Cranbrook School

# Chemistry Department KS Curriculum Overview

Mission Statement: To elevate academic standards, inspire a fervent interest in chemistry, ensure students acquire a comprehensive understanding of its practical applications, and intertwine rigorous theory with hands-on learning experiences.

**KS3 Intent:** The primary objective during KS3 is to nurture inquisitiveness and cultivate an affinity for chemistry. The KS3 curriculum, aligned with the National Curriculum, is taught in Years 7 and 8 to ensure ample preparation time for GCSE, where students can delve into three distinct science courses. This educational plan strives to enhance students' hands-on and investigative abilities, scientific literacy, vocabulary, scientific mindset, measurement precision, analytical and evaluative proficiencies, as well as communication skills. It also encourages the application of relevant mathematical competencies, including basic calculations and graph analysis.

| KS3 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 7 | **Topic 1: Elements, compounds and mixtures**<br><br>**Subject Content:**<br><br>Hazards and working safely; solids, liquids and gases; physical changes; Brownian motion; diffusion; gas pressure; elements, mixtures and atoms; metals and non-metals; making iron sulfide; chemical reactions (oxidation) and chemical formulae; thermal decomposition reactions.<br><br>**Learner Skills:**<br><br>Using models and symbols in chemistry. Using the periodic table. Using key vocabulary to describe elements, compounds and their properties. Making observations and predictions. Assessing risks and hazards. Using the scientific method to make predictions, hypotheses and theories. | | **Topic 2: The periodic table of elements**<br><br>**Subject Content:**<br><br>The history of the periodic table: From Dalton to Mosley; elements of group 1, 2, 7, 0, metals, non-metals and metalloids; understanding what happens when an element burns; reactions of metal and non-metal oxides; using models to explain the chemistry of the periodic table; special properties of carbon and silicon; choosing elements for a purpose.<br><br>**Learner Skills:**<br><br>Using the scientific method to make predictions, hypotheses and theories. Recognising the importance of peer review and publishing results. Evaluate data and suggest reasons for outliers. Assess risks and hazards. Recognise and assess models. | | **Topic 3: Mixing, dissolving and separating**<br><br>**Subject Content:**<br><br>Dissolving and solutions; filtration; evaporation and crystallisation; distillation; chromatography.<br><br>**Learner Skills:**<br><br>Using key equipment and making measurements. Identifying sources of error (systematic and human error). Evaluating risks and hazards with equipment. Designing simple experiments and justifying simple procedures. | |
| | **Rationale:**<br><br>The content covers topics like hazards, states of matter, chemical reactions, and fundamental concepts in chemistry. Concurrently, students develop skills in using models, chemical symbols, and the periodic table effectively; using key vocabulary, making observations and predictions, assessing risks, and employing the scientific method. These elements collectively provide students with a solid foundation in chemistry, enabling them to navigate chemical concepts encountered later on in KS3 with competence and confidence. For example, students should be able to draw on the particle model to explain phenomena such as filtration. This builds on the KS2 material states of matter. | | **Rationale:**<br><br>Through an exploration of the historical development of the periodic table, comprehension of elemental properties, chemical reactions, and the use of models for conceptualising chemistry, students gain essential knowledge. Additionally, learning to choose elements for specific purposes offers practical application in various scientific fields. In parallel, students develop crucial skills such as applying the scientific method, recognising the significance of peer review and publication, evaluating data, assessing risks, and understanding and critiquing scientific models. These competencies collectively prepare students for scientific inquiry and problem-solving, fostering a deep appreciation for the collaborative and dynamic nature of scientific discovery. With a foundational understanding of chemical reactions and elements gained from the previous | | **Rationale:**<br><br>The subject content covers dissolving, solutions, filtration, evaporation, crystallisation, and distillation. Simultaneously, students develop crucial skills, including equipment usage, error identification, risk assessment, and experimental design. These elements enable precise and safe engagement with chemistry concepts and laboratory practices. Students will be able to explain physical processes using the particle model (taught in the first topic), further making rationalisations for scientific phenomena. | |

