Revision Checklist for AS/A Level Chemistry 9701

Guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

REVISION CHECKLIST for AS/A Level Chemistry 9701

A guide for students

How to use this guide

The guide describes what you need to know about your GCE Advanced Subsidiary level (AS) or GCE Advanced Level (A) Chemistry examinations. Centres choose one of the three options for their students:

- To take all Advanced Level components (AS and A2) in the same examination session leading to the full Advanced Level (A).
- To follow a staged assessment route to the Advanced Level (A) by taking the Advanced Subsidiary (AS) qualification in an earlier examination session. Subject to satisfactory performance such students are then only required to take the final part of the assessment (A2) leading to the full A Level (A).
- To take the Advanced Subsidiary (AS) qualification only.

It is important when using this revision checklist that you know which one of the above three options has been chosen by your school, college or centre. If you do not know, then your chemistry teacher and examinations officer will know.

This guide will help you to plan your revision programme for the Theory and Practical examination papers, but not the Option examination paper (A2 only). It will explain what examiners are looking for in the answers you write. It can also be used to help you revise, by using ticks in Section 3 ('what you need to know') to check what you know and which topic areas you have covered.

The guide contains the following sections:

Section 1 - How will you be tested?
This section will give you information about the different types of Theory, Practical and Option examination papers that are available.

Section 2 - What will be tested?
This section describes the areas of knowledge, understanding and skills that you will be tested on.

Section 3 - What you need to know
This shows the syllabus content for AS and A2 in a simple way so that you can check:

- the topics you need to know about
- how the Theory differs from the Practical syllabus
- details about each topic in the syllabus
- how much of the syllabus you have covered

Section 1 - How will you be tested?

1.1 The examination papers you will take

AS Level candidates are required to enter for papers 1, 2 and 3

A2 candidates are required to enter for papers 4, 5 and 6

A Level candidates are required to enter for papers 1, 2, 3, 4, 5 and 6

1.2 Information about the examination papers

The table below gives you outline information about all the examination papers

Paper	Type of Paper	Duration	Marks	Weighting (%)	
				AS	A
1	Multiple Choice	1 h	40	32	16
2	Structured Questions on AS Core	1 h 15 min	60	48	24
3	Practical Test	1 h 15 min	25	20	10
4	Structured Questions on A2 Core	1 h 15 min	60	-	23
5	Practical Test	1 h 30 min	30	-	11
6	Options	1 h	40	-	16

1.3 Information about each examination paper.

Paper 1 (1 hr) (40 marks)

40 multiple choice questions based on the AS core (Syllabus sections 1 to 10). 30 items will be of the direct choice type and 10 of the multiple completion type. All questions will include 4 responses.

Paper 2 (1¼ hr) (60 marks)

A variable number of structured questions all compulsory, based on the AS core (Syllabus sections 1 to 10). You write your answers on the question paper.

Paper 3 Practical Test (1¼ hr) (25 marks)

This will feature experiments and investigations. The Examiners will not be restricted by the subject content. The scope of the practical test is indicated in the Practical Chemistry Syllabus. The techniques required will be less demanding than those required for Paper 5 and will consist of a simple titration and a qualitative analysis.

Paper 4 (1¼ hr) (60 marks)

Combining a variable number of structured and free response style questions, all compulsory, based on the A2 core syllabus. You write your answers on the question paper.

Paper 5 Practical Test (1½ hr) (30 marks)

This will feature experiments and investigations of a more demanding nature, the Examiners will not be restricted by subject content. Approximately 30% of the marks will be for assessment of planning skills. The scope of the practical test is indicated in the Practical Chemistry syllabus and may test a wider variety of skills and more complicated titrations, investigations and analysis.

Paper 6 (1 hr) (40 marks)
You will be required to choose only 2 out of the 5 option topics. These will have been the 2 topics you have been taught. Answer all the questions for those 2 options. This section will be governed by the Option Syllabuses (but knowledge of core material may be required) and will count for a total of 40 marks.

Section 2 - What will be tested?

2.1 Assessment Objectives
The Examiners take account of the following in your examination papers.

Assessment Objective:	What this examines:
A - **knowledge** with **understanding**	Remembering facts and applying these facts to new situations
B - ability in **handling**, **applying** and **evaluating** information	How you extract information and rearrange it in a sensible pattern. How you carry out calculations and make predictions. You also need to reflect upon the validity and reliability of that information commenting on possible sources of error
C - use of **experimental skills** and **investigations**	Planning and carrying out experiments and recording, analyzing and evaluating information. You also need to reflect upon the validity and reliability of that information. You need to comment on possible sources of error and you need to identify ways in which to improve that experimental work

2.2 Assessment Objective Details
The assessment objectives listed below reflect those parts of the aims of the course which will be assessed. This is a brief description and your teacher will be able to provide you with more detailed information on assessment objectives.

A. Knowledge with understanding

Demonstrate with relation to understanding:
scientific phenomena, facts, laws, definitions, concepts, theories
scientific vocabulary, terminology, conventions (including symbols, quantities and units)
scientific instruments and apparatus, including techniques of operation and aspects of safety
scientific quantities and their determination
scientific and technological applications with their social, economic and environmental implications
present reasoned explanations for phenomena, patterns and relationships

B. Handling, applying and evaluating information

You should be able (in words or by using symbolic, graphical and numerical forms of presentation) to:
locate, select, organise and present information from a variety of sources
handle information, distinguishing the relevant from the extraneous
manipulate numerical and other data and translate information from one form to another
analyse and evaluate information so as to identify patterns, report trends and draw inferences
construct arguments to support hypotheses or to justify a course of action
apply knowledge, including principles, to novel situations
evaluate information and hypotheses

C. Experimental skills and investigations

You should be able to:
plan investigations
use techniques, apparatus and materials
make and record observations, measurements and estimates
interpret and evaluate observations and experimental results
select techniques, apparatus and materials
evaluate methods and suggest possible improvements

2.3 Allocation of marks to assessment objectives and syllabus area

Whilst the overall allocation of marks to assessment objectives A and B in the theory papers is given below, the balance on each paper may vary slightly from year to year.

