A Level Chemistry

Curriculum Overview 2020-2021

Statement of intent

A-Level Chemistry - In designing a curriculum to provide challenging opportunities for our students to think and communicate at the highest level, we aim to produce the very best chemists. Our students will develop understanding and awareness of the science that surrounds them and how chemical reactions are an integral aspect of their daily lives. They will develop technical expertise with a range of equipment, and knowledge of how science and technology impacts society; students will develop this competence and confidence in a variety of practical, mathematical and problem-solving skills through Required Practicals and a broad range of other planned practical activities. Transferable skills, such as the scientific method and data analysis and evaluation, will prepare students by providing a strong foundation for a specialised scientific career, whilst equipping them with the knowledge needed for their future, preparing them to become informed citizens. Thus, through our aim to provide a curriculum to inspire and engage all students and help them to identify and understand the chemistry, both in the examined curriculum and in the world around them, we also aspire to equip students with a variety of transferable skills that can be applied in the workplace across a range of careers, not only in the field of chemistry.

Further rationale underpinning our curriculum design includes the careful selection of the order in which topics are taught; this enables students planned opportunities to practise their skills in the context of new knowledge that they are gaining and to interleave more practical topics with those that are naturally more theoretical, where possible. Aspects of some topics are especially taught to bridge transitions such as that from GCSE to A-Level and from Y12 to Y13. Some topics are taught in a spiral fashion, to make learning long-lasting and to develop progressively deeper knowledge and link different topics together, appreciating how they underpin each other. Thus, students' knowledge is built up in a logical, incremental manner, which we consider to be vital to foster a thorough understanding of complex scientific concepts.

The chemistry curriculum, though, remains dynamic and evolving, to cater for the buoying of any topics that may have been less successfully tackled in the most recent external examinations. Collaborative, periodic review and evaluation means that chemistry schemes of work continue to develop and respond to our intent to develop and embed challenge, metacognition, long-term retention and scientific literacy into our curriculum. A continuously developing suite of electronic resources and study packs, linked closely to the curriculum, is designed to motivate students and to fully support their independent learning outside the classroom, serving to extend both the breadth and depth of the formal curriculum and encourage the their motivation for life-long learning.

In lessons, we employ effective questioning, to push students' thinking beyond their initial responses. Scientific language is vital in Chemistry and is highlighted in lesson plans during the teaching of each topic and summarised in the form of glossaries. Teachers use these terms in their teaching and encourage and develop students' use of these in their verbal and written responses. Students carry out practical work in the majority of topics, with the highest levels of safety, recording data effectively, to facilitate its analysis and evaluation to reach their own valid conclusions. Appropriate and timely assessments are used to check the cumulative knowledge and skills gained by students, to identify those

who require extra support whilst highlighting those who are thriving and require enhancement opportunities. We actively develop students' examination technique throughout the course through regular use of examination questions in all topics, together with a special focus on command words and specialist vocabulary.

Our curriculum exceeds what is visible in lessons and we believe that for students to achieve the very best examination results possible, our broader curriculum must enhance what is directly examinable. Daily drop -in sessions are available for A-Level students and we facilitate peer support networks. We prepare and enter Year 12 students for the Cambridge Chemistry Challenge competition and Year 13 students for the RSC Chemistry Olympiad. We support students with their applications for Nuffield Research Placements and provide personalised support for those students applying for Chemistry-related degree courses and apprenticeships, together with subject support sessions for those students sitting the BMAT. We retain invaluable, active links with our Alumni, who provide our current students with valuable insight into university courses and careers. Some students provide tutoring in the wider school community, by tutoring younger pupils and assisting in lessons, where they, gain valuable personal development in terms of communication skills and organisation through their community involvement.

We make students aware of how the theory that they study links to the vast array of occupations that use chemistry and to chemistry-specific careers. They are given opportunities to articulate their points of view about scientific developments, broadening their awareness through research, debate and discussion. We build the 'cultural capital' of our students by including examples of where they can connect the scientific principles and theory that they learn with applications of chemistry to everyday life, together with the implications of the chemical changes that humans are effecting in the world. Examples include global warming, damage to the ozone layer, the detrimental effects of some therapeutic drugs, sustainability and pollution issues linked to extraction, processing and use of raw materials and the potential wider environmental effects of their own disposal of chemicals from the laboratory. Students are encouraged to further their understanding of current developments through wider reading and journal articles that we circulate. We foster students' interest in and enthusiasm for the chemistry, including the further study of Chemistry related careers associated with chemistry through trips to university chemistry departments, visits from universities and companies with specialised equipment and assistance in securing industry placements.