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| | | module, students can more effectively delve into the chemical patterns found in the periodic table, thus alleviating the demands on their working memory. Students find combustion reactions challenging in KS4, so this is taught in more depth and breadth here with examples of how elements other than carbon burn. | |

| KS3 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 8 | Topic 4: Explaining chemical changes<br><br>Subject Content:<br><br>Acids and alkalis; Indicators; Neutralisation; Salts; Reactions of acids; Combustion; Fuels; Acid rain; Testing for gases.<br><br>Learner Skills:<br><br>Using acids and alkalis safely. Investigative skills to include planning, analysing and evaluation based around neutralisation reactions. Identifying and controlling variables and making and recording accurate measurements. Use of key vocabulary relating to investigations. | | Topic 5: Obtaining useful materials<br><br>Subject Content:<br><br>Extracting metals; Displacement reactions; Environmental impact of metal extraction; extracting plant materials; Exothermic and endothermic reactions; Catalysts; Ceramics; Polymers; Composites<br><br>Learner Skills:<br><br>Making predictions and making a hypothesis. Recognising and reducing risks in practical work and simple risk assessments. Evaluating industrial processes. Justify why materials are used. Making measurements. | | Topic 6: Using our Earth Sustainably<br><br>Subject Content:<br><br>The Atmosphere; Air quality and Environmental Pollution; Global Warming; Recycling.<br><br>Learner Skills:<br><br>Structure arguments around risks of climate change. Explain and evaluate models of climate change. Develop debating and collaborative skills. Recognise the importance of peer review and publishing. | |
| | Rationale:<br><br>The subject content covers fundamental chemistry topics, including acids, alkalis, indicators, neutralisation, salts, combustion, fuels, acid rain, and gas testing, providing a comprehensive understanding of chemical reactions and their environmental impact.<br><br>Concurrently, learners acquire valuable skills such as safe handling of acids and alkalis, investigative abilities encompassing planning, analysis, and evaluation of neutralisation reactions, proficiency in identifying and controlling variables, accurate measurement recording, and mastery of key vocabulary relevant to investigations. These skills enhance safety, critical thinking, experimental accuracy, and effective communication in scientific contexts. In conjunction with the knowledge from year 7, students should be able to give relevant suggestions to improve practical work. Many KS4 students struggle with combustion reactions. Here, we teach a straightforward method: how to use word equations to write symbol equations and then | | Rationale:<br><br>The subject content encompasses essential chemistry and materials science themes, including metal extraction, displacement reactions, environmental consequences, exothermic and endothermic reactions, catalysts, ceramics, polymers, and composites, fostering a holistic grasp of materials and their practical applications.<br><br>Concurrently, students cultivate valuable skills, such as formulating hypotheses, making predictions, conducting risk assessments, evaluating industrial processes, and justifying material choices. These competencies bolster critical thinking, safety awareness, and the capacity to make informed decisions regarding material utilisation and sustainability. Additionally, by building on the previous topics, students develop the ability to independently plan practical experiments, design methods with clearly defined variables and predictions, and execute them with greater autonomy and confidence. Teaching this here, allows students to draw | | Rationale:<br><br>The inclusion of this subject content and learner skills aims to provide students with crucial knowledge and abilities to address environmental challenges effectively while fostering a discerning approach to information. The topics encompass the atmosphere, air quality, global warming, and recycling, offering insights into environmental issues and sustainability. Additionally, students develop skills such as structuring arguments around climate change risks, evaluating climate change models, enhancing debating and collaborative abilities, recognising the importance of peer review and publication in disseminating scientific knowledge, and discerning the value of trustworthy scientific sources over newspapers and blogs. This comprehensive approach not only equips students to be informed and responsible citizens but also empowers them to critically assess and differentiate between reliable scientific information and potentially biased or inaccurate sources in the broader discourse on environmental issues. This module is presented as the final segment, enabling students to develop a more profound | |

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| | balance them. Students can then apply this method to unfamiliar situations. | on their knowledge from the preceding topic on how to write chemical equations. | comprehension of the environmental and sustainability topics explored in the "obtaining raw materials" topic. When combined with the "chemical changes" topic, it allows students to draw on their knowledge allowing them to apply their mechanistic knowledge of chemical changes to pollution and their corresponding solutions. |