Type of Paper	Assessment Objective Tested
Theory Papers (Papers 1, 2, 4 and 6)	Knowledge with understanding (Assessment Objective A), approximately 60% of marks, (approximately 35% for knowledge and 25% for understanding).
	Handling, applying and evaluating information (Assessment Objective B), approximately 40%.
Options Theory Section (Paper 6)	This section is designed to test appropriate aspects of Assessment Objectives A and B. Every effort is made to produce questions of similar difficulty with a reasonable spread of skills for each option. The differences between options mean that different skills will be required.
Practical Test (Papers 3 & 5)	This paper is designed to test appropriate aspects of experimental skills and investigations, (Assessment Objective C).
	The practical paper may involve some calculations based on experimental results and will be allocated between 15% to 30% of the total marks available for the practical test.

2.4 Data Booklet

A Data Booklet is available for use in Papers 1, 2, 4 and 6.

Section 3 - What you need to know

3.1 Introduction
What you need to know is presented in a table, which describes the things you may be tested on in the examinations. These are arranged into themes, each being divided into topic areas. These topics are then subdivided into specific "things you should be able to do". These topics will be placed into one of two columns:

- **The first column is for students studying AS and A2.**
- **The second column is *additional* material for students studying A2.**

You need only refer to the first column (headed **students studying AS and A2)** if you are studying AS Level chemistry. If you are studying A Level chemistry then ***both*** columns are needed. If you are unsure about which material to use, you should ask your teacher for advice.

3.2 How to use the table
You can use the table throughout your chemistry course to check the theme and topic areas you have covered. You can also use it as a revision aid. When you have a good knowledge of a topic, you tick the appropriate space in the checklist column.
The themes are:

Physical Chemistry: Atoms, molecules and stoichiometry
Physical Chemistry: Atomic structure
Physical Chemistry: Chemical bonding
Physical Chemistry: States of matter
Physical Chemistry: Chemical energetics
Physical Chemistry: Electrochemistry
Physical Chemistry: Equilibria
Physical Chemistry: Reaction kinetics
Inorganic Chemistry: The periodic table/chemical periodicity
Inorganic Chemistry: Group II
Inorganic Chemistry: Group IV
Inorganic Chemistry: Group VII
Inorganic Chemistry: An introduction to the chemistry of transition elements
Inorganic Chemistry: Nitrogen and sulphur
Organic Chemistry: Introductory topics
Organic Chemistry: Hydrocarbons
Organic Chemistry: Halogen derivatives
Organic Chemistry: Hydroxy compounds
Organic Chemistry: Carbonyl compounds
Organic Chemistry: Carboxylic acids and derivatives
Organic Chemistry: Nitrogen compounds
Organic Chemistry: Polymerisation
Practical syllabus.

3.3 Testing yourself

Test yourself as follows:

- cover up the details with a piece of paper
- try to remember the details
- when you have remembered the details correctly, put a tick in the appropriate space in the checklist column.

If you use a pencil to tick the space you can retest yourself whenever you want by simply rubbing out the ticks. If you are using the table to check the topics you have covered, you can put a tick in the topic column next to the appropriate bullet point.

The column headed **comments** can be used:

- to add further information about the details for each bullet point
- to note relevant page numbers from your text book
- to add learning aids e.g. OIL RIG (for oxidation is loss (of electrons) and reduction is gain (of electrons)
- to highlight areas of difficulty/ things which you need to ask your teacher about.

Physical Chemistry: Atoms, molecules and stoichiometry

Syllabus Section	Theme	Topic	Students studying A/S and A2			***Additional*** **material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
1	Atoms, molecules and stoichiometry	Relative masses of atoms and molecules	Define the terms relative atomic, isotopic, molecular and formula masses, based on the carbon-12 scale					
		The mole; the Avogadro constant	Define the term mole in terms of the Avogadro constant					
		The determination of relative atomic masses, Ar, and relative molecular masses, M*r*, from mass spectra	Analysis of mass spectra in terms of isotopic abundances		Knowledge of the working of the mass spectrometer is not required	Analysis of mass spectra in terms of molecular fragments.		
			Calculate the relative atomic mass of an element given the relative abundances of its isotopes, or its mass spectrum		The term relative formula mass will be used for ionic compounds and relative molecular mass for covalent compounds			
		The calculation of empirical and molecular formulae	Define the terms empirical and molecular formulae					
			Calculate empirical and molecular formulae, using combustion data or composition by mass					

		Reacting masses and volumes (of solutions and gases)	Write and construct balanced equations					
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
1	Atoms, molecules and stoichiometry		Perform calculations, including use of the mole concept, involving: (i) reacting masses (from formulae and equations) (ii) volumes of gases (e.g. in the burning of hydrocarbons) (iii) volumes and concentrations of solutions					
			Deduce stoichiometric relationships from calculations					

Physical Chemistry: Atomic Structure

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
2	Atomic Structure	The nucleus of the atom: neutrons and protons, isotopes, proton and nucleon numbers	Identify and describe protons, neutrons and electrons in terms of their relative charges and relative masses					
			Deduce the behaviour of beams of protons, neutrons and electrons in electric fields					
			Describe the distribution of mass and charges within an atom					
			Deduce the numbers of protons, neutrons and electrons present in both atoms and ions given Proton, nucleon numbers and charge					
			Describe the contribution of protons and neutrons to atomic nuclei in terms of proton number and nucleon number					
			Distinguish between isotopes on the basis of different numbers of neutrons present					

		Electrons: electronic energy levels, ionisation energies, atomic orbitals, extranuclear structure	Describe the number and relative energies of the s, p and d orbitals for the principal quantum numbers 1, 2 and 3 and also the 4s and 4p orbitals					

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**	
			Things you should be able to do		Comment	Things you should be able to do	
2	Atomic Structure		Describe the shapes of s and p orbitals				
			State the electronic configuration of atoms and ions given the proton number and charge				
			Explain and use the term ionisation energy				
			Explain the factors influencing the ionisation energies of elements				
			Explain the trends in ionisation energies across a period and down a group of the Periodic Table				
			Deduce the electronic configurations of elements from successive ionisation energy data				
			Interpret successive ionisation energy data of an element in terms of the position of that element within the Periodic Table				

