Programme of study for Chemistry Year 12

Autumn (1st term)	Autumn (2nd term)	Spring (1st term)	Spring (2nd Term)	Summer (1st term)	Summer (2nd term)
Topic / Big Question: **Teacher 1:** Topic: Bonding **Teacher 2:** Topic: Atomic structure	Topic / Big Question: **Teacher 1:** Topic: Kinetics Topic: Nomenclature and Alkanes **Teacher 2:** Topic: Amount of substance.	Topic / Big Question: **Teacher 1** Topic: Haloalkanes **Teacher 2:** Topic: Energetics	Topic / Big Question: **Teacher 1** Topic: Alkenes **Teacher 2:** Topic: Equilibria	Topic / Big Question: **Teacher 1:** Topic: Alcohols **Teacher 2:** Topic: Redox Topic: Group 2 and 7	Topic / Big Question: **Teacher 1:** Topic: Organic analysis **Teacher 2:** Topic: periodicity
Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures.	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures.	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures.	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures.	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures.	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures. AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation. to issues, to: • make judgements and reach conclusions •develop and refine practical design and procedures. Solve problems set in practical contexts.

					Apply scientific knowledge to practical contexts Comment on experimental design and evaluate scientific methods. Present data in appropriate ways Evaluate results and draw conclusions with reference to measurement uncertainties and errors. Identify variables including those that must be controlled. Plot and interpret graphs. Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science. Consider margins of error, accuracy and precision of data
Key Learning Outcomes (students should know): Teacher 1: Bonding predict the charge on a simple ion using the position of the element in the Periodic Table construct formulas for ionic compounds. Represent a covalent bond using a line and a co-ordinate bond using an arrow. relate the melting point and conductivity of materials to the type of structure and the bonding present. explain the energy changes associated with changes of state.	Key Learning Outcomes (students should know): Teacher 1: kinetics Define the term activation energy explain why most collisions do not lead to a reaction. Draw and interpret distribution curves for different temperatures. Use the Maxwell–Boltzmann distribution to explain why a small temperature increase can lead to a large increase in rate. Explain how a change in concentration or a change in pressure influences the rate of a reaction. Use a Maxwell–Boltzmann distribution to help explain how	Key Learning Outcomes (students should know): Teacher 1: Halogenoalkanes outline the nucleophilic substitution mechanisms of these reactions. explain why the carbon–halogen bond enthalpy influences the rate of reaction. explain the role of the reagent as both nucleophile and base. outline the elimination mechanisms of these reactions. use equations, such as the following, to explain how chlorine atoms catalyse decomposition of ozone: $Cl\bullet + O_3 \rightarrow ClO\bullet + O_2$ and $ClO\bullet + O_3 \rightarrow 2O_2 + Cl\bullet$	Key Learning Outcomes (students should know): Teacher 1: Alkenes define the term stereoisomer. draw the structural formulas of *E* and *Z* isomers. apply the CIP priority rules to *E* and *Z* isomers. outline the mechanisms for addition reactions. explain the formation of major and minor products by reference to the relative stabilities of primary, secondary and tertiary carbocation intermediates. draw the repeating unit from a monomer structure.	Key Learning Outcomes (students should know): Teacher 1: Alcohols use partial charges to show that a bond is polar. explain why some molecules with polar bonds do not have a permanent dipole. explain the meaning of the term biofuel. justify the conditions used in the production of ethanol by fermentation of glucose. write equations to support the statement that ethanol produced by fermentation is a carbon-neutral fuel and give reasons why this statement is not valid. outline the mechanism for the formation of an alcohol by the	Key Learning Outcomes (students should know): Teacher 1: Organic analysis identify the functional groups using reactions in the specification. use precise atomic masses and the precise molecular mass to determine the molecular formula of a compound. use infrared spectra and the Chemistry Data Sheet or Booklet to identify particular bonds, and therefore functional groups, and also to identify impurities. Teacher 2: Periodicity Period 3: - explain the trends in atomic radius and first ionisation energy.