We begin teaching the GCSE course in Year 9. This allows enough teaching time for students to study all three sciences as separate GCSEs. We follow the AQA GCSE Chemistry Specification (8462). All chemistry students will sit the higher level paper unless substantial reasons are given.

| KS3 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 9 | GCSE Topic 1: Atomic structure<br><br>Subject Content:<br><br>Separating mixtures; History of the atom; Structure of the atom; Ions and isotopes; Electronic structure.<br><br>Learner Skills:<br><br>Calculating relative atomic mass. Development, usage and limitations of models. Use of SI units and standard form. Visualise and represent 2D and 3D forms. Selecting and using basic laboratory apparatus. | GCSE Topic 2: The Periodic Table<br><br>Subject Content:<br><br>Development of the Periodic Table; Group 1 elements; Group 7 elements; Trends in reactivity; Transition elements<br><br>Learner Skills:<br><br>Identifying patterns and trends, graph drawing, how the periodic table has developed over time. Link observations to chemical equations. Explaining how testing a prediction can support or refute a new scientific idea. | GCSE Topic 3: Structure and bonding<br><br>Subject Content:<br><br>States of matter; Ions and ionic bonding; Giant ionic structures; Covalent bonding; Structure of simple molecules; Giant covalent structures; Fullerenes and graphene; Bonding in metals; Giant metallic structures; Nanoparticles.<br><br>Learner Skills:<br><br>Use of models, understanding limitations of models, graph drawing, using standard form. Making predictions using scientific knowledge and understanding. Focus on literacy skills for explanations. Scientific vocabulary. Suggest reasons why the perception of risk is often very different from the measured risk (in regards to nanoparticles). | | GCSE Topic 13: The Earth's Atmosphere<br><br>Subject Content:<br><br>History of our atmosphere; Greenhouse gases; Global Climate Change; Atmospheric Pollutants<br><br>Learner Skills:<br><br>Develop an awareness of the limitations of science and consider any ethical issues which may arise. Analyse data and use orders of magnitude estimates. | GCSE Topic 14: The Earth's Resources<br><br>Subject Content:<br><br>Finite and renewable resources; Water; Treating waste water; Extracting metals from ores; Life cycle assessments; Reduce, reuse and recycle<br><br>Required Practical 8: Analysis and purification of water<br><br>Learner Skills:<br><br>Use of appropriate apparatus to make and record a range of measurements accurately including mass. Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater. Use of appropriate apparatus and techniques for the measurement of pH in different situations. Analyse data around water sources and |

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| | | | | | treatment. Justify material selection. |
| | Rationale:<br><br>This topic sets the foundation for GCSE. The model of the atom is introduced. Basic practical skills are reviewed. This historical context provides an opportunity for students to show an understanding of why and describe how scientific methods and theories develop over time. Students cannot progress in chemistry without understanding the concept of an atom. | Rationale:<br><br>This topic builds on understanding of the development of scientific models from Topic 1. Knowledge of electronic structure is applied to the arrangement of the periodic table and to trends in reactivity. Students learn more about chemical equations, building on their KS3 knowledge. Students develop their ability to make predictions based on data sets and how predictions can be limited due to said data sets. Needs to be taught earlier on to provide a solid foundation to chemistry. | Rationale:<br><br>This subject builds upon the foundational knowledge of the particle model acquired during KS3. It then delves into the exploration of chemical bonding and how particles interact to dictate macroscopic properties such as melting points, boiling points, and electrical conductivity. This forms a critical foundation for much of the subsequent GCSE course, empowering students to provide rationale for chemical equations and formulas (by using dot and cross diagrams, valency, and ion charges.) Given the inherent complexity of these concepts, early exposure and regular revisitation are essential. While primarily theoretical in nature, practical experiments within this subject aim to bridge theory and application, enabling students to utilise their understanding to make informed predictions about the properties of various elements, mixtures, and compounds. Students should also be able describe and explain specified examples of the technological applications of nanoparticles, a growing science. | Rationale:<br><br>Revisits and consolidates topics covered in KS3, provides opportunity to learn more about peer review and the use of models to understand global climate systems and their limitations (models are only as good as their data). This topic is generally easier for students compared to the previous one. Teaching it at this point allows students to apply what they've learned in earlier lessons to confidently write chemical formulas for gases and recognise atmospheric gases as small molecules. | Rationale:<br><br>The first required practical is introduced, now that prep room pressure is relieved. They learn to use precise measurement apparatus, handle heating devices safely, measure pH effectively, and analyse water-related data.<br><br>Overall, fostering scientific knowledge, practical skills, and environmental consciousness, enabling students to contribute to sustainable practices and responsible resource management. As such this topic connects well to topic 13 |

