Chemistry 7081

This subject may be taken at both the May/June and January examinations.

Introduction

This syllabus provides a relevant course for all those who will end their study of chemistry at this stage, and lays a secure foundation for those who will continue their studies in this or related subjects.

Questions will be set in SI units except that pressure may be expressed in atmospheres (atm).

The syllabus has been designed so that teachers may be free to plan their own courses and explore some of the suggestions put forward in modern teaching programmes. It is essential that emphasis is laid on experimental work, preferably carried out by the pupils themselves. The syllabus stresses the unifying concepts and principles of chemistry, aims to minimise the summary work expected of pupils and should be used to emphasise the importance of chemistry for society and its power to contribute to the pattern of society in the future.

As in the past, the style of examination questions will continue to change to take account of modern developments. The examination papers will test not only knowledge and understanding, but also the ability to use these to solve problems in chemistry and to devise experiments to test hypotheses.

Aims

The syllabus aims to:

1. illustrate the unifying patterns and themes of chemistry;
2. develop an appreciation of the usefulness and limitations of the procedures used by chemists and a logical approach to problem solving in a wider context;
3. emphasise the practical nature of chemistry, encourage practical and investigative skills with correct and safe laboratory techniques, and make students aware of the importance to scientific method of accurate experimental work and reporting;
4. develop students' ability to form hypotheses and to design experiments to test them;
5. illustrate the widespread importance of chemistry, and the way materials are used in the world;
6. show how the work of the chemist has social, industrial, technological, environmental and economic consequences for the community.

Assessment objectives

The examination will test:

1. Knowledge and understanding of:
   - (a) chemical facts and practical techniques together with the major applications and everyday uses of chemistry;
   - (b) chemical terminology, symbols and conventions;
   - (c) relevant physical quantities and their determination;
   - (d) physical and chemical principles, concepts, theories, definitions, laws, models, patterns and generalisations;
   - (e) social, economic, environmental and technological contributions, applications and implications of chemistry.

2. The ability of the candidate to:

(a) select suitable apparatus for carrying out experiments accurately and safely;
(b) organise, present and interpret data in the form of tables, graphs, symbols, diagrams or written statements;
(c) communicate scientific ideas, observations and arguments logically, concisely and sensibly;
(d) perform simple chemical calculations in familiar and unfamiliar situations;
(e) apply logical thinking to problem solving;
(f) devise safe, suitable, simple experiments and procedures for solving chemical problems;
(g) evaluate the results of an experiment, appreciating possible errors;
(h) select and use appropriate facts to illustrate models or hypotheses in the interpretation of observations;
(i) use experimental data, recognising patterns in such data; form hypotheses and deduce relationships, making decisions based on the examination of evidence and arguments;
(j) apply appropriate chemical principles, concepts, theories, definitions, laws, models and patterns to interpret, draw conclusions and make generalisations and predictions from chemical facts, observations and experimental data;
(k) appreciate the importance and implications of the social, economic, environmental and technological contributions and applications of chemistry.

Mathematical requirements

The following are the minimum mathematical skills that may be required to answer examination questions.

Ability to:

(a) carry out simple arithmetical processes such as addition, subtraction, multiplication and division of quantities, expressed in decimal notation or as fractions; simple percentage calculations; calculations involving ratios; direct and inverse proportion;
(b) use index notation; solve simple algebraic equations;
(c) plot and interpret simple graphs; carry out extrapolations and interpolations on them; determine slopes of graphs.

The scheme of assessment

The examination will consist of two compulsory papers.

About 60% of the overall examination marks will be allocated to Knowledge and Understanding (AO1) with the remaining 40% being allocated to Application, Analysis and Evaluation (AO2).

The target weightings for the various aspects of chemistry will be of the order of:

Chemical principles	70%
Experimental techniques and design of experiments	20%
Quantitative aspects	10%

Paper 1 (1 hour 15 minutes) 40% of total mark. This will consist of a number of short answer questions and questions requiring some extended writing to a total of 100 marks. Candidates will be asked to record their answers on the question paper. Approximately 10% of the marks will be awarded for questions requiring some extended writing.