Physical Chemistry: Chemical Bonding

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
3	Chemical Bonding	Ionic (electrovalent) bonding	Describe ionic (electrovalent) bonding, as in sodium chloride and magnesium oxide, including the use of 'dot-and-cross' diagrams					
		Covalent bonding and co-ordinate (dative covalent) bonding	Describe, including the use of 'dot-and-cross' diagrams, covalent bonding. For example as in hydrogen, oxygen, chlorine, hydrogen chloride, carbon dioxide, methane and ethene					
			Describe, including the use of 'dot-and-cross' diagrams, co-ordinate (dative covalent) bonding. For example as in the formation of the ammonium ion and in the Al_2Cl_6 molecule					
			Explain the shapes of and bond angles in molecules by using the qualitative model of electron-pair repulsion (including lone pairs). Use simple examples such as BF_3 (trigonal); CO_2 (linear); CH_4 (tetrahedral); NH_3 (pyramidal); H_2O (non-linear); SF_6 (octahedral) to illustrate your answers					
			Describe covalent bonding in terms of orbital overlap, giving σ and π bonds					

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
3	Chemical Bonding		Explain the shape of, and bond angles in, the ethane and ethene molecules in terms of σ and π bonds			Explain the shape of, and bond angles in benzene molecules in terms of σ and π bonds		
			Predict the shapes of and bond angles in molecules similar to those stated above.					
		Covalent bonding: bond energies, bond lengths and bond polarities	Explain the terms bond energy, bond length and bond polarity and use them to compare the reactivities of covalent bonds					
			Show understanding of chemical reactions in terms of energy transfers associated with the breaking and making of chemical bonds					
		Intermolecular forces, including hydrogen bonding	Describe hydrogen bonding, using ammonia and water as simple examples of molecules containing N-H and O-H groups					
			Describe intermolecular forces (van der Waals' forces), based on permanent and induced dipoles, as in $CHCl_3(l)$; $Br_2(l)$ and the liquid noble gases					
		Metallic bonding	Describe metallic bonding in terms of a lattice of positive ions surrounded by mobile electrons					

		Bonding and physical properties	Describe, interpret and predict the effect of different types of bonding (ionic bonding; covalent bonding; hydrogen bonding; other intermolecular interactions; metallic bonding) on the physical properties of substances. Deduce the type of bonding present from given information					
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
4	States of Matter	The gaseous state: ideal gas behaviour and deviations from it	State the basic assumptions of the kinetic theory as applied to an ideal gas					
			Explain qualitatively in terms of intermolecular forces and molecular size the conditions necessary for a gas to approach ideal behaviour					
			Explain qualitatively in terms of intermolecular forces and molecular size the limitations of ideality at very high pressures and very low temperatures					
		The gaseous state: pV = nRT and its use in determining a value for Mr	State and use the general gas equation pV = nRT in calculations, including the determination of Mr					

		The liquid state: the kinetic concept of the liquid state and simple kinetic-molecular descriptions of changes of state	Describe, using a kinetic-molecular model, the liquid state; melting; vaporisation and vapour pressure					
		The solid state: lattice structures	Describe, in simple terms, the lattice structure of a crystalline solid which is: (i) ionic, as in sodium chloride, magnesium oxide (ii) simple molecular, as in iodine (iii) giant molecular, as in graphite; diamond; silicon(IV) oxide (iv) hydrogen-bonded, as in ice (v) metallic, as in copper		The concept of the 'unit cell' is not required			
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
4	States of Matter		Explain the strength, high melting point, electrical insulating properties of ceramics in terms of their giant molecular structure					
			Relate the uses of ceramics, based on magnesium oxide, aluminium oxide and silicon(IV) oxide, to their properties (suitable examples include furnace linings; electrical insulators; glass; crockery)					

			Describe and interpret the uses of the aluminium metal, including its alloys, and copper metal, including brass, in terms of their physical properties					
			Understand that materials are a finite resource and the importance of recycling processes					
			Outline the importance of hydrogen bonding to the physical properties of substances, including ice and water					
			Suggest from quoted physical data the type of structure and bonding present in a substance					

Physical Chemistry: Chemical Energetics

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
5	Chemical Energetics	Enthalpy changes	Explain that chemical reactions are accompanied by energy changes, principally in the form of heat energy; the energy changes can be exothermic (ΔH, negative) or endothermic (ΔH, positive)					
			Explain and use the terms: enthalpy change of reaction and standard conditions, with particular reference to: formation; combustion; hydration; solution; neutralisation; atomisation					
			Explain and use the terms: bond energy (ΔH positive, i.e. bond breaking)			Explain and use the terms: lattice energy (ΔH negative, i.e. gaseous ions to solid lattice)		
			Calculate enthalpy changes from appropriate experimental results, including the use of the relationship enthalpy change = mcΔT			Explain, in qualitative terms, the effect of ionic charge and of ionic radius on the numerical magnitude of a lattice energy		
			Construct and interpret a reaction pathway diagram, in terms of the enthalpy change of the reaction and of the activation energy					

Syllabus Section	Theme	Topic	Students studying A/S and A2			***Additional*** **material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
5	Chemical Energetics	Hess' Law, including Born-Haber cycles	Apply Hess' Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to determining enthalpy changes that cannot be found by direct experiment, e.g. an enthalpy change of formation from enthalpy changes of combustion			Apply Hess' Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to the formation of a simple ionic solid and of its aqueous solution		
			Apply Hess' Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to average bond energies			Apply Hess' Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to Born-Haber cycles (including ionisation energy and electron affinity)		

Physical Chemistry: Electrochemistry

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
6	Electrochemistry	Redox processes	Describe and explain redox processes in terms of electron transfer and/or of changes in oxidation number (oxidation state)					
		Industrial processes	Explain, including the electrode reactions, the industrial processes of: (i) the electrolysis of brine, using a diaphragm cell (ii) the extraction of aluminium from molten aluminium oxide/cryolite (iii) the electrolytic purification of copper					
		Electrode potentials				Define the terms: (i) standard electrode (redox) potential (ii) standard cell potential		
						Describe the standard hydrogen electrode		
						Describe methods used to measure the standard electrode potentials of: (i) metals or non-metals in contact with their ions in aqueous solution (ii) ions of the same element in different oxidation states		
						Calculate a standard cell potential by combining two standard electrode potentials		
						Use standard cell potentials to explain/deduce the direction of electron flow from a simple cell		