| GCSE Subject AOS | AO1 | AO2 | AO3 | AO4 |
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| KS4 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 10 | GCSE Topic 4: Chemical Calculations (part 1)<br><br>Subject Content:<br><br>Relative masses; Moles; Equations and calculations; Expressing concentrations; Yield; Atom Economy; volumes of gases<br><br>Learner Skills: | GCSE Topic 5: Chemical Changes<br><br>Subject Content:<br><br>Reactivity series; Displacement reactions; Extracting metals; Salts from metals; Salts from insoluble bases; Neutralisation; pH scale; Strong and weak acids | GCSE Topic 7: Energy Changes<br><br>Subject Content:<br><br>Exothermic and endothermic reactions; Using energy transfers; Reaction profiles; Bond energy calculations; Chemical cells and batteries; Fuel cells | GCSE Topic 6: Electrolysis<br><br>Subject Content:<br><br>Electrolysis of molten compounds, Reactions at electrodes; Extraction of aluminium; Electrolysis of aqueous solutions | GCSE Topic 4: Chemical calculations (part 2)<br><br>Subject Content:<br><br>Expressing concentrations; Titrations; Titration calculations; Volumes of gases<br><br>Required practical 2: Titration | GCSE Topic 9: Crude oil and fuels<br><br>Subject Content:<br>Hydrocarbons; Fractional distillation of oil; Burning hydrocarbon fuels; Cracking hydrocarbons<br><br>Learner Skills: |

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| | Use of standard form. Chemical calculations using moles. Ratios and percentages. Changing the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. | **Required practical 1: Preparation of a salt**<br><br>**Learner Skills:**<br><br>Experimental skills and strategies, evaluate methods, writing equations. Writing ionic equations and half equations. Interpreting graphs. Safe use and careful handling of liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes and/or products | **Required practical 4: Investigating temperature change**<br><br>**Learner Skills:**<br><br>Writing half equations. Energy calculations. Sketching and interpreting energy graphs. Making and recording appropriate observations during chemical reactions including changes in temperature. Use of appropriate apparatus to make and record a range of measurements accurately, including mass, temperature and volume of liquids | **Required practical 3: Electrolysis of aqueous solutions**<br><br>**Learner Skills:**<br><br>Writing half equations. Making predictions. | **Learner Skills:**<br><br>Use of units. Chemical calculations using moles. Risk assessment. Rearrange equations. Substitute numerical values into algebraic equations using appropriate units for physical quantities. | IUPAC chemical nomenclature of organic compounds. Use models to explain data, but determine the limitations of said models. |
| | **Rationale:**<br><br>The decision to introduce more complex mathematical concepts in chemistry is grounded in the steady progression of students' mathematical abilities, both within chemistry and across other subjects. Their prior chemistry knowledge, gained from the topics previously, provides a solid foundation for them to confidently apply mole concepts to chemical equations, even in unfamiliar scenarios. Prior teaching in both chemistry and other science and maths subjects equips students with the essential skills to manipulate quantities effectively, thereby reducing the cognitive load on their working memory. | **Rationale:**<br><br>Next to chemical calculations this allows students to progress to applying moles to titration calculations. | **Rationale:**<br><br>With a deeper understanding of moles, students can now work out why reactions stop producing or absorbing heat using ideas about limiting reactants. Using the reactivity series (the previous module) students can explain how batteries work. Acid-base chemistry learnt in y8 and y9 is important in understanding how fuel cells work. This creates an excellent opportunity for retrieval practice. | **Rationale:**<br><br>The incorporation of electrolysis topics and associated learner skills is driven by the need to provide students with a comprehensive foundation in electrochemical processes.<br><br>Both topics 3 and 7 should establish a strong groundwork for topic 6, thereby reducing cognitive load. This creates an excellent opportunity for retrieval practice. | **Rationale:**<br><br>Topic 4 has been thoughtfully placed at this juncture to allow for a paced learning approach. Titrations, an integral component in forensic science and drug analysis, find their context here. This positioning affords students the opportunity to revisit and comprehend the concepts of acids and bases within the framework of titrations and moles, fostering a deeper understanding of their interplay. This presents a valuable chance to engage in retrieval exercises for both mole calculations and acid-base chemistry. | **Rationale:**<br><br>Students are introduced to organic chemistry, which provides an opportunity to revisit the concepts of structure and bonding covered earlier in the year and in the previous year (year nine). This helps students gain a deeper appreciation for the significance of structure and bonding in comprehending the physical aspects of the world around them. |