Assessment

Half termly assessment in Chemistry consist of a mixture of extended and short answer questions as well as multiple choice questions and those relating to the testing of their practical knowledge and understanding.

Homework

Shorter practice questions, exam questions, practical write ups and independent work using study packs, banks of exam papers and purchased on-line resources

Clubs and/or intervention

Chemistry Clinics: student support, including homework and practical write-up support.; student one- to ones and target setting/ monitoring; individualised work programmes

Parental/Carer support
VLE resources and email communication and homework set through Bromcom

Helpful sources of information
VLE, AQA website, Study packs, Course and Practical Guides, Kerboodle.com, and Seneca learning.

Year 12 Overview

Term	Knowledge	Assessment	Connections to learning	Connections to future pathways
Autumn 1	**<u>Physical Chemistry</u>:** **Atomic structure** The chemical properties of elements depend on their atomic structure and in particular on the arrangement of electrons around the nucleus. The arrangement of electrons in orbitals is linked to the way in which elements are organised in the Periodic Table. Chemis can measure the mass of atoms and molecules to a high degree of accuracy in a mass spectrometer. The principles of operation of a modern mass spectrometer are studied.			
	<u>Course Induction/ GCSE Bridging & atomic structure-</u> ➢ Atomic structure ➢ Units, formulae and equations ➢ Maths skills, Mr and moles ➢ Atomic number, mass number and isotopes ➢ Introduction to practical skills & health and safety ➢ Electron configuration ➢ Time of flight mass spectrometry ➢ Mass spectrometry calculations ➢ Ionisation energy ➢ Required Practical: Making up a standard solution	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge	➢ Atomic structure taught at GCSE (Chemistry and Trilogy); aspects italicised are new for A-Level	**Future learning: degrees** ➢ Chemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Research scientist (physical sciences) ➢ Higher education lecturer

	➢ Required Practical: acid-base titration	questions, exam questions		➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemistry ➢ Pharmacist ➢ Lab technician
Autumn 1	**<u>Physical Chemistry</u>:** **Amount of Substance** When chemists measure out an amount of a substance, they use an amount in moles. The mole is a useful quantity because one mole of a substance always contains the same number of entities of the substance. An amount in moles can be measured out by mass in grams, by volume in dm3 of a solution of known concentration and by volume in dm^3 of a gas.			

	<u>Amount of substance</u> ➢ The mole and the Avogadro constant ➢ Equations and concentration calculations ➢ Reacting masses and limiting reagents ➢ Application: Finding the formula of a hydrated salt ➢ Making up a standard solution ➢ <u>Acid- base titration</u> ➢ Empirical formula ➢ Application: Determination of the concentration of ethanoic acid in vinegar ➢ Ideal gas calculations ➢ Application: Mr of a volatile liquid ➢ % yield and atom economy ➢ Application: determination of the % conversion of a carbonate ➢ Application: determining the Mr of succinic acid ➢ Application: determining the amount of aspirin in a tablet ➢ Application: determining the % by mass of a base in an indigestion tablet	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Calculations taught at GCSE Chemistry) ➢ Italicised are new areas for all students ➢ Underlined will not have been covered by Trilogy students at GCSE	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist, ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

<table>
<tr><td rowspan="2">Autumn 2</td><td colspan="4"><u>Physical Chemistry</u>:
Bonding & Periodicity

The physical and chemical properties of compounds depend on the ways in which the compounds are held together by chemical bonds and by intermolecular forces. Theories of bonding explain how atoms or ions are held together in these structures. Materials scientists use knowledge of structure and bonding to engineer new materials with desirable properties. These new materials may off new applications in a range of different modern technologies.</td></tr>
<tr><td><u>Bonding</u>
➢ Ionic bonding
➢ Covalent bonding
➢ Metallic bonding & crystal structures
➢ Application: determining structure & bonding
➢ Intermolecular forces
➢ Bonding & physical properties
➢ Shapes of molecules & ions
➢ States of matter
➢ Periodicity</td><td>➢ Exam questions (Multiple choice, structured, closed short answer, and open response)
➢ Assessed homework
➢ Required practical write ups
➢ Assessment at end of ½ term
➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions</td><td>➢ Bonding is covered at GCSE
➢ New areas are italicised</td><td>Future learning: degrees
➢ Chemistry
➢ Biology
➢ Pre-clinical medicine
➢ Mathematics
➢ Pharmacology
Careers
➢ Analytical chemist
➢ Pharmacologist
➢ Doctor
➢ Research scientist (physical sciences)
➢ Toxicologist Environmental consultant
➢ Higher education lecturer
➢ Science writer
➢ Secondary school teacher
➢ Industrial chemist
➢ Environmental chemist</td></tr>
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Organic Chemistry:
Introduction to Organic Chemistry
Alkanes

