: ring highest two marks for each skill (Max 6 each assessment)				Relevant comments (for example, if help was given)
		C1	C2	C3	C4	
Marks to be transferred to Coursework Assessment Summary Form		(max 12)	(max 12)	(max 12)	(max 12)	TOTAL (max 48)

INSTRUCTIONS FOR COMPLETING INDIVIDUAL CANDIDATE RECORD CARDS

1. Complete the information at the head of the form.
2. Mark each item of Coursework for each candidate according to instructions given in the Syllabus and Training Manual.
3. Enter marks and total marks in the appropriate spaces. Complete any other sections of the form required.
4. Ensure that the addition of marks is independently checked.
5. **It is essential that the marks of candidates from different teaching groups within each Centre are moderated internally.** This means that the marks awarded to all candidates within a Centre must be brought to a common standard by the teacher responsible for co-ordinating the internal assessment (i.e. the internal moderator), and a single valid and reliable set of marks should be produced which reflects the relative attainment of all the candidates in the Coursework component at the Centre.
6. Transfer the marks to the Coursework Assessment Summary Form in accordance with the instructions given on that document.
7. Retain all Individual Candidate Record Cards and Coursework **which will be required for external moderation.** Further detailed instructions about external moderation will be sent in late March of the year of the June examination and early October of the year of the November examination. See also the instructions on the Coursework Assessment Summary Form.

Note: These Record Cards are to be used by teachers only for students who have undertaken Coursework as part of their IGCSE.

SCIENCES

Coursework Assessment Summary Form

IGCSE 2010

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number						Centre Name		June/November	2	0	1	0
Syllabus Code	0	6	2	0	Syllabus Title	CHEMISTRY	Component Number	0	4	Component Title	COURSEWORK	

Candidate Number	Candidate Name	Teaching Group/ Set	C1 (max 12)	C2 (max 12)	C3 (max 12)	C4 (max 12)	Total Mark (max 48)	Internally Moderated Mark (max 48)

Name of teacher completing this form		Signature		Date						
Name of internal moderator		Signature		Date						

UNIVERSITY of CAMBRIDGE International Examinations

A. INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1. Complete the information at the head of the form.
2. List the candidates in an order which will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate index number order, where this is known; see item B.1 below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate group or set.
3. Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows:
   (a) Where there are columns for individual skills or assignments, enter the marks initially awarded (i.e. before internal moderation took place).
   (b) In the column headed 'Total Mark', enter the total mark awarded before internal moderation took place.
   (c) In the column headed 'Internally Moderated Mark', enter the total mark awarded *after* internal moderation took place.
4. Both the teacher completing the form and the internal moderator (or moderators) should check the form and complete and sign the bottom portion.

B. PROCEDURES FOR EXTERNAL MODERATION

1. University of Cambridge International Examinations (CIE) sends a computer-printed Coursework mark sheet MS1 to each Centre (in late March for the June examination and in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed Coursework mark sheet MS1.
2. The top copy of the computer-printed Coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 30 April for the June examination and 31 October for the November examination.
3. CIE will select a list of candidates whose work is required for external moderation. As soon as this list is received, send candidates' work, with the corresponding Individual Candidate Record Cards, this summary form and the second copy of MS1, to CIE.
4. Experiment Forms, Work Sheets and Marking Schemes must be included for each task **that has contributed to the final mark of these candidates**.
5. Photocopies of the samples may be sent **but** candidates' original work, with marks and comments from the teacher, is preferred.
6. (a) The pieces of work for each skill should **not** be stapled together, nor should individual sheets be enclosed in plastic wallets.
   (b) Each piece of work should be clearly labelled with the skill being assessed, Centre name, candidate name and index number and the mark awarded. For each task, supply the information requested in B.4 above.
7. CIE reserves the right to ask for further samples of Coursework.

APPENDIX: ADDITIONAL INFORMATION

Spiritual, Ethical, Social, Legislative, Economic and Cultural Issues

The syllabus provides a number of areas in which candidates may appreciate the moral, social, ethical, economic and cultural issues surrounding chemical industry, both on a local and on a global scale. It is expected that candidates will gain a deeper appreciation and understanding of the atomic and molecular workings of the world around them.

Whilst gaining experience of practical skills, candidates have the opportunity to develop their ability to work as a team, where appropriate, and to value the contribution of others' ideas.

Sustainable Development, Health and Safety Considerations and International Developments

This syllabus offers opportunities to develop ideas on sustainable development and environmental issues, health and safety, and the international dimension.

Sustainable development and environmental issues
Aspects of environmental education and sustainable development occur in relation to reducing the impact of chemical industry on the environment and improving efficiency of synthesis.
Aspects of environmental education and sustainable development are covered in topics 6.2, 7.1, 10.3, 11, 13, 14.2, 14.8(a).

Health and safety
The following Health and safety Issues feature in this syllabus:

- Candidates are required to adhere to good health and safety practice in the laboratory.
- Issues associated with the impact of electricity generation and chemical industry on the environment.

Health and safety issues are covered in topics 6.2, 7.1, 11, 14.2.

The International dimension
There are opportunities in this syllabus to investigate local, national and international contributions to the subject field and to appreciate the global significance of chemistry. For example, fuel cells topic 6.2, industrial processes topics 10.3(a), 11 and 14.5, polymer chemistry topic 14.8(a) and environmental chemistry topic 13.

Avoidance of Bias

CIE has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind.

Language

This syllabus and the associated assessment materials are available in English only.

Resources

Copies of syllabuses, the most recent question papers and Principal Examiners' reports are available on the Syllabus and Support Materials CD-ROM, which is sent to all CIE Centres.

Resources are also listed on CIE's public website at www.cie.org.uk.

Access to teachers' email discussion groups and suggested schemes of work may be found on the CIE Teacher Support website at http://teachers.cie.org.uk. This website is available to teachers at registered CIE Centres.