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| KS4 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 11 | GCSE Topic 8: Rates and Equilibrium<br><br>Subject Content:<br><br>Rate of reaction; Collision theory; Effect of surface area, temperature, concentration and pressure; Catalysts; Reversible reactions; Dynamic equilibrium; Altering conditions<br><br>Required practical 5: Investigating rates of reaction<br><br>Learner Skills:<br><br>Experimental skills, making predictions and hypotheses, using scientific knowledge and understanding, make and record measurements, evaluate methods and identify variables. Justify units and draw tables and graphs. | GCSE Topic 12: Chemical analysis<br><br>Subject Content:<br><br>Pure substances and mixtures; Analysing chromatograms; Testing for gases; Testing for positive and negative ions; Instrumental analysis<br><br>Required practical 6: Paper chromatography (current students will have to do this here)<br><br>Required practical 7: Testing for ions<br><br>Learner Skills:<br><br>Experimental skills, using scientific knowledge and understanding to interpret results of qualitative tests. Make and record measurements. Justify particular methods and make improvements to experimental procedures. | GCSE Topic 10: Organic reactions<br>GCSE Topic 11: Polymers<br><br>Subject Content:<br><br>Reactions of alkenes; Structures of alcohols, carboxylic acids, esters; Reactions and uses of alcohols; Carboxylic acids and esters; Addition polymerisation; Condensation polymerisation; Natural polymers; DNA<br><br>Learner Skills:<br><br>IUPAC chemical nomenclature of organic compounds | GCSE Topic 15: Using our resources<br><br>Subject Content:<br><br>Rusting; Alloys; Properties of polymers; Glass, ceramics and composites; Making ammonia; Economics of Haber process; Making fertilisers<br><br>Learner Skills:<br><br>Risk assessment.<br>Interpreting graphs and data. | Revision | Exams |
| | Rationale:<br><br>Links back to the C7 Energy topic but this is a key practical and theoretical unit of work, best positioned in early Y11. Students find equilibrium concept difficult and it will be revisited in C15 where more practical applications of the theory are explored. This will help to embed the learning. | Rationale:<br><br>The final required practicals are included now so that they are covered well before the mock examinations. Great prospects for conducting retrieval exercises related to ionic equations and writing ionic formulas. | Rationale:<br><br>These topics follow on from Topic 9, with opportunity to further embed prior learning and build upon it in preparation for the summer exams. They link together very well and students are supported in revision sessions outside of the classroom in making these connections between modules. | Rationale:<br><br>The final topic, which links many of the earlier units together, forming the ideal basis for revision, which is further supported outside the classroom in revision sessions. Students feel more confident in tackling the harder concepts in chemistry. | | |