Organic chemistry is the study of the millions of covalent compounds of the element carbon. These structurally diverse compounds vary from naturally occurring petroleum fuels to DNA and the molecules in living systems. Organic compounds also demonstrate human ingenuity in the vast range of synthetic materials created by chemists. Many of these compounds are used as drugs, medicines and plastics. Organic compounds are named using the International Union of Pure and Applied Chemistry (IUPAC) system and the structure or formula of molecules can be represented in various different ways. Organic mechanisms are studied, which enable reactions to be explained. In the search for sustainable chemistry, for safer agrochemicals and for new materials to match the desire for new technology, chemistry plays the dominant role.

Alkanes are the main constituent of crude oil, which is an important raw material for the chemical industry. Alkanes are also used as fuels and the environmental consequences of this use are considered.

Introduction to Organic Chemistry ➢ Definitions and nomenclature ➢ Structural isomers ➢ E-Z isomers ➢ Fractional distillation ➢ Cracking ➢ Formation of halogenoalkanes ➢ Ozone layer depletion ➢ Combustion of alkanes	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE Chemistry and Trilogy cover some nomenclature (although limited) and fractional distillation, cracking and some combustion of alkanes (in less detail) ➢ New areas are italicised	**Future learning: degrees** ➢ Chemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology ➢ Biochemistry ➢ Biomedical science **Careers** ➢ Analytical chemist ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist ➢ Toxicologist ➢ Environmental consultant

				➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician
Spring 1	**<u>Physical Chemistry:</u> Energetics Kinetics Equilibria** The enthalpy change in a chemical reaction can be measured accurately. It is important to know this value for chemical reactions that are used as a source of heat energy in applications such as domestic boilers and internal combustion engines. The study of kinetics enables chemists to determine how a change in conditions affects the speed of a chemical reaction. Whilst the reactivity of chemicals is a significant factor in how fast chemical reactions proceed, there are variables that can be manipulated in order to speed them up or slow them down. In contrast with kinetics, which is a study of how quickly reactions occur, a study of equilibria indicates how far reactions will go. Le Chatelier's principle can be used to predict the effects of changes in temperature, pressure and concentration on the yield of a reversible reaction. This has important consequences for many industrial processes. The further study of the equilibrium constant, *K*c, considers how the mathematical expression for the equilibrium constant enables us to calculate how an equilibrium yield will be influenced by the concentration of reactants and products.			
	<u>Energetics</u> ➢ Enthalpy changes ➢ Calculating enthalpy changes ➢ Application: measuring enthalpy changes- displacement ➢ Application: measuring enthalpy changes- neutralisation	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups	➢ KS4: exothermic and endothermic reactions; energy level diagrams ➢ KS4: rates of reactions; collision theory	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology

	➢ Application: measuring enthalpy changes- combustion of alcohols <u>Kinetics</u>: ➢ Rates of reactions ➢ Rates & collision theory ➢ Maxwell-Boltzmann distribution ➢ Required Practical: Effect of temperature on reaction rate ➢ Effect of concentration on rate ➢ Hess's Law ➢ Required Practical: determining an enthalpy change that cannot be measured directly ➢ Bond enthalpy calculations <u>Equilibria</u> ➢ Equilibria ➢ The equilibrium constant, Kc ➢ Application: Kc for an esterification reaction	➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions ➢		**Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Doctor ➢ Research scientist (physical sciences) ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Pharmacist ➢ Lab technician
	<u>Organic Chemistry:</u> Halogenoalkanes Alkenes In contrast with kinetics, which is a study of how quickly reactions occur, a study of equilibria indicates how far reactions will go. Le Chatelier's principle can be used to predict the effects of changes in temperature, pressure and concentration on the yield of a reversible reaction. This has important consequences for many industrial processes. The further study of the equilibrium constant, *K*c, considers how the mathematical expression for the equilibrium constant enables us to calculate how an equilibrium yield will be influenced by the concentration of reactants and products.			
	<u>Halogenoalkanes</u> ➢ Physical and chemical properties & nomenclature review ➢ Nucleophilic substitution ➢ Elimination <u>Alkenes</u>	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework	➢ GCSE: some reactions of alkenes; simple structures; addition polymers	**Future learning: degrees** ➢ Chemistry ➢ Biochemistry ➢ Biology ➢ Pre-clinical medicine