A Periodic Table, including atomic numbers and relative atomic masses (rounded, in most cases, to the nearest whole number) will be printed in each question paper. The table will include all the elements up to radium.

Relative atomic masses and the molar volume for gases will also be given when required. Electronic calculators may be used in any part of the examination; four figure mathematical tables may be issued to candidates requesting them.

Paper 2 (2 hours) 60% of total mark. This will consist of two sections, A and B, which will aim to complement the testing of abilities in Paper 1.

Section A:

This section will consist of five compulsory structured questions and answers will be recorded by the candidates on the question paper.

Candidates will be given opportunity to demonstrate their knowledge and understanding. This section will also seek to test ability in the application of understanding to solving problems, including quantitative problems. The ability to use scientific information given, for example, in graphical or tabular form may also be tested in this section, and questions may call for candidates to use patterns in chemical knowledge. At least one of these questions in this section will relate to procedures that are adopted in carrying out a chemical experiment.

Section B:

This section will consist of four questions and candidates will be expected to answer two questions.

Questions in this section will require candidates to organise material and present ideas in a clear and logical form. Candidates may be expected, for example, to show that they can provide a descriptive account of a familiar experiment or process. Candidates may also be expected to handle patterns in chemical knowledge and to show critical and imaginative ability. Questions may be set which will enable candidates to show that they have developed an investigative approach to the subject as a result of laboratory work.

Syllabus content

1. Principles of chemistry

The experimental basis underlying much of this section, eg atomic and ionic theory and the Periodic Table, is to be found in the other sections. The discussion of atomic and ionic theories should lead to the ability to interpret what is seen in the laboratory in terms of molecules, atoms, ions and electrons and their movement. Molecular and ionic equations should be used to contribute to this end.

1.1 Atoms

Candidates should be able to:

(a) recall simple experiments leading to the idea of the smallness of particles and to their motion including dilution of coloured solutions, diffusion experiments and Brownian motion;

(b) define an element, and an atom as the particle of which elements are composed;

(c) recall that atomic masses are the masses of atoms relative to 12C = 12 and are referred to as relative atomic masses;

(d) understand a mole of atoms as a number of atoms equal to the Avogadro constant.

1.2 Chemical formulae

Candidates should be able to:

(a) apply the idea of a mole of atoms in finding chemical formulae;
(b) recall investigations to find the formulae of simple compounds such as copper(II) oxide and water;
(c) recall that the formulae of other compounds have been obtained experimentally.

1.3 Relative molecular and formula masses

Candidates should be able to:

(a) recall that the mole is an amount of substance which can also be expressed as the Avogadro constant number of particles (atoms, molecules, formulae, ions or electrons) or as a relative formula mass in grams;
(b) find the molar volumes of some gases from practical data and from relative formula masses and densities, and from them deduce Avogadro's law;
(c) understand the significance of the molar volume of a gas.

1.4 Chemical equations

Candidates should be able to:

(a) recall quantitative experimental investigations, including direct mass determination, the use of standard solutions and the measurement of volumes in reactions involving gases, to determine the relative numbers of particles involved in chemical reactions;
(b) write balance chemical equations to represent the reactions studied in this syllabus;
(c) recall that the state symbols (l), (s), (g) and (aq) are used in chemical equations to represent liquids, solids, gases and aqueous solutions respectively.

1.5 The Periodic Table

Candidates should be able to:

(a) appreciate the Periodic Table as the arrangement of elements according to atomic number;
(b) classify elements as 'metals' and 'non-metals' on the basis of their properties and be aware that some elements exhibit a mixture of the properties of metals and non-metals;
(c) recall families of elements including the alkali metals (Group 1), the alkaline earth metals (Group 2) and the halogens (Group 7);
(d) discuss the correlation of charges of ions with position in the Periodic Table;
(e) discuss the relative reactivities of the elements in Groups of metals and non-metals;
(f) recall the noble gases (Group 0) as a family of inert gases;
(g) discuss sequences in the valencies of the elements across periods such as CH_4, NH_3, OH_2, ClH.