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# Chemistry Department KS Curriculum Overview

| A Level Subject AOS | AO1 Knowledge | AO2 Application | **AO3 Analysis** | **AO4 Evaluation** |
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The A level Chemistry course is content lead. We begin Year 12 by studying the 'Foundations in Chemistry' module which lays the base for all subsequent modules. The course is thereafter split between two teachers, with one teaching largely the Organic side of the course and the other teaching most of the Physical and Inorganic. The development of practical skills runs throughout the course and is assessed through the exam papers and the Practical Endorsement at the end of Year 13.

| KS5 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 12 | Atoms, ions and compounds<br>Amount of substance<br>Electrons and bonding<br><br>Subject Content:<br><br>Atomic structure and isotopes, relative mass, formulae and equations, amount of substance and the mole, determination of formulae, moles and volumes, reacting quantities, electron structure, ionic bonding and structure, covalent bonding<br><br>PAG 1: Moles Determination<br><br>Learner Skills:<br><br>Use of models, chemical calculations (simple and multi-step), working with standard for and significant figures, using ratios, fractions and percentages. Use of equations. | Acids and redox<br>Shapes of molecules and intermolecular forces<br>Periodicity<br><br>Subject Content:<br><br>Acids, bases and neutralisation, acid-base titrations, redox, shapes of molecules and ions, electronegativity and polarity, intermolecular forces, hydrogen bonding, the periodic table, ionisation energies, periodic trends in bonding and structure<br><br>PAG 2: Acid-base titration<br><br>Learner Skills:<br><br>Using angles and shapes in 2-D and 3-D structure. Explanation of reduction and oxidation. Ionic equations and half equations. Recognising and interpreting trends in data. Students acquire a range of essential laboratory skills. These include measuring liquid volumes accurately (1.2.2(a)), mastering the use of volumetric flasks and adopting precise techniques | Basic organic concepts<br>Alkanes<br>Alkenes<br>Reactivity trends<br><br>Subject Content:<br><br>Nomenclature of organic compounds, representing the formulae of organic compounds, isomerism, properties of alkanes, radical substitution mechanism, properties of alkenes, stereoisomerism, reaction of alkenes, electrophilic addition mechanism, polymerisation, Group 2, the halogens, qualitative analysis,<br><br>PAG 4: Qualitative analysis of ions<br><br>Learner Skills:<br><br>Representing organic compounds, formula and structure, visualising and representing 2-D and 3-D forms, explaining and predicting properties. students acquire essential skills, including the use of laboratory apparatus for qualitative ion tests and the | Alcohols<br>Haloalkanes<br>Enthalpy<br><br>Subject Content:<br><br>Properties of alcohols, reactions of alcohols, haloalkenes, organohalogen compounds in the environment, enthalpy changes, measuring enthalpy, bond enthalpies, Hess' law and enthalpy cycles<br><br>PAG 3: Enthalpy determination<br><br>Learner Skills:<br><br>This section addresses various factors influencing energy changes during reactions and the associated calculations. It encompasses considerations such as energy losses from reaction containers, the phenomenon of incomplete combustion (as covered in PAG 3.3), variations in specific heat capacity values (with specific mention of solutions potentially differing slightly from pure water), and | Reaction rates and equilibrium<br>Organic synthesis<br>Spectroscopy<br><br>Subject Content:<br><br>Reaction rates, catalysts, Boltzman distribution, dynamic equilibrium and le Chateliers principle, the equilibrium constant, practical techniques in organic chemistry, synthetic routes, mass spectrometry, infrared spectroscopy<br><br>PAG 5: Synthesis of an organic liquid<br><br>Learner Skills:<br><br>This section encompasses a range of practical skills and safety considerations. It covers the use of laboratory apparatus for tasks such as heating under reflux, which is also relevant to PAG 6. Furthermore, it delves into the purification of liquid products, including the utilisation of separating funnels. Students also gain proficiency in laboratory apparatus for distillation. | Making aspirin<br>Aromatic chemistry<br><br>Subject Content:<br><br>Introducing benzene, electrophilic substitution reactions, phenol, directing groups<br><br>PAG 6: Synthesis of an organic solid (although this may be deferred)<br><br>Learner Skills:<br><br>The practical skills covered in this section encompass various laboratory techniques and safety considerations. These include the use of laboratory apparatus for tasks such as heating under reflux, filtration with fluted filter paper or under reduced pressure, and purification through recrystallization. Additionally, students are introduced to the use of melting point apparatus and techniques like thin-layer or paper chromatography for analytical purposes. Furthermore, the |