	➢ Physical & chemical properties and review of structural and E-Z isomerism and CIP priorities ➢ Reactions of alkenes ➢ Addition polymers	➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions		➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician
Spring 2	**<u>Physical Chemistry</u>:** **Oxidation, Reduction & Redox Reactions** Redox reactions involve a transfer of electrons from the reducing agent to the oxidising agent. The change in the oxidation state of an element in a compound or ion is used to identify the element that has been oxidised or reduced in a given reaction. Separate half-equations are written for the oxidation or reduction processes. These half-equations can then be combined to give an overall equation for any redox reaction.			
	<u>Redox</u> ➢ Oxidation, reduction & redox reactions ➢ Oxidation states ➢ Redox equations	➢ Exam questions (Multiple choice, structured, closed short answer, and open response)	➢ GCSE: oxidation & reduction; half equations	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology

		➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions		➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist ➢ Toxicologist ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

<u>Inorganic Chemistry:</u>
Group 2
Group 7

The elements in Group 2 are called the alkaline earth metals. The trends in the solubilities of the hydroxides and the sulfates of these elements are linked to their use. Barium sulfate, magnesium hydroxide and magnesium sulfate have applications in medicines whilst calcium hydroxide is used in agriculture to change soil pH, which is essential for good crop production and maintaining the food supply.

The halogens in Group 7 are very reactive non-metals. Trends in their physical properties are examined and explained. Fluorine is too dangerous to be used in a school laboratory but the reactions of chlorine are studied. Challenges in studying the properties of

	elements in this group include explaining the trends in ability of the halogens to behave as oxidising agents and the halide ions to behave as reducing agents.			
	<u>Group 2</u> ➢ Chemical properties ➢ Physical properties ➢ Uses <u>Group 7</u> ➢ Physical properties ➢ Oxidising ability of halogens ➢ Used of chlorine ➢ Reducing ability of halide ions ➢ Required Practical: Tests for Anions & Cations	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE: structure of the Periodic Table	**Future learning: degrees** ➢ Chemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician
	<u>Organic Chemistry</u> Alcohols & Organic Analysis A-Level: Optical isomerism			

Summer 1	Alcohols have many scientific, medicinal and industrial uses. Ethanol is one such alcohol and it is produced using different methods, which are considered in this section. Ethanol can be used as a biofuel. Our understanding of organic molecules, their structure and the way they react, has been enhanced by organic analysis. This section considers some of the analytical techniques used by chemists, including test-tube reactions and spectroscopic techniques Compounds that contain an asymmetric carbon atom form stereoisomers that differ in their effect on plane polarised light. This type of isomerism is called optical isomerism.			
Summer 2	<u>Alcohols</u> ➢ Chemical & physical properties ➢ Reactions ➢ Ethanol production ➢ Uses ➢ Required Practical: Distillation <u>Organic Analysis</u> ➢ Mass spectrometry ➢ Infra-red spectroscopy ➢ Required Practical: Tests for alcohols, aldehydes and carboxylic acids <u>Optical Isomerism</u> ➢ Nomenclature & isomerism ➢ Stereoisomerism ➢ Synthesis of optical isomers ➢ Introduction to organic preparation ➢ Preparation of an organic solid	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions ➢	➢ GCSE Chemistry: alcohols and their reactions; ethanol production	**Future learning: degrees** ➢ Chemistry ➢ Biochemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist

				➢ Lab technician
	A-Level : Physical Chemistry **Rate Equations** In rate equations, the mathematical relationship between rate of reaction and concentration gives information about the mechanism of a reaction that may occur in several steps.			
	Rate Equations ➢ Introduction to rates of reaction ➢ The rate expression and order of reaction ➢ Determining the rate equation ➢ The rate determining step ➢ Following reactions: colorimetry ➢ Required Practical: The iodine clock ➢ Required Practical: continuous monitoring method ➢ Arrhenius equation	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ KS4: rates of reaction ➢ Y12: Kinetics	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Doctor ➢ Research scientist (physical sciences) ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