1.6 Structure of the atom in relation to the Periodic Table

Candidates should be able to:

(a) recall the structure of an atom in terms of protons, neutrons and electrons;
(b) explain the terms atomic number, mass number, isotopes and relative atomic mass;
(c) relate periodicity to electronic configuration;

(d) relate similarity of electron configuration to similarity of the chemical properties of the Group 1 elements (2.1; 2.8.1; 2.8.8.1) and the Group 7 elements (2.7; 2.8.7; 2.8.18.7; 2.8.18.18.7);
(e) link electron configuration and ionic charge;
(f) appreciate the importance of the noble gas electron configurations (2; 2.8; 2.8.8; 2.8.18.8; 2.8.18.18.8).

1.7 Ionic compounds

Candidates should be able to:

(a) describe the formation of ions by gain or loss of electrons;
(b) describe the formation of ionic crystals such as sodium chloride;
(c) appreciate the ionic bond as the result of an attraction between oppositely charged ions;
(d) describe an ionic crystal as a giant three-dimensional ionic structure held together by attraction between oppositely charged ions.

1.8 Electrolysis

Candidates should be able to:

(a) recall simple experiments to distinguish between electrolytes and non-electrolytes;
(b) understand an electric current as a flow of electrons or ions;
(c) recall the faraday as a mole of electrons;
(d) recall quantitative studies of the products of the electrolysis of molten salts or aqueous solutions;
(e) recall the charges on common ions met in the syllabus;
(f) write ionic equations representing the reaction at each electrode during electrolysis;
(g) understand oxidation and reduction as the loss and gain of electrons respectively;
(h) appreciate that experiments on migration of ions provides some evidence for the ionic theory;
(i) connect displacement experiments between metals and ions with work on the reactivity series.

1.9 Covalent compounds

Candidates should be able to:

(a) describe the formation of covalent bonds by sharing of electrons;
(b) appreciate the covalent bond as the result of attraction between the bonding pair of electrons and the nuclei of the atoms involved in the bond;
(c) recall the existence of simple molecular crystals of ice, solid carbon dioxide, solid methane, solid ammonia and iodine at suitable temperatures;
(d) describe the shapes of the above molecules and the weak forces between the molecules in the crystals;
(e) appreciate that weak intermolecular forces result in low melting points and boiling points;
(f) describe the giant molecular covalent crystals of diamond and graphite;
(g) appreciate that atoms in diamond and graphite are held together by strong covalent bonds which result in high sublimation points.

1.10 Metallic crystals

Candidates should be able to:

(a) describe a metal as a giant structure in which electrons are free to move throughout the whole structure;
(b) relate the structure of a metal to observable properties such as conductivity and malleability.

2. Chemistry of the elements

This section is concerned with the simple inorganic chemistry of metals and non-metals.

2.1 The Group 7 elements chlorine, bromine and iodine

Candidates should be able to:

(a) describe the physical characteristics of the elements;
(b) recall the inter-conversion of halogen and halide ion;
(c) appreciate the difference between hydrogen chloride and hydrochloric acid;
(d) describe the properties of solutions of hydrogen chloride in water and in methylbenzene;
(e) describe the laboratory preparation of chlorine from hydrochloric acid;
(f) state a simple chemical test for chlorine;
(g) discuss similarities in the chemistry of these elements which establish them as a family of elements;
(h) discuss reactions in which one halogen displaces another;
(i) make predictions about the properties of other halogens;
(j) make appropriate links between this section and the chlorides of the metals in sections 2.7, 2.8 and 2.9, and other halides of the Group 1 elements.