						Use standard cell potentials to predict the feasibility of a reaction		
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
6	Electrochemistry					Construct redox equations using the relevant half-equations		
						Predict qualitatively how the value of an electrode potential varies with the concentration of the aqueous ion		
		Batteries and fuel cells				State the possible advantages of developing other types of cell, e.g. the H2/O2 fuel cell and improved batteries (as in electric vehicles) in terms of smaller size, lower mass and higher voltage		
		Electrolysis: factors affecting the substance and the amount of that substance liberated during electrolysis				Predict the identity of the substance liberated during electrolysis from the state of electrolyte (molten or aqueous), position in the redox series (electrode potential) and concentration		
		Electrolysis: the Faraday constant, the Avogadro constant and their relationship				State the relationship, F = Le, between the Faraday constant, the Avogadro constant and the charge on the electron		
						Calculate: (i) the quantity of charge passed during electrolysis (ii) the mass and/or volume of substance liberated during electrolysis, including those in the electrolysis of H2SO4(aq); Na2SO4(aq)		

						Describe the determination of a value of the Avogadro constant by an electrolytic method		

Physical Chemistry: Equilibria

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
7	Equilibria	Reversible reactions	Explain, in terms of rates of the forward and reverse reactions, what is meant by a reversible reaction					
		Dynamic equilibrium	Explain, in terms of rates of the forward and reverse reactions, what is meant by a dynamic equilibrium					
		Factors affecting chemical equilibria	State Le Chatelier's Principle and apply it to deduce the qualitative effects of changes in temperature, concentration or pressure, on a system at equilibrium					
			Deduce whether changes in concentration, pressure, temperature or the presence of a catalyst, affect the value of the equilibrium constant for a reaction					
		Equilibrium constants	Deduce expressions for equilibrium constants in terms of concentrations, Kc, and partial pressures, Kp		Treatment of the relationship between Kp and Kc is not required			

			Calculate the values of equilibrium constants in terms of concentrations or partial pressures from appropriate data					
			Calculate the quantities present at equilibrium, given appropriate data		Such calculations will not require the solving of quadratic equations			
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
7	Equilibria	The Haber process	Describe and explain the conditions used in the Haber process					
		The Contact process	Describe and explain the conditions used in the Contact process					
		Bronsted-Lowry theory of acids and bases	Show understanding of, and use the Bronsted-Lowry theory of acids and bases					
		Acid dissociation constants, Ka and pKa	Explain qualitatively the differences in behaviour between strong and weak acids and bases in terms of the extent of dissociation			Explain the terms pH; Ka; pKa; and apply use in calculations		
						Calculate [H+(aq)] and pH values for strong and weak acids and strong bases		
		The ionic product of water, Kw				Explain the term Kw and apply use in calculations		
		pH: choice of pH indicators				Explain the choice of suitable indicators for acid-base titrations, given appropriate data		

						Describe the changes in pH during acid-base titrations and explain these changes in terms of the strengths of the acids and bases		
		Buffer solutions				Explain how buffer solutions control pH		
						Describe and explain their uses, including the role of HCO_3^- ion in controlling pH in blood		
						Calculate the pH of buffer solutions, given appropriate data		

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
7	Equilibria	Solubility product				Show understanding of, and use, the concept of solubility product, Ksp		
						Calculate Ksp from concentrations and vice versa		
		The common ion effect				Show understanding of the common ion effect		

Physical Chemistry: Reaction Kinetics

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
8	Reaction Kinetics	Terminology	Explain and use the terms: rate of reaction; activation energy; catalysis			Explain and use the terms: rate equation; order of reaction; rate constant; half-life of a reaction; rate-determining step		
		Collision theory and Boltzmann distribution	Explain qualitatively, in terms of collisions, the effect of concentration changes on the rate of a reaction					
			Show understanding of the term activation energy, by reference to the Boltzmann distribution					
			Explain qualitatively, in terms of the Boltzmann distribution and the collision frequency, the effect of temperature change on the rate of a reaction					
		General catalysis	Explain that, in the presence of a catalyst, a reaction has a different mechanism, i.e. one of lower activation energy					
			Interpret this catalytic effect in terms of the Boltzmann distribution					
			Describe enzymes as biological catalysts (proteins) which usually have very specific activity					

		Rate equations				Construct and use rate equations of the form rate = k[A]m[B]n		Limited to simple cases of single step reactions (multi-step processes) with a rate-determining step for which m and n are 0, 1 or 2
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
8	Reaction Kinetics	Order of reaction				Deducing the order of a reaction by the initial rates method		
						Justifying, for zero- and first-order reactions, the order of reaction from concentration-time graphs		
						Verifying that a suggested reaction mechanism is consistent with the observed kinetics		
						Predicting the order that would result from a given reaction mechanism (and vice versa)		
						Calculating an initial rate using concentration data		Integrated forms of rate are not required
						Show understanding that the half-life of a first-order reaction is independent of concentration		
						Use the half-life of a first-order reaction in calculations		
		Rate constant				Calculate a rate constant using the initial rates method		

						devise a suitable experimental technique for studying the rate of a reaction, from given information		
		Modes of action in homogeneous and heterogeneous catalysis				The catalytic role of iron in the Haber process		
						The catalytic removal of oxides of nitrogen in the exhaust gases from car engines		
						The catalytic role of atmospheric oxides of nitrogen in the oxidation of atmospheric sulphur dioxide		
						The catalytic role of Fe^{3+} in the I^- / $S2O_8$ reaction		