draw diagrams to represent these structures involving specified numbers of particles. explain the shapes of, and bond angles in, simple molecules and ions with up to six electron pairs (including lone pairs of electrons) surrounding the central atom. use partial charges to show that a bond is polar. explain why some molecules with polar bonds do not have a permanent dipole. explain the existence of these forces between familiar and unfamiliar molecules. explain how melting and boiling points are influenced by these intermolecular forces. Teacher 2: Atomic structure interpret simple mass spectra of elements. calculate relative atomic mass from isotopic abundance, limited to mononuclear ions. define first ionisation energy. write equations for first and successive ionisation energies. explain how first and successive ionisation energies in Period 3	a catalyst increases the rate of a reaction involving a gas. Teacher 1: Nomenclature and Alkanes draw structural, displayed and skeletal formulas for given organic compounds. apply IUPAC rules for nomenclature to name organic compounds limited to chains and rings with up to six carbon atoms each. apply IUPAC rules for nomenclature to draw the structure of an organic compound from the IUPAC name limited to chains and rings with up to six carbon atoms each. define the term structural isomer. draw the structures of chain, position and functional group isomers. explain the economic reasons for cracking alkanes. Distinguish the differences between thermal and catalytic cracking. Write equations for complete and incomplete combustion. explain why sulfur dioxide can be removed from flue gases using calcium oxide or calcium carbonate.	Teacher 2: Energetics Define standard enthalpy of combustion and formation. Use $q=mc\Delta T$ equation to calculate the molar enthalpy change for a reaction Use $q=mc\Delta T$ in related calculations. Define the term mean bond enthalpy. Use mean bond enthalpies to calculate an approximate value of ΔH for reactions in the gaseous phase. Explain why values from mean bond enthalpy calculations differ from those determined using Hess's law. Use Hess's law to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation.	draw the repeating unit from a section of the polymer chain. draw the structure of the monomer from a section of the polymer. explain why addition polymers are unreactive. explain the nature of intermolecular forces between molecules of polyalkenes. Teacher 2: Equilibria Use Le Chatelier's principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium. Explain why, for a reversible reaction used in an industrial process, a compromise temperature and pressure may be used. Construct an expression for kc for a homogenous system in equilibrium. Calculate a value for kc from the equilibrium concentrations for a homogenous system at a constant temperature. Perform calculations involving kc Predict the qualitative effects of changes of temperature on the value of kc. derive partial pressure from mole fraction and total pressure	reaction of an alkene with steam in the presence of an acid catalyst. discuss the environmental (including ethical) issues linked to decision making about biofuel use. write equations for oxidation reactions of alcohol (equations showing [O] as oxidant are acceptable) explain how the method used to oxidise a primary alcohol determines whether an aldehyde or carboxylic acid is obtained. use chemical tests to distinguish between aldehydes and ketones including Fehling's solution and Tollens' reagent. outline the mechanism for the elimination of water from alcohols. Teacher 2: Redox work out the oxidation state of an element in a compound or ion from the formula. write half-equations identifying the oxidation and reduction processes in redox reactions. combine half-equations to give an overall redox equation. Teacher 2: Group 2 and 7 Group 2:	explain the melting point of the elements in terms of their structure and bonding.

(Na–Ar) and in Group 2 (Be–Ba) give evidence for electron configuration in sub-shells and in shells.	explain reaction as a free-radical substitution mechanism involving initiation, propagation and termination steps. Use equations, such as the following, to explain how chlorine atoms catalyse decomposition of ozone. Teacher 2: Amount of substance define relative atomic mass (Ar) define relative molecular mass (Mr) carry out calculations: - using the Avogadro constant - using mass of substance, Mr, and amount in moles - using concentration, volume and amount of substance in a solution. Use the PV=nRT in calculations. calculate empirical formula from data giving composition by mass or percentage by mass. calculate molecular formula from the empirical formula and relative molecular mass. write balanced equations for reactions studied.		construct an expression for Kp for a homogeneous system in equilibrium perform calculations involving Kp predict the qualitative effects of changes in temperature and pressure on the position of equilibrium predict the qualitative effects of changes in temperature on the value of Kp understand that, whilst a catalyst can affect the rate of attainment of an equilibrium, it does not affect the value of the equilibrium constant.	explain the trends in atomic radius and first ionisation energy. explain the melting point of the elements in terms of their structure and bonding. explain why BaCl2 solution is used to test for sulfate ions and why it is acidified. Group 7: explain the trend in electronegativity. explain the trend in the boiling point of the elements in terms of their structure and bonding. Explain why: - silver nitrate solution is used to identify halide ions. - the silver nitrate solution is acidified. - ammonia solution is added. The use of chlorine in water treatment. The reaction of chlorine with cold, dilute, aqueous NaOH and uses of the solution formed. Carry out simple test-tube reactions to identify: - cations – Group 2, NH_4^+ anions – Group 7 (halide ions), OH–, CO_3^{2-}, SO_4^{2-}	