2.2 Oxygen

Candidates should be able to:

(a) recall the industrial extraction of oxygen, by fractional distillation, from liquid air;
(b) recall the gases present in air and their approximate percentage by volume;
(c) understand oxidation and reduction as the addition and removal of oxygen respectively;
(d) state a simple chemical test for oxygen;
(e) discuss the reactions with oxygen in air of magnesium, iron, copper, carbon, sulphur and methane;
(f) recall how to determine the percentage by volume of oxygen in the air from at least one of the above reactions;
(g) discuss oxides of the carbon, nitrogen and sulphur and their reactions with water;
(h) recall the conditions under which iron rusts;
(i) describe how rusting of iron may be prevented by grease, oil, paint, plastic and galvanising;
(j) discuss the reduction of oxides in terms of the reactivity of elements.

2.3 Sulphur

Candidates should be able to:

(a) recall industrial sources of sulphur;
(b) describe the physical characteristics of the element including its allotropes;

(c) recall the nature of sulphur dioxide;
(d) state a simple chemical test for sulphur dioxide;
(e) describe the reaction of sulphur dioxide with alkalis;
(f) describe the reaction of sulphites with dilute acids;
(g) state a precipitation test for sulphates.

2.4 Nitrogen

Candidates should be able to:

(a) recall the industrial extraction of nitrogen, by fractional distillation, from liquid air;
(b) recall the importance of the inert nature of nitrogen in protecting food;
(c) describe the laboratory preparation of ammonia;
(d) recall the physical properties of ammonia;
(e) state a simple chemical test for ammonia;
(f) recall the reaction of nitrogen with oxygen to form nitrogen monoxide and nitrogen dioxide;
(g) discuss the simple chemistry of aqueous ammonia, ammonium chloride, ammonium nitrate and ammonium sulphate;
(h) recall that nitric acid is made from ammonia;
(i) make appropriate links between this section and the nitrates of the metals in section 2.7 and the reaction of copper with nitric acid in section 2.9.

2.5 Carbon

Candidates should be able to:

(a) describe the physical characteristics of the element including its allotropes;
(b) discuss the differences in the physical characteristics and reactivity of diamond and graphite in relation to their structures;
(c) discuss the reaction of carbon with metal oxides;
(d) describe the laboratory preparation of carbon dioxide;
(e) recall the physical and chemical properties of carbon dioxide;
(f) state a simple chemical test for carbon dioxide;
(g) recall common uses of carbon dioxide including carbonating drinks and in fire extinguishers;
(h) recall that incomplete combustion of fuels may produce carbon monoxide;
(i) discuss the toxic nature of carbon monoxide and its effect on the body;
(j) make appropriate links between this section and the carbonates of the metals in section 2.7 and copper(II) carbonate in section 2.9.

2.6 Hydrogen

Candidates should be able to:

(a) recall the effect of dilute hydrochloric and dilute sulphuric acids on magnesium, aluminium, zinc and iron;
(b) describe the laboratory preparation of hydrogen;
(c) state a simple chemical test for hydrogen;
(d) describe the combustion of hydrogen with oxygen to form water;
(e) state a simple chemical test to show the presence of water;
(f) describe a physical test to show if water is pure;
(g) describe the reaction of hydrogen with chlorine.

2.7 The Group 1 elements lithium, sodium and potassium

Candidates should be able to:

(a) describe the action of these elements on water;
(b) recognise that the reactivities of these elements with water provides a basis for their recognition as a family of elements;
(c) discuss the simple physical and chemical properties of the hydroxides, halides, sulphates, nitrates and carbonates of these elements in terms of general patterns of behaviour;
(d) make predictions about other elements and their compounds in this Group.

2.8 The Group 2 elements magnesium and calcium

Candidates should be able to:

(a) describe the action of these elements on water;
(b) discuss the simple physical and chemical properties of the oxides, hydroxides, chlorides and carbonates of these elements in terms of general patterns of behaviour;
(c) make predictions about other elements and their compounds in this Group.