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| | | for preparing standard solutions (1.2.2(e)). Additionally, students become proficient in the use of laboratory apparatus for titration, employing burettes and pipettes with precision (1.2.2(d)(i)). They also gain expertise in the application of acid-base indicators during titrations, whether working with weak or strong acids and alkalis (1.2.2(f)). | ability to make and record qualitative observations. They apply these skills in identifying ions in Group 2 salt mixtures (PAG 4.1) and unknown compounds (PAG 4.2 & 4.3), selecting appropriate tests and explaining their methodologies, observations, and resulting inferences. | deviations from standard conditions. | Additionally, the importance of identifying potential hazards and conducting risk assessments, as outlined in CPAC3, reinforces safety awareness and aligns with broader safety principles within the chemistry curriculum. | identification of potential hazards and the importance of risk assessment are emphasised, reinforcing safety protocols and aligning with broader safety principles within the chemistry curriculum. |
| | Rationale:<br><br>These topics form the main part of the 'Foundations in Chemistry' module, underpinning the whole course. Consolidation and extension of knowledge from GCSE and introduction the requirements of the Practical Endorsement. Essential language of chemistry and how this is communicated. | Rationale:<br><br>These topics conclude the 'Foundations in Chemistry' module, again with consolidation and extension of knowledge from GCSE, particularly structure and bonding which is essential for all further topics. Practical titrations skills are refined and linked to the earlier work on chemical calculations. | Rationale:<br><br>These topics set the foundation for Organic Chemistry, most of which will be new content, not previously studied at GCSE level. Reaction mechanisms are studied for the first time. Reactivity trends follows on from and links to the previous Periodicity and Redox topics. | Rationale:<br><br>The organic chemistry looks at further homologous series and moves onto practical synthesis techniques. Physical chemistry is introduced in the enthalpy topic. | Rationale:<br><br>The rates and equilibrium topics review and build on GCSE knowledge, balanced against the organic topics which will be almost completely new. This completes the AS Chemistry course. Spectroscopy must be taught here as we have now finished teaching the structures encountered in AS analytical techniques. | Rationale:<br><br>Following the summer examinations, we move onto the A2 part of the course. |

| KS5 | Autumn 1 | Autumn 2 | Spring 1 | Spring 2 | Summer 1 | Summer 2 |
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| 13 | Carbonyls and carboxylic acids<br>Rates of Reaction, Equilibrium<br><br>Subject Content:<br><br>Carbonyl compounds, identifying aldehydes and ketones, carboxylic acids, carboxylic acid derivatives, orders, rate equations and rate constants, concentration-time graphs, rate-concentration graphs | Acids, bases and pH<br>Buffers and neutralisation<br>Amines, amino acids and polymers<br><br>Subject Content:<br><br>Bronsted-Lowry acids and bases, pH scale and strong acids, the acid dissociation contant Ka, pH of weak acids, pH and strong bases, buffer solutions, neutralisation, amines, amino | Organic synthesis<br>Chromatography and spectroscopy<br>Redox and electrode potentials<br><br>Subject Content:<br><br>carbon-carbon bond formation, further practical techniques, further synthetic routes, chromatography and functional group analysis, NMR spectroscopy, interpreting NMR spectra, | Enthalpy and entropy<br>Transition elements<br><br>Subject Content:<br><br>Lattice enthalpy, enthalpy changes in solution, factors affecting lattice enthalpy and hydration, entropy, free energy, d-block elements, formation and shapes of complex ions, stereoisomerism in complex ions, ligand substitution and | Revision | Exams |