	balance equations for unfamiliar reactions when reactants and products are specified. Use balanced equations to calculate: - masses - volumes of gases - percentage yields - percentage atom economies concentrations and volumes for reactions in solutions.				

Autumn Term – centrally planned, standardised and teacher marked piece(s) of work	Spring Term – centrally planned, standardised and teacher marked piece(s) of work	Summer Term – centrally planned, standardised and teacher marked piece(s) of work
Bonding end of topic test Atomic structure end of topic test Linear exam	Introduction to organic chemistry and alkanes end of topic test Amount of substance end of topic test Energetics end of topic test Required practical 5	Equilibria end of topic test required practical 6 Linear exams

Building understanding: Rationale / breakdown for your sequence of lessons:
Teacher 1 delivers physical chemistry and organic chemistry. Teacher 2 delivers inorganic and physical chemistry. This is split in the same way as how the examination papers are.

Physical chemistry is interleaved throughout the two years and taught by both teachers.

Teacher 1:
Bonding: Bonding is often introduced first because it's essential to understanding how compounds are formed. It lays the foundation for students to comprehend chemical reactions and the behaviour of atoms and molecules.

Kinetics: Kinetics, the study of reaction rates, is a logical follow-up to bonding. Once students understand how compounds are formed, they can then delve into how these compounds react and how fast these reactions occur. This topic introduces students to the concept of chemical change and reaction mechanisms.

Introduction to Organic Chemistry: Organic chemistry is typically introduced after the fundamental principles of bonding and kinetics have been covered. This is because it builds upon these principles and introduces students to the vast field of carbon-based compounds, which is essential for understanding a wide range of chemical reactions and compounds.

Alkanes: Alkanes are usually among the first organic compounds studied because they are the simplest hydrocarbons, composed of only carbon and hydrogen. They provide a straightforward introduction to the nomenclature, structure, and isomerism in organic chemistry.

Halogenoalkanes: Halogenoalkanes, or alkyl halides, are a natural progression from alkanes as they introduce functional groups and chemical reactions in organic molecules. This topic expands on the concept of carbon-carbon and carbon-halogen bonds, which students would have already encountered.

Alkenes: Alkenes are another crucial group of organic compounds, introducing the concept of double bonds. After understanding alkanes and halogenoalkanes, students can grasp the significance of different functional groups in organic molecules.

Alcohols: Alcohols introduce another common functional group, the hydroxyl group (-OH). This topic builds upon previous knowledge of bonding and organic reactions, allowing students to understand the properties and reactions of alcohol compounds.

Organic Analysis: Organic analysis is often taught towards the end of the organic chemistry section because it combines knowledge of all the previous topics. It focuses on the identification and analysis of organic compounds, utilizing techniques like spectroscopy, chromatography, and mass spectrometry. Students need a solid understanding of the earlier topics to effectively analyse and interpret the data obtained from these methods.

In summary, the sequencing of these topics follows a logical progression from foundational principles (bonding and kinetics) to the more complex and specialised aspects of organic chemistry. This approach helps students build their knowledge step by step and allows for a smoother transition between topics.

Teacher 2:
Atomic Structure: This topic is often introduced first because it lays the foundation for understanding all other chemical principles and it builds on content taught at GCSE. It covers the fundamental concepts of the atom, including the structure of the nucleus, electron arrangement, and the periodic table. Without a grasp of atomic structure, it's challenging to understand other chemical phenomena.

Amount of Substance: After students have a good understanding of atomic structure, the concept of amount of substance comes into play. This topic introduces the mole concept, stoichiometry, and how to calculate quantities of substances in chemical reactions. It's a fundamental concept that connects atomic theory to practical chemical calculations.