2.9 The transition metals iron and copper

Candidates should be able to:

(a) describe the action of steam, hydrogen chloride and chlorine on iron;
(b) discuss the formation of iron(II) and iron(III) hydroxides;
(c) describe the action of nitric acid on copper;
(d) discuss the simple chemical and physical properties of copper(II) oxide, hydroxide, nitrate, sulphate, carbonate, and chloride;
(e) recall the existence of copper(I) compounds such as copper(I) oxide;
(f) describe the reaction of copper(II) ions with ammonia to form the complex ion $[Cu(H_2O)_2(NH_3)_4]^{2+}$
(g) appreciate that the study of these two metals and their compounds illustrates typical transition metal properties of variable valency, formation of coloured compounds and formation of complex ions;

2.10 Reactivity series

Candidates should be able to:

(a) appreciate that the reactivity of elements can be used to order elements;
(b) relate the pattern in the reactions of the elements and their compounds which are specified elsewhere in the syllabus to a reactivity series;
(c) recall evidence used to establish the following order of reactivity: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, (hydrogen) and copper;
(d) establish position within a reactivity series using displacement reactions involving metals and their compounds in aqueous solutions.

2.11 Simple tests for ions

Candidates should be able to:

(a) recall simple tests for the cations sodium, potassium, calcium, ammonium, copper(II), iron(II) and iron(III) (flame tests are sufficient for sodium, potassium and calcium);
(b) recall simple tests for the anions chloride, bromide and iodide; sulphate and carbonate.

3. Organic chemistry

This section provides a simple introduction to the organic chemistry of carbon.

3.1 Alkanes

Candidates should be able to:

(a) identify alkanes as saturated hydrocarbons;
(b) explain the terms homologous series and general formula;
(c) recall that, in alkanes, the four bonds on each carbon atom are directed to the corners of a tetrahedron;
(d) draw displayed formulae for alkanes;
(e) explain the term isomerism;
(f) draw isomers of alkanes containing up to five carbon atoms where they exist, and name them;
(g) describe the halogenation of alkanes.

3.2 Alkenes

Candidates should be able to:

(a) identify alkenes as unsaturated hydrocarbons;
(b) recall that, in alkenes, the three bonds on each carbon atom are directed to the corners of an equilateral triangle;
(c) draw displayed formulae for alkenes;
(d) describe the addition of halogens to alkenes;
(e) recall that ethane-1,2-diol is made from ethene.

3.3 Ethanol

Candidates should be able to:

(a) discuss the industrial preparation of ethanol by fermentation and the hydrolysis of ethene;
(b) describe the reaction of ethanol with sodium and phosphorus pentachloride;
(c) describe the oxidation of ethanol to ethanoic acid;
(d) describe the dehydration of ethanol to ethene;
(e) describe the reaction of ethanol with carboxylic acids, such as ethanoic acid, to form esters;
(f) recall that many esters have distinct pleasant smells.

4. Physical chemistry

This section deals with some of the physical aspects of chemistry.

4.1 States of matter

Candidates should be able to:

(a) recall there are three states of matter: gas, liquid and solid;
(b) discuss the interconversion of gas, liquid and solid;
(c) explain the differences between mixtures and compounds;
(d) recall techniques for separation including distillation, fractional distillation, filtration, crystallisation, paper chromatography;
(e) discuss the states of matter in terms of the kinetic theory;
(f) explain how heats of vaporisation can be used to compare the energy needed to separate the same number of different particles.

4.2 Acidity, alkalinity and neutralisation

Candidates should be able to:

(a) recall how to test for acidity and alkalinity using suitable indicators;
(b) recall the colours produced by the following indicators in acidic solution and alkaline solution: litmus, phenolphthalein, methyl orange and universal indicator;
(c) describe the pH scale, running from 0–14, as an arbitrary scale of acidity and alkalinity;
(d) describe solutions which have a pH value less than 7 as acidic and those with a pH value of more than 7 as alkaline; solutions with a pH of 7 are neutral;
(e) describe how to carry out acid-alkali titrations in which concentrations are given in moles;
(f) describe how to prepare salts using neutralisation reactions including the reaction of excess metal oxide/metal carbonate and dilute acid.