	A-Level: Physical Chemistry **Acids, Bases & Buffers** Acids and bases are important in domestic, environmental and industrial contexts. Acidity in aqueous solutions is caused by hydrogen ions and a logarithmic scale, pH, has been devised to measure acidity. Buffer solutions, which can be made from partially neutralised weak acids, resist changes in pH and find many important industrial and biological applications.			
	Acids, bases & buffers ➢ Defining and acid & pH ➢ pH scale and Kw ➢ Weak acids & bases ➢ Acid- base titrations ➢ Acid-base titrations & indicators ➢ Required Practical: Investigating pH change ➢ Buffer solutions ➢ Sodium carbonate titration: multiple equivalence points ➢ Buffers investigation	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ KS4: acids and bases; pH scale	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant

				➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

Year 13 Overview

Term	Knowledge	Assessment	Connections to learning	Connections to future pathways
Autumn 1	**<u>Organic Chemistry</u>:** **Aldehydes & Ketones** **Carboxylic Acids & their Derivatives** **Chromatography** **Nuclear Magnetic Resonance Spectroscopy** Aldehydes, ketones, carboxylic acids and their derivatives all contain the carbonyl group which is attacked by nucleophiles. This section includes the addition reactions of aldehydes and ketones. Carboxylic acids are weak acids but strong enough to liberate carbon dioxide from carbonates. Esters occur naturally in vegetable oils and animal fats. Important products obtained from esters include biodiesel, soap and glycerol. Chemists use a variety of techniques to deduce the structure of compounds. In this section, nuclear magnetic resonance spectroscopy is added to mass spectrometry and infrared spectroscopy as an analytical technique. The emphasis is on the use of analytical data to solve problems rather than on spectroscopic theory.			

	<u>Aldehydes & ketones</u> ➢ Identifying organic compounds ➢ Properties and reactions of aldehydes & ketones <u>Carboxylic acids</u> ➢ Carboxylic acids structure & properties ➢ Esters ➢ Required Practical: Prepare and organic solid & test its purity ➢ Required practical: Preparation & purification of an organic liquid ➢ Acylation <u>Chromatography</u> ➢ Chromatography theory ➢ Paper chromatography ➢ Required practical: ➢ Separation by TLC <u>NMR</u> ➢ Carbon-13 NMR ➢ Proton NMR ➢ Interpreting NMR spectra	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ KS4 Chemistry: structure and some reactions of carboxylic acids; uses of esters ➢ GCSE: paper chromatography ➢ Y12 analytical techniques	**Future learning: degrees** ➢ Chemistry ➢ Biochemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

<table>
<tr><td>Autumn 2</td><td colspan="4"><u>Organic Chemistry:</u>
Aromatic Chemistry
Amines
Polymers
Amino acids, Proteins & DNA
Organic synthesis

Aromatic chemistry takes benzene as an example of this type of molecule and looks at the structure of the benzene ring and its substitution reactions.

Amines are compounds based on ammonia where hydrogen atoms have been replaced by alkyl or aryl groups. This section includes their reactions as nucleophiles

The study of polymers is extended to include condensation polymers. The ways in which condensation polymers are formed are studied, together with their properties and typical uses. Problems associated with the reuse or disposal of both addition and condensation polymers are considered.

Amino acids, proteins and DNA are the molecules of life. In this section, the structure and bonding in these molecules and the way they interact is studied. Drug action is also considered.
The formation of new organic compounds by multi-step syntheses using reactions included in the specification is covered in this section.</td></tr>
<tr><td></td><td><u>Aromatic Chemistry</u>
➢ Properties and reaction of benzene
➢ Thermochemical evidence for benzene’s structure
➢ Nitration of benzene
➢ Friedel-Crafts acylation
➢ Pure substances and mixtures

<u>Amines</u>
➢ Amines in organic synthetic pathways
➢ Nomenclature and properties
➢ Synthesis of amines</td><td>➢ Exam questions (Multiple choice, structured, closed short answer, and open response)
➢ Assessed homework
➢ Required practical write ups
➢ Assessment at end of ½ term
➢ In lesson retrieval quiz and multiple</td><td>➢ Y12 organic nomenclature and representations of organic compound
➢ Y12: delocalisation of electrons in alkenes; testing for unsaturation
➢ GCSE : addition and condensation polymers</td><td>Future learning: degrees
➢ Chemistry
➢ Biochemistry
➢ Biology
➢ Pre-clinical medicine
➢ Mathematics
➢ Pharmacology
Careers
➢ Analytical chemist
➢ Chemical engineer
➢ Clinical biochemist</td></tr>
</table>