Inorganic Chemistry: The Periodic Table/Chemical Periodicity

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9	The Periodic Table/Chemical Periodicity	Periodicity of physical properties of the elements across the third period (sodium to argon)	Describe qualitatively (and indicate the periodicity in) the variations in atomic radius, ionic radius, melting point and electrical conductivity of the elements (see the Data Booklet)					
			Explain qualitatively the variation in atomic radius and ionic radius					
			Interpret the variation in melting point and in electrical conductivity in terms of the presence of simple molecular, giant molecular or metallic bonding in the elements					
			Explain the variation in first ionisation energy					
		Periodicity of chemical properties of the elements in the third period	Describe the reactions, if any, of the elements with oxygen to give Na2O; MgO; Al2O3; P4O10; SO2; SO3					
			Describe the reactions, if any, of the elements with chlorine to give NaCl; MgCl2; Al2Cl6; SiCl4; PCl5					
			Describe the reactions, if any, of the elements Na and Mg only with water					
			State and explain the variation in oxidation number of the oxides and chlorides					

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9	The Periodic Table/Chemical Periodicity		Describe the reactions of the oxides with water		Treatment of peroxides and superoxides is not required			
			Describe and explain the acid/base behaviour of oxides and hydroxides, including, where relevant, amphoteric behaviour in reaction with sodium hydroxide (only) and acids					
			Describe and explain the reactions of the chlorides with water					
			Interpret the variations and trends in chemical properties in terms of bonding and electronegativity					
			Suggest the types of chemical bonding present in chlorides and oxides from observations of their chemical and physical properties					
			Predict the characteristic properties of an element in a given group by using knowledge of chemical periodicity					

			Deduce the nature, possible position in the Periodic Table, and identity of unknown elements from given information of physical and chemical properties					

Inorganic Chemistry: Group II

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.2	Group II	Similarities and trends in the properties of the Group II metals and their compounds	Describe the reactions of the elements with oxygen and water					
			Describe the behaviour of the oxides with water					
			Describe the thermal decomposition of the nitrates and carbonates			Interpret and explain qualitatively the trend in the thermal stability of the nitrates and carbonates in terms of the charge density of the cation and the polarisability of the large anion		
			Interpret and make predictions from the trends in physical and chemical properties of the elements and their compounds					
						Interpret and explain qualitatively the variation in solubility of the sulphates in terms of relative magnitudes of the enthalpy change of hydration and the corresponding lattice energy		

		Uses of Group II compounds	Explain the use of magnesium oxide as a refractory lining material and calcium carbonate as a building material					
			Describe the use of lime in agriculture					

Inorganic Chemistry: Group IV

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.3	Group IV	General properties				Understand that the elements (carbon to lead) and their compounds change their physical and chemical properties with increasing proton number from non-metals through metalloids to metals		
		The variation in melting points and electrical conductivities				Outline the variation in melting point and in electrical conductivity of the elements and interpret them in terms of structure and bonding		
		The bonding, molecular shape, volatility and hydrolysis of the tetrachlorides				Describe and explain the bonding, molecular shape and volatility of the tetrachlorides		
						Describe and explain the reactions of the tetrachlorides with water in terms of structure and bonding		

		The bonding, acid/base nature and thermal stability of the oxides				Describe and explain the bonding, acid-base nature and thermal stability of the oxides of oxidation states II and IV		
						Recognize the properties and uses of ceramics based on silicon(IV) oxide		
		The relative stability of higher and lower oxidation states				Describe and explain the relative stability of higher and lower oxidation states of the elements in their oxides and aqueous cations, including where relevant E^o values		

Inorganic Chemistry: Group VII

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.4	Group VII	Characteristic physical properties	Describe the trends in volatility and colour of chlorine, bromine and iodine					
			Interpret the volatility of the elements, chlorine, bromine and iodine, in terms of van der Waals' forces					
		The relative reactivity of the elements as oxidising agents	Describe the relative reactivity of the elements, chlorine, bromine and iodine as oxidizing agents			Deduce from E^o values the relative reactivity of the elements, chlorine, bromine and iodine, as oxidizing agents		
			Describe and explain the reactions of the elements with hydrogen					
			Describe and explain the relative thermal stabilities of the hydrides,					
			Interpret these relative stabilities in terms of bond energies					

		Some reactions of the halide ions	Describe and explain the reactions of halide ions with aqueous silver ions followed by aqueous ammonia,					
			Describe and explain the reactions of halide ions with concentrated sulphuric acid					
		The manufacture of chlorine	Outline a method for the manufacture of chlorine from brine by a diaphragm cell					
		The reactions of chlorine with aqueous sodium hydroxide	Describe and interpret in terms of changes of oxidation number the reaction of chlorine with cold, and with hot, aqueous sodium hydroxide					

Inorganic Chemistry: An introduction to the chemistry of transition elements

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.5	An introduction to the chemistry of transition elements	General physical and chemical properties of the elements (titanium to copper) and their compounds	State examples of catalysis by transition metals and their compounds					
						Explain the meant of transition element, in terms of d-block elements forming one or more stable ions with incomplete d orbitals		
						State the electronic configuration of the first row transition elements and of their ions		

						State the atomic radii, ionic radii and first ionisation energies of the transition elements are relatively invariant (similar)		
						Contrast, qualitatively, the melting point; density; atomic radius; ionic radius; first ionisation energy and conductivity of the transition elements with calcium as a typical s-block element		
						Describe the tendency of transition elements to have variable oxidation states		
						Predict from a given electronic configuration, the likely oxidation states of a transition element		
						Describe and explain the use of Fe^{3+}/Fe^{2+}, MnO_4^-/Mn^{2+} and $Cr2O_7^{2-}/Cr^{3+}$ as examples of redox systems		

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.5	An introduction to the chemistry of transition elements					Explain the reactions of transition elements with ligands to form complexes, including the complexes of copper(II) ions with water and ammonia		
						Predict, using E^o values, the likelihood of redox reactions		
						Explain qualitatively that ligand exchange may occur		Include CO/O2 in haemoglobin
		Colour of complexes				Describe the formation and state the colour of these complexes		