4.3 Energetics

Candidates should be able to:

(a) recall that energy changes accompany simple processes;
(b) recall that processes may be described as exothermic when heat is given out and endothermic when heat is absorbed;
(c) discuss energy changes accompanying combustion, solution, neutralisation and precipitation;
(d) explain the term enthalpy;
(e) write thermochemical equations using the ΔH notation;
(f) draw energy profiles for exothermic and endothermic reactions;
(g) recall the Principle of Conservation of Energy;
(h) appreciate that heats of reaction are the result of energy changes when bonds are broken and formed;
(i) use average bond dissociation energies to calculate the energy change during a simple chemical reaction.

4.4 Rates of Reactions

Candidates should be able to:

(a) recall that the rate of a reaction may be affected by certain conditions;
(b) describe the significance, in a chemical reaction, of surface area, concentration, temperature and the use of a catalyst;
(c) appreciate the effects of particle size, concentration and temperature in terms of effective collisions using a simple kinetic model.

4.5 Equilibria in Chemistry

Candidates should be able to:

(a) discuss the idea of a simple reversible reaction, such as the hydration of heated anhydrous copper(II) sulphate;
(b) describe other reversible reactions;
(c) explain the concept of dynamic equilibrium and the use of the symbol in equations;
(d) account for dynamic equilibrium in terms of the kinetic theory.

5. Chemistry in society

It is intended that this aspect of Chemistry should add relevance and interest to the whole course. The material of this section could be integrated into the course wherever suitable as soon as the underlying principles have been met. It is important to present Chemistry as a developing subject and to bring pupils to an appreciation of its nature and scope. For this reason a fairly wide range of material is covered but detailed treatment is not expected.

In the treatment of industrial processes the emphasis should be on the raw materials available, the demand for products and the principles underlying the processes. Some attention should also be give to the environmental problems that may arise as a result of the processes.

5.1 Principles underlying the extraction of metals

Candidates should be able to:

(a) recall the raw materials used in the production of aluminium;
(b) describe the electrolysis of a solution of alumina in cryolite;
(c) recall the raw materials used in the manufacture of iron;
(d) describe the extraction of iron in the blast furnace;
(e) identify carbon monoxide as the reducing agent in the above process;
(f) describe the extraction of zinc by both electrolysis and reduction by carbon monoxide;
(g) describe the extraction of chromium by the Thermite process;
(h) relate the methods of extraction of the metals in this section to their positions in the reactivity series;
(i) describe the use of electrolysis in the purification of copper;
(j) recall some important uses of the metals in this section;
(k) discuss some of the problems of dealing with waste from metal-extracting processes.

5.2 Natural oil and gas

Candidates should be able to:

(a) recall that crude oil is a complex mixture of hydrocarbons;
(b) describe how crude oil is separated into fractions by fractional distillation;
(c) identify the fractions obtained from crude oil;
(d) state the physical properties and uses of the different fractions;
(e) recall that fractional distillation of crude oil produces more long-chain hydrocarbons and less of the short-chain than required;
(f) describe how long-chain hydrocarbons are cracked to give more short-chain hydrocarbons;
(g) discuss the potential damage to the environment that may arise from the spillage of crude oil and the release of hydrocarbons into the atmosphere.

5.3 Synthetic polymers

Candidates should be able to:

(a) recall that a polymer is formed by joining up many small molecules of monomer;
(b) recall that polymers may be made by two different processes: addition and condensation;
(c) recall that ethene is used in the manufacture of the addition polymer poly(ethene) (polyethene);

(d) describe the formation of poly(ethene) and draw its structure;
(e) apply the principles of addition polymerisation to other addition polymers, including poly(phenylethene) (polystyrene);
(f) recall the monomers used in the manufacture of the condensation polymer nylon;
(g) describe the formation of nylon and draw its structure in a block diagram format;
(h) apply the principles of condensation polymerisation to other condensation polymers, including terylene.