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| | and initial rates, rate determining step, rate constants and temperature, the equilibrium constants Kc and Kp, controlling the position of equilibrium<br><br>**PAG 7: Qualitative analysis of organic functional groups**<br>**PAG 9: Rates of reaction, continuous monitoring method**<br>**PAG 10: Rates of reaction, initial rates method**<br><br>**Learner Skills:**<br><br>Solving algebraic equations, using software to process data, using logarithms in calculations. Within this practical activity group, students will acquire essential laboratory skills. They will learn to employ various laboratory apparatus for qualitative tests aimed at identifying organic functional groups (1.2.2(d)(iii)). Additionally, students will gain proficiency in using equipment like water baths, electric heaters, or sand baths for the purpose of controlled heating (1.2.2(b)). Furthermore, this practical exercise emphasizes the ability to make accurate and detailed qualitative observations, a fundamental aspect of scientific methodology (1.2.1(d)). This rates PAG covers the following core techniques and competencies as a | acids, amides and chirality, condensation polymers.<br><br>**PAG 11: pH measurement**<br><br>**Learner Skills:**<br><br>Using logarithms in calculations and rearranging the subject of the equation. The determination of pH levels can be accomplished through the utilization of pH charts, a pH meter, or a pH probe integrated into a data logger, aligning with 1.2.2(c). | combined analytic techniques, redox reactions, redox titrations, electrode potentials, predictions from electrode potential, storage and fuel cells.<br><br>**PAG 8: Electrochemical Cells**<br><br>**PAG 6: Synthesis of an organic solid**<br><br>**Learner Skills:**<br><br>Analytical skills, rearranging the subjects of more complex equations. Setting up of electrochemical cells and measuring voltages, 1.2.2(j) | precipitation, redox and qualitative analysis<br><br>**PAG 12: Research Skills**<br><br>**Learner Skills:**<br><br>Visualising and understanding symmetry of 2-D and 3-D shapes. Research. Incorporating investigative approaches and techniques into practical work is a fundamental aspect of scientific education, as outlined in 1.2.1(a). Additionally, students are encouraged to employ both online and offline research skills, encompassing the use of websites, textbooks, and various printed scientific sources of information, in accordance with 1.2.1(h). Furthermore, it's crucial that students develop the skill of correctly citing their sources of information, as emphasized in 1.2.1(j). | | |

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| | minimum requirement: firstly, measuring reaction rates through continuous monitoring methods, in accordance with 1.2.2(l)(ii); secondly, mastering the use of appropriate laboratory apparatus to precisely record time measurements, aligning with 1.2.2(a); and thirdly, applying the use of appropriate software for data processing, which is also addressed in 1.2.1(g). Within this Practical Activity Group 10, students will acquire crucial skills and techniques for the study of chemical reactions. These encompass, at a minimum, the ability to measure reaction rates using an initial rate method, such as a clock reaction, in alignment with 1.2.2(l)(i). Furthermore, students will develop proficiency in identifying and controlling variables, meeting the requirements of CPAC2. Additionally, they will gain hands-on experience in using appropriate software to process and analyse data, which is also discussed in 1.2.1(g). It's worth noting that the latter skill can also be further explored in Practical Activity Group 9. | | | | | |
| | Rationale:<br><br>Builds on the Y12 work on Rates and Equilibrium but much more quantitative study. Important quantitative techniques | Rationale:<br><br>These topics are important in many chemical and biological processes and our health and well-being. The physical chemistry modules | Rationale:<br><br>Organic synthesis, chromatography and spectroscopy have to be taught here to reduce the cognitive load on students | Rationale:<br><br>Completes the study of the periodic table, looking at the transition metals. Draws together the physical chemistry topics to look at | | |

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| | | build upon the y12 acid and base module. A highly mathematical module, students will feel better equipped due to the mathematical nature of the previous module which also involved rearranging equations.<br><br>In regards to amino acids, polymers and amines, students have been taught a lot about organic chemistry so should be better equipped for this module than if we taught it earlier in the course. | due to the myriad of complex compounds they are asked to solve the structure of using combined techniques. | why chemical reactions happen. Completes the A level program of study. It's important to note that these practicals within the Practical Activity Group (PAG) are optional. If you've already covered these essential skills in previous practical work with your students, you have the flexibility to exclude these specific activities from your teaching. However, please keep in mind that students should still engage in a minimum of 12 practical activities to fulfil the standard requirements of the Practical Endorsement. | | |