



**BROOK 6TH FORM
& ACADEMY**

A UNIVERSITY TECHNOLOGY COLLEGE

AS – Chemistry –Year 12



Autumn Term:

Autumn Term: 2024

Autumn term - 2024

3.1 Physical Chemistry

3.1.1 Atomic structure

3.1.2 Amounts of substance

Half term

3.2.3 Bonding

Christmas break

Spring Term: 2025

Spring term -2025

3.1.5 Kinetics

3.1.6 Chemical equilibria, Le Chatelier's principle and K_c

3.1.7 Oxidation, reduction and redox equations

3.2 Inorganic chemistry

3.2.1 Periodicity

3.2.2 Group 2, the alkaline earth metals

3.2.3 Group 7(17), the halogens

Easter break

Summer Term: 2025

Summer term -2025

3.3 Organic chemistry

3.3.1 Introduction to organic chemistry

3.3.2 Alkanes

3.3.3 Halogen alkanes

3.3.4 Alkenes

3.3.5 Alcohols

3.3.6 Organic analysis

Curriculum Intent and Implementation

Vision:

Our vision here in the Chemistry department is to inspire and equip students with the knowledge, skills, and enthusiasm necessary to understand and apply chemical principles through hands-on experiments, fostering a deeper appreciation of the scientific method and its impact on the world around us.

Mission:

Our mission is to provide a stimulating and supportive learning environment where students can develop their practical chemistry skills, critical thinking, and scientific literacy. We aim to cultivate curiosity, innovation, and a lifelong passion for science through engaging and meaningful laboratory experiences. Through our practical chemistry curriculum, we aim to nurture inquisitive minds, develop competent and confident individuals, and inspire the next generation of scientists.

Goals:

Develop Scientific skills:

We work hard to ensure that all students are helped to develop the following scientific Skills:

- Acquire essential laboratory techniques and safety practices.
- Promote precision, accuracy, and attention to detail in experimental work.
- Develop independent and collaborative problem-solving abilities.

Enhance Scientific Understanding

- All students are helped to reinforce their theoretical knowledge through practical application.
- Teachers must foster an understanding of the scientific method, including hypothesis formulation, experimental design, data collection, and analysis.
- Students are helped to see the relevance of chemistry in everyday life and its applications in various fields such as medicine, industry, and environmental science.

Promote Inquiry and Critical Thinking:

Teachers at Brook sixth form stimulate curiosity and questioning, encourage students to analyse and interpret data, draw conclusions, and communicate findings effectively. Through class discussions, students are helped to develop the ability to critically evaluate scientific information and experimental outcomes.

Cultivate a Safe and Supportive Learning Environment:

Here in the chemistry department, we understand the importance of safety and we take on the challenge to ensure all students understand and adhere to safety protocols. The science team provides equal opportunities for all students to participate and succeed in laboratory activities. We celebrate and welcome the diversity of our students, hence foster a collaborative and respectful atmosphere that supports diverse learning needs and styles.

Prepare our students for Future Endeavours:

Here in the Chemistry department, we know that transferable skills are critical for science students as they equip them with versatile abilities that are valuable across various professional and academic fields. Whatever, endeavours our students may pursue in their future careers, we equip them with the skills and confidence needed for higher education and careers in science and related fields.

As a team, we aim at developing them into lifelong learners with the ability to adapt in an ever-changing scientific landscape. In addition, we encourage ethical and responsible conduct in scientific practice.

Implementation:

Constructive learning:

We understand the need to place the learner in the centre of their learning journey. Therefore, the department adopt and implement the constructive learning approach in our lessons, enabling learners actively construct their own understanding and knowledge through experiences and reflecting on those experiences. We therefore emphasise of hands-on activities, critical thinking, and collaboration, allowing students to connect new information to prior knowledge and apply it in meaningful ways and ultimately take responsibility for their learning.

Structured Curriculum:

A well-organized sequence of practical activities aligned with theoretical lessons, progressing from fundamental techniques to more complex experiments. We work collaboratively at helping our learner link ideas across different areas of the curriculum.

Resources and Support:

We adapt learning to the very needs of individual students in order to help them reach their potential. In addition, we provide appropriate materials, equipment, and guidance to facilitate effective learning experiences.

Assessment and Feedback:

We aim at developing our students into reflective learners, through regular formative and summative assessments to monitor progress, identify areas for improvement, and provide constructive feedback.

3.1.1 Atomic structure

Prior learning	Retrieval :	Inclusivity and Differentiations:
<p><u>Prior Knowledge]</u></p> <p>GCSE Chemistry - The structure of atoms (although this is revisited here).</p> <p>GCSE Physics - The structure of atoms (although this is revisited here). - The effect of a force on moving objects. - The effect of a magnetic field on a moving, electrically charged particle (Separate Science)</p>	<p>Retrieval: Starter- Retrieval at the start of each lesson/ Quizzes to retrieve previous knowledge/ opportunities in the lesson to link new knowledge to previous knowledge.</p> <p>Strategies:</p> <ul style="list-style-type: none"> ○ Spaced retrieval (to combats the forgetting curve) ○ Retrieval mats/grids ○ Draw it !..label it! ○ Free recall Concept mapping ○ Peer teaching <p>Afl strategies: Low/high stake Quizzes, Targeted Questioning, Peer Talk and responses Peer Assessment & Self-Assessment, Thumb signs pose-pause –pounce, exit and self-peer assessment etc.</p>	<p>Inclusivity and Differentiations: To ensure we provide a supportive environment and meet the individual learning needs of our SEND students we adopt the following strategies in our science lessons:</p> <ul style="list-style-type: none"> ○ Chunk information into manageable bite sized tasks ○ Provide Visual /multisensory aids to help students develop understanding ○ Provide tiered activities/HW that allows all learners to make progress at their own pace ○ Flexible groupings to provide effective collaboration ○