5.4 The heavy chemicals industry

Candidates should be able to:

(a) recall the raw materials used in the industrial manufacture of ammonia;
(b) describe the industrial synthesis of ammonia via the Haber Process;
(c) recall important uses of ammonia including the manufacture of NPK fertilisers;
(d) describe the industrial manufacture of nitric acid from ammonia;
(e) recall the raw materials used in the industrial manufacture of sulphuric acid;
(f) describe the industrial synthesis of sulphuric acid via the Contact Process;
(g) recall important uses of sulphuric acid;
(h) appreciate that sulphur dioxide and nitrogen oxides are pollutant gases which contribute to acid rain;
(i) discuss some of the problems associated with acid rain;
(j) describe the industrial manufacture of sodium hydroxide and chlorine by the electrolysis of brine;
(k) recall important uses of sodium hydroxide and chlorine;
(l) describe the manufacture of soap.

Textbooks and other resources

Changes to the examination system in the United Kingdom over the past two decades has resulted in some divergence between the traditional content of the GCE Ordinary Level chemistry syllabus and that of GCSE chemistry. The basics concepts are common to both examinations. However, some textbooks designed to cover the chemistry content of GCSE science double award, or indeed GCSE chemistry, will not provide complete cover for the O level syllabus. Some additional input may be required. Teachers will need to make a judgement on how closely texts written for GCSE cover the O level syllabus content.

The following are comprehensive first examination texts suitable for use on O level courses.

Author	Title/ISBN	Publisher
G C Hill	Chemistry Counts (ISBN 0 340 63934 2)	Hodder and Stoughton 2002
E Ramsden	Key Science Chemistry (ISBN 0 748 73009 5)	Stanley Thornes 1999

The following series of 12 wall charts is designed for use with O level chemistry courses.

	Macmillan Chemistry Wall Charts (ISBN 0 333 611 322)	Macmillan 1996

In addition teachers may find it useful to have other works to hand for reference.

The following are comprehensive A level chemistry texts.

Author	Title/ISBN	Publisher
M Freemantle	Chemistry in Action (ISBN 0 333 56515 0)	Thomson Learning 1995
G Hill & J Holman	Chemistry in Context (ISBN 0 17 448191 8)	Nelson-Thornes 1995
K Gadd & S Gurr	Chemistry (ISBN 0 17 448236 1)	Nelson-Thornes 1994
A & P Fullick	Chemistry (ISBN 0 435 570 803)	Heinemann 2000

Teachers may also find the following provide useful background information.

The Essential Chemical Industry (ISBN 185342 556 7) available from The Chemical Industry Education Centre (CIEC), Department of Chemistry, University of York, Heslington, York YO1 5DD United Kingdom.

Oil and Chemical Processing available from Public Affairs Department, Esso UK plc Mailpoint 8, ExxonMobile House, Ermyn Way, Leatherhead, Surrey KT22 8UX United Kingdom.

Resources for teachers

Chief Examiner's comments

The mark scheme with examiners' report including the Chief Examiner's comments, is issued to centres after each examination session and can also be found on the Edexcel International website www.edexcel-international.org It is also available from Edexcel International Publications.

Edexcel publications

Copies of the mark scheme with examiners' reports and copies of past examination papers can be obtained from:

Edexcel International Publications
Adamsway
Mansfield
Notts
NG18 4FN,
UK

Telephone: + 44 1623 450 781

Fax: + 44 1623 450 481

E-mail: intpublications@linneydirect.com

How to contact Edexcel International

For further information and for all general enquiries, please contact:

Edexcel International
190 High Holborn
London
WC1V 7BH
UK

Telephone: +44 (0) 190 884 7750

Fax: +44 (0) 207 190 6700

Email: www.edexcel.org.uk/ask

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