Energetics: Energetics deals with the concept of energy changes in chemical reactions, such as enthalpy changes, heat, and bond energies. Once students understand the basics of chemical reactions and stoichiometry, they can start exploring the energy aspect of these reactions, which is critical for understanding reaction mechanisms and thermodynamics.

Equilibria: Equilibria builds on the understanding of chemical reactions and energy changes. It introduces the concept of dynamic chemical equilibria, the equilibrium constant, and Le Chatelier's principle. This topic helps students comprehend how reactions reach a state of balance and how they can be influenced.

Redox: Redox (reduction-oxidation) reactions involve the transfer of electrons between substances. By introducing redox after equilibria, students have a firm grasp of reaction dynamics and energy changes, making it easier to understand electron transfer reactions.

Group 2 and 7: Transitioning to specific groups in the periodic table provides students with an opportunity to apply their knowledge of atomic structure, bonding, and reactivity to a subset of elements. Groups 2 and 7 (alkali metals and halogens) have distinctive properties and reactivity patterns, which are easier to explore once students have a solid foundation in fundamental chemistry.

Periodicity: The periodicity topic ties everything together by emphasising the patterns and trends in the periodic table. It builds on the students' understanding of atomic structure, bonding, and the properties of elements in specific groups. It helps students identify and predict trends in properties like atomic size, ionisation energy, and electron affinity across the periodic table.

In summary, this sequencing is designed to help students progress from fundamental concepts (atomic structure) to more complex topics (energetics, equilibria, redox) and finally apply their knowledge to specific groups of elements (Group 2 and 7) before exploring the periodic trends that unify the entire periodic table. This gradual progression provides students with a structured and logical approach to understanding chemistry.

Home – Learning:	Home – Learning:	Home – Learning:	Home – Learning:	Home – Learning:	Home – Learning:
Teacher to set based on course content and required practical.	Assessed home-learning on bonding. Amount of substance booklet to be completed through the duration of half term	Assessed home-learning on required practical 1. Assessed home-learning on required practical 3.	Assessed home-learning on amount of substance. Assessed home-learning on alkanes and Halogenoalkanes	Assessed home learning on alkenes and alcohols. Assessed home learning on equilibrium	Research tasks for required practical’s

Reading / High Quality Text:

On regular occasion, students are given pre-learning reading on topics to encourage them to become more independent in their learning. Students are shown how to tackle exam questions through underlining keywords and command words. Understanding of these command words are tested in our connector/starter activities as well.

In chemistry exams, in each paper there is a 6-mark question where quality of written communication is assessed. This is taught through modelling techniques of looking at previous students work and assessing where the marks are given and what makes a good answer.

Students are also encouraged to use Jim Clark's book as a reference for calculations in chemistry.

Numeracy:

20% of marks in A-level assessments will require the use of mathematical skills therefore is an integral part of their learning.

Students are required to work out:
work out bond angles for shapes of molecules in bonding.

calculate weighted means e.g., calculation of an atomic mass based on supplied isotopic abundances

Kinetic energy and time, distance and velocity equations used in atomic structure. The two equations are combined. They also use Avogadro's constant to calculate mass one ion.

Recognise and make use of appropriate units in calculation.

Students are required to calculate weighted means, e.g. calculation of an atomic mass based on supplied isotopic abundances.

Numeracy:

Amount of substance involves looking at calculations within chemistry.
Students will need to report calculations to appropriate number of significant figures.
They will have to convert units.
Students will be taught how to identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined.
Use ratios, percentages and fractions in calculations.
select appropriate titration data (i.e. identification of outliers) in order to calculate mean titres.
Students are required to draw graphs and draw tangents to work out rate of reaction.

Evaluate the effect of changing experimental parameters on measurable values e.g. how the value of Kc would change with temperature given different specified conditions (estimate value).

Recognise and make use of appropriate units in calculation.

Calculate the value of an equilibrium constant Kc and Kp.

Numeracy:
Recognise and make use of appropriate units in calculation

Redox equations require students use charges of species to ensure both sides equal to zero by inserting electrons into the equation.

Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):

Enrichment workshops, lectures and visits will be organised as part of the science week programme and students are encouraged to read chemistry review magazine that can be found in the sixth form library. This magazine contains useful articles and exam tips.