	➢ Base properties of amines ➢ Amines as nucleophiles <u>Polymers</u> ➢ Addition polymers ➢ Condensation polymers ➢ Biodegradability of polymers <u>Amino acids, proteins & DNA</u> ➢ Amino acids: Structure and properties ➢ Reactions of amino acids ➢ Proteins ➢ Enzymes ➢ Action of anti-cancer drugs ➢ DNA <u>Organic synthesis</u> ➢ Organic pathways- principles ➢ Elucidating organic pathways	choice hinge questions, exam questions	➢ Y12: Alkenes; addition polymers	➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician
	<u>Physical Chemistry:]</u> Thermodynamics The further study of thermodynamics builds on the Energetics section and is important in understanding the stability of compounds and why chemical reactions occur. Enthalpy change is linked with entropy change enabling the free-energy change to be calculated.			

	<u>Thermodynamics</u> ➢ Link to AS thermodynamics ➢ Thermodynamics definitions ➢ Born-Haber cycles ➢ Entropy and delta S ➢ Trends in lattice enthalpy ➢ Enthalpy of solution ➢ Gibb's free energy	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE: Energy in reactions ➢ Y12: Energetics	**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician
Spring 1	**<u>Physical Chemistry:</u> Electrode Potentials & Electrochemical Cells**			

	Redox reactions take place in electrochemical cells where electrons are transferred from the reducing agent to the oxidising agent indirectly via an external circuit. A potential difference is created that can drive an electric current to do work. Electrochemical cells have very important commercial applications as a portable supply of electricity to power electronic devices such as mobile phones, tablets and laptops. On a larger scale, they can provide energy to power a vehicle.			
	<u>Electrode potentials and electrochemical cells</u> ➢ Oxidation state, half-equations & redox equations ➢ Half-cells & electrochemical cells ➢ Predicting the direction of redox reactions ➢ Further electrochemical cells ➢ Feasibility of redox reactions ➢ Commercial cells ➢ Required Practical: Measuring the EMF of an electrochemical cell	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions		**Future learning: degrees** ➢ Chemistry ➢ Chem. engineering ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant ➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist, ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician

Spring 2	**<u>Inorganic Chemistry</u>: of Ions in Aqueous Solution** The reactions of the Period 3 elements with oxygen are considered. The pH of the solutions formed when the oxides react with water illustrates further trends in properties across this period. Explanations of these reactions offer opportunities to develop an in-depth understanding of how and why these reactions occur. The 3d block contains 10 elements, all of which are metals. Unlike the metals in Groups 1 and 2, the transition metals Ti to Cu form coloured compounds and compounds where the transition metal exists in different oxidation states. Some of these metals are familiar as catalysts. The properties of these elements are studied in this section with opportunities for a wide range of practical investigations. The reactions of transition metal ions in aqueous solution provide a practical opportunity for students to show and to understand how transition metal ions can be identified by test-tube reactions in the laboratory.			
	<u>Properties of Period 3 elements and their oxides</u> ➢ AS periodicity ➢ Period 3 elements and their reaction with water ➢ Oxide formation and melting point ➢ Reactions of Period 3 oxides <u>Transition metals</u> ➢ Properties of transition metals ➢ Ligands, complexes & their shapes ➢ Ligand substitution theory ➢ Ligand substitution reactions ➢ Coloured ions theory ➢ Redox titrations ➢ Redox titrations calculations ➢ Determining concentration via colorimetry ➢ Heterogeneous catalysts ➢ Homogeneous catalysts ➢ Industrial catalysts	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE: structure and bonding ➢ Y12: structure, bonding and properties ➢ Y12: Periodicity GCSE: transition metals	**Future learning: degrees** ➢ Chemistry ➢ Biology ➢ Pre-clinical medicine ➢ Mathematics ➢ Pharmacology **Careers** ➢ Analytical chemist ➢ Chemical engineer ➢ Clinical biochemist ➢ Pharmacologist ➢ Doctor ➢ Research scientist (physical sciences) ➢ Toxicologist ➢ Environmental consultant

	➢ Auocatalysis ➢ Variable oxidation states <u>Reactions of ions in aqueous solution</u> ➢ Reactions of ions in aqueous solution theory ➢ Reactions of ions in aqueous solution- observations ➢ Required Practical: Identify transition metal ions in aqueous solution			➢ Higher education lecturer ➢ Science writer ➢ Secondary school teacher ➢ Industrial chemist ➢ Environmental chemist ➢ Pharmacist ➢ Lab technician