Inorganic Chemistry: Nitrogen and Sulphur

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.6	Nitrogen and sulphur	Nitrogen: Its unreactivity	Explain the lack of reactivity of nitrogen					
		Nitrogen: Ammonia, ammonium ion, nitric acid and fertilisers	Describe the formation and structure of the ammonium ion					
			Describe the displacement of ammonia from its salts					
			Describe the Haber process for the manufacture of ammonia from its elements, giving essential operating conditions, and interpret these conditions (qualitatively) in terms of the principles of kinetics and equilibria					
			Understand the industrial importance of ammonia and nitrogen compounds derived from ammonia					
		Nitrogen: The environmental impact of nitrogen oxides and nitrates	Understand the environmental consequences of the uncontrolled use of nitrate fertilisers					
			Understand and explain the occurrence, and catalytic removal, of oxides of nitrogen					
			Explain why atmospheric oxides of nitrogen are pollutants, including their catalytic role in the oxidation of atmospheric sulphur dioxide					

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
9.6	Nitrogen and sulphur	Sulphur: The formation of atmospheric sulphur dioxide and the use of sulphur dioxide in food preservation	Describe the formation of atmospheric sulphur dioxide from the combustion of sulphur contaminated carbonaceous fuels					
			State the role of sulphur dioxide in the formation of acid-rain and describe the main environmental consequences of acid-rain					
			Describe the use of sulphur dioxide in food preservation					
		Sulphur: Sulphuric acid	State the main details of the Contact process for sulphuric acid production					
			Understand the industrial importance of sulphuric acid					

Organic Chemistry: Introductory topics

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
Although there are features of organic chemistry topics that are distinctive, it is intended that you make cross-references with other themes/topics in the syllabus. When describing preparative reactions, you will be expected to quote the reagents, e.g. aqueous NaOH, the essential practical conditions, e.g. reflux, and the identity of each of the major products. Detailed knowledge of practical procedures are not required: however, you may be expected to suggest (from your knowledge of the reagents, essential conditions and products) what steps may be needed to purify / extract a required product from the reaction mixture. In equations for organic redox reactions, the symbols [O] and [H] are acceptable. In each of the sections below, 10.1 to 10.8, you will be expected to be able to predict the reaction products of a given compound in reactions that are chemically similar to those specified.								
10.1	Introductory topics	Molecular, structural and empirical formulae	Write structural formulae e.g. CH3CH2CH2OH for propan-1-ol and not C3H7OH.					
			Write displayed formulae showing the relative placing of all atoms and the number of bonds between all the atoms The convention for representing the aromatic ring is preferred The symbol for cyclohexane is acceptable					
			Draw optical isomers giving three-dimensional structures according to the convention used					

		Functional groups and the naming of organic compounds	Interpret and use the nomenclature, general formulae and displayed formulae of alkanes and alkenes		Knowledge of benzene or its compounds is not required for A/S	Interpret and use the nomenclature, general formulae and displayed formulae of arenes		You will be expected to recognize the shape of the benzene ring when it is present in organic compounds.
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.1	Introductory topics		Interpret and use the nomenclature, general formulae and displayed formulae of halogenoalkanes			Interpret and use the nomenclature, general formulae and displayed formulae halogenoarenes		
			Interpret and use the nomenclature, general formulae and displayed formulae of alcohols (including primary, secondary and tertiary)			Interpret, and use the nomenclature, general formulae and displayed formulae of phenols		
			Interpret and use the nomenclature, general formulae and displayed formulae of aldehydes and ketones					
			Interpret and use the nomenclature, general formulae and displayed formulae of carboxylic acids and esters			Interpret and use the nomenclature, general formulae and displayed formulae of acyl chlorides		
			Interpret and use the nomenclature, general formulae and displayed formulae of amines (primary only) and nitriles			Interpret and use the nomenclature, general formulae and displayed formulae of amides and amino acids		
		Characteristic organic reactions	Interpret and use the term: functional group					

			Interpret and use the terms: homolytic and heterolytic fission					
			Interpret and use the terms: free radical, initiation, propagation and termination					
			Interpret and use the terms: nucleophile and electrophile					
			Interpret and use the terms: addition, substitution, elimination and hydrolysis					

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.1	Introductory topics		Interpret and use the terms: oxidation and reduction		In equations for organic redox reactions, the symbols [O] and [H] are acceptable			
		Shapes of organic molecules; σ and π bonds	Describe the shapes of the ethane and ethane molecules			Describe the shape of the benzene molecule		
			Predict the shapes of other related molecules					
			Explain the shapes of the ethane and ethene molecules in terms of σ and π carbon-carbon bonds			Explain the shape of the benzene molecule in terms of σ and π carbon-carbon bonds		
		Isomerism: structural; cis-trans; optical	Describe structural isomerism					

			Describe cis-trans isomerism in alkenes, and explain its origin in terms of restricted rotation due to the presence of π bonds					
			Explain what is meant by a chiral centre and that such a centre gives rise to optical isomerism					
			Deduce the possible isomers for an organic molecule of known molecular formula					
			Identify chiral centres and / or cis-trans isomerism in a molecule of given structural formula					

Organic Chemistry: Hydrocarbons

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.2	Hydrocarbons	Alkanes	Be aware of the general unreactivity of alkanes, including towards polar reagents		Exemplified by ethane			
			Describe the chemistry of alkanes: combustion, substitution by chlorine and substitution by bromine					
			Describe the mechanism of free-radical substitution at methyl groups with particular reference to the initiation, propagation and termination reactions					
		Alkenes	Describe the chemistry of alkenes: addition of hydrogen, steam, hydrogen halides and halogens		Exemplified by ethene			
			Describe the chemistry of alkenes: oxidation by cold, dilute manganate(VII) ions to form the diol					
			Describe the chemistry of alkenes: oxidation by hot, concentrated manganate(VII) ions leading to the rupture of the carbon-to-carbon double bond in order to determine the position of alkene linkages in larger molecules					
			Describe the chemistry of alkenes: polymerisation					

			Describe the mechanism of electrophilic addition in alkenes, using bromine/ethene as an example					
Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.2	Hydrocarbons	Arenes				Describe the chemistry of arenas: substitution reactions with chlorine and with bromine		Exemplified by benzene and methylbenzene
						Describe the chemistry of arenas: nitration		
						Describe the chemistry of arenas: oxidation of the side-chain to give a carboxylic acid		
						Describe the mechanism of electrophilic substitution in arenes, using the mononitration of benzene as an example		
						Describe the effect of the delocalisation of electrons in the electrophilic substitution in arenes		
						Predict whether halogenation will occur in the side-chain or aromatic nucleus in arenes depending on reaction conditions		
						Apply the knowledge of positions of substitution in the electrophilic substitution of arenes		
		Hydrocarbons as fuels	Explain the use of crude oil as a source of aliphatic and aromatic hydrocarbons					

			Suggest how 'cracking' can be used to obtain more useful alkanes and alkenes of lower Mr from larger hydrocarbon molecules					
			Describe and explain how the combustion reactions of alkanes lead to their use as fuels in the home, industry and transport					

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.2	Hydrocarbons		Recognise the environmental consequences of carbon monoxide, oxides of nitrogen and unburnt hydrocarbons arising from the internal combustion engine					
			Recognise the environmental consequences of the catalytic removal of pollutant gases					

Organic Chemistry: Halogen derivatives

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.3	Halogen derivatives	Halogenoalkanes and halogenoarenes	Recall the chemistry of halogenoalkanes as exemplified by the following nucleophilic substitution reactions of bromoethane: hydrolysis; formation of nitriles; formation of primary amines by reaction with ammonia					
			Recall the chemistry of halogenoalkanes as exemplified by the elimination of hydrogen bromide from 2-bromopropane					
			Describe the mechanism of nucleophilic substitution in halogenoalkanes					
			Explain the uses of fluoroalkanes and fluorohalogenoalkanes in terms of their relative chemical inertness					
			Recognise the concern about the effect of chlorofluoroalkanes on the ozone layer					

		Relative strength of the C-Hal bond	Interpret the different reactivities of halogenoalkanes e.g. CFCs; anaesthetics; flame retardants and plastics with particular reference to hydrolysis and to the relative strengths of the C-Hal bonds			Interpret the different reactivities of halogenoalkanes including chlorobenzene with particular reference to hydrolysis and to the relative strengths of the C-Hal bonds		

Organic Chemistry: Hydroxy compounds

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.3	Hydroxy compounds	Alcohols	Recall the chemistry of alcohols, exemplified by ethanol: combustion		(exemplified by ethanol)			
			Recall the chemistry of alcohols, exemplified by ethanol: substitution to give halogenoalkanes					
			Recall the chemistry of alcohols, exemplified by ethanol: reaction with sodium					
			Recall the chemistry of alcohols, exemplified by ethanol: oxidation to carbonyl compounds and carboxylic acids					
			Recall the chemistry of alcohols, exemplified by ethanol: dehydration to alkenes					
			Recall the chemistry of alcohols, exemplified by ethanol: ester formation					
			Classify hydroxy compounds into primary, secondary and tertiary alcohols					
			Suggest characteristic distinguishing reactions, e.g. mild oxidation					

						Deduce the presence of a $CH_3CH(OH)$- group in an alcohol from its reaction with alkaline aqueous iodine to form tri-iodomethane		
		Phenol				Recall the chemistry of phenol, as exemplified by the reaction with bases		

Syllabus Section	**Theme**	**Topic**	**Students studying A/S and A2**			***Additional* material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.3	Hydroxy compounds					Recall the chemistry of phenol, as exemplified by the reaction with sodium		
						Recall the chemistry of phenol, as exemplified by the reaction of nitration and of bromination of the aromatic ring		
						Explain the relative acidities of water, phenol and ethanol		

Organic Chemistry: Carbonyl compounds

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.5	Carbonyl compounds	Aldehydes Ketones			Exemplified by ethanal and propanone			Exemplified by phenylethanone
			Describe the formation of aldehydes and ketones from primary and secondary alcohols respectively using $Cr2O_7^{2-}/H^+$					
			Describe the reduction of aldehydes and ketones e.g. using NaBH4					
			Describe the mechanism of the nucleophilic addition reactions of hydrogen cyanide with aldehydes and ketones					
			Describe the use of 2,4-dinitrophenylhydrazine (2,4-DNPH) to detect the presence of carbonyl compounds					
			Deduce the nature (aldehyde or ketone) of an unknown carbonyl compound from the results of simple tests (i.e. Fehling's and Tollens' reagents; ease of oxidation)					
						Describe the reaction of CH3CO- compounds with alkaline aqueous iodine to give tri-iodomethane		

Organic Chemistry: Carboxylic acids and deivatives

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.6	Carboxylic acids and derivatives	Carboxylic acids	Describe the formation of carboxylic acids from alcohols, aldehydes and nitriles		Exemplified by ethanoic acid and benzoic acid			
			Describe the reactions of carboxylic acids in the formation of salts			Describe the reactions of carboxylic acids in the formation of acyl chlorides		
			Describe the reactions of carboxylic acids in the formation of esters					
						Explain the acidity of carboxylic acids and of chlorine-substituted ethanoic acids in terms of their structures		
		Acyl chlorides				Describe the hydrolysis of acyl chlorides		Exemplified by ethanoyl chloride
						Describe the reactions of acyl chlorides with alcohols, phenols and primary amines		
						Explain the relative ease of hydrolysis of acyl chlorides, alkyl chlorides and aryl chlorides		
		Esters	Describe the formation of esters from carboxylic acids using ethyl ethanoate as an example		Exemplified by ethyl ethanoate	Describe the formation of esters acyl chlorides using phenyl benzoate as an example		Exemplified by phenyl benzoate
			Describe the acid and base hydrolysis of esters			Describe the formation of polyesters		
			State the major commercial uses of esters e.g. solvents; perfumes; flavourings					

Organic Chemistry: Nitrogen compounds

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.7	Nitrogen compounds	Primary amines				Describe the formation of ethylamine (by nitrile reduction) and of phenylamine (by the reduction of nitrobenzene)		Exemplified by ethylamine and phenylamine
						Explain the basicity of amines		
						Explain the relative basicities of ammonia, ethylamine and phenylamine in terms of their structures		
						Describe the reaction of phenylamine with: aqueous bromine and nitrous acid to give the diazonium salt and phenol		
						Describe the coupling of benzenediazonium chloride and phenol and the use of similar reactions in the formation of dyestuff		
		Amides				Describe the formation of amides from the reaction between RNH2 and R′COCl		Exemplified by ethanamide
						Describe amide hydrolysis on treatment with aqueous alkali or acid		
		Amino acids				Describe the acid/base properties of amino acids and the formation of zwitterions		Exemplified by aminoethanoic acid
		Proteins				Describe the formation of peptide bonds between amino acids and, hence, explain protein formation		
						Describe the hydrolysis of proteins		
						Describe the formation of polyamides		

Organic Chemistry: Polymerisation

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
10.8	Polymerisation	Addition polymerisation	Describe the characteristics of addition polymerisation as exemplified by poly(ethene) and pvc					
			Recognise the difficulty of the disposal of poly(alkene)s, i.e. non-biodegradability and harmful combustion products					
		Condensation polymerisation				Describe the characteristics of condensation polymerisation in polyesters as exemplified by Terylene		
						Describe the characteristics of condensation polymerisation in polyamides as exemplified by peptides, proteins, nylon 6 and nylon 66		
		Polymerisation				Predict the type of polymerisation reaction for a given monomer or pair of monomers		
						Deduce the repeat unit of a polymer obtained from a given monomer or pair of monomers		
						Deduce the type of polymerisation reaction which produces a given section of a polymer molecule		
						Identify the monomer(s) present in a given section of a polymer molecule		

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
11.1	The Chemistry of Life	Protein Chemistry				Recall that proteins are condensation polymers formed from amino acid monomers and recognise and describe the generalised structure of amino acids.		
						Explain the importance of amino acid sequence (primary structure) in determining the properties of proteins.		
						Distinguish between the primary, secondary and tertiary structure of proteins and explain the stabilisation of secondary and tertiary structure.		
						Describe and explain the characteristics of enzyme catalysis, including : (i) specificity and the idea of competitive inhibition; (ii) structural integrity in relation to denaturation and non-competitive inhibition.		Using a simple lock and key model
						Given information, use core chemistry to explain how small molecules interact with proteins and how they can modify the structure and function of biological systems (for example, enzyme inhibitors or cofactors, disrupting protein-protein interactions, blocking ion channels).		
		Genetic information				Describe the double helical structure of DNA in terms of a sugar-phosphate backbone and attached bases.		You will be expected to know the general structure in terms of a block diagram, but not detailed structures

						Explain the significance of hydrogen-bonding in the pairing of bases in DNA in relation to the replication of genetic information.		
						Explain in outline how DNA encodes for the amino acid sequence in proteins with reference to mRNA, tRNA and the ribosome in translation and transcription.		
						Explain the chemistry of DNA mutation from provided data.		
						Discuss the genetic basis of disease in terms of altered protein structure and function.		For example, sickle cell anaemia.
						Explain how modification to protein/enzyme primary structure can result in new structure and/or function.		
		Energy				Outline, in terms of the hydrolysis of ATP to ADP + P_i, the provision of energy for the cell.		
		Metals in biological systems				Understand why some metals are essential to life and, given information and with reference to chemistry of the core syllabus, be able to explain the chemistry involved.		For example, iron in haemoglobin, sodium and potassium in transmission of nerve impulses, zinc as an enzyme cofactor.
						Recognise that some metals are toxic and discuss, in chemical terms, the problems associated with heavy metals in the environment entering the food chain.		For example, mercury.

Syllabus Section	Theme	Topic	Students studying A/S and A2			***Additional*** **material for students studying A2**		
			Things you should be able to do		Comment	Things you should be able to do		Comment
11.2	Applications of Analytical Chemistry	Methods of detection and analysis				Describe simply the process of electrophoresis and the effect of pH, using peptides and amino acids as examples.		
						Outline, in simple terms, the principles of nuclear magnetic resonance in ^{1}H and be able to interpret simple NMR spectra.		
						Show awareness of the use of NMR and X-ray crystallography in determining the structure of macromolecules and in understanding their function.		
						State what is meant by partition coefficient and calculate a partition coefficient for a system in which the solute is in the same molecular state in the two solvents.		
						Understand qualitatively paper, high performance liquid, thin layer and gas/liquid chromatography in terms of adsorption and/or partition and be able to interpret data from these techniques.		
						Explain the concept of mass spectroscopy, deduce the number of carbon atoms in a compound using the M+1 peak and the presence of bromine and chlorine atoms using the M+2 peak and suggest the identity of molecules formed by simple fragmentation in a given mass spectrum.		

		Applications in chemistry and society				Explain, in simple terms, the technique of DNA fingerprinting and its applications in forensic science, archaeology and medicine.		
						Describe the importance to modern medicine, and the challenges, of separating and characterising the proteins in cells.		
						Draw conclusions given appropriate information and data from environmental monitoring.		For example, PCBs in the atmosphere, isotopic ratios in ice cores

Syllabus Section	Theme	Topic	Students studying A/S and A2			*Additional* material for students studying A2		
			Things you should be able to do		Comment	Things you should be able to do		Comment
11.3	Design and Materials	Medicinal chemistry and drug delivery				Discuss the challenges of drug design and explain, in simple terms, how molecules may be identified and developed to overcome these problems.		
						Discuss the challenges of drug delivery and explain, in simple terms, how materials may be developed to overcome these problems.		
		Properties of polymers				Discuss the properties and structures of polymers based on their methods of formation.		Both addition and condensation should be considered
						Discuss how the presence of side-chains and intermolecular forces affect the properties of polymeric materials.		For example, spider silk
		Nanotechnology				Show awareness of nanotechnology and, given information and data, be able to discuss the chemistry involved with reference to the core syllabus.		
		Environment and energy				Discuss how a knowledge of chemistry can be used to overcome environmental problems.		For example, ground water contamination, oil spillages, CFCs.
						Discuss how a knowledge of chemistry can be used to extend the life of existing resources, to identify alternative resources and to improve the efficiency of energy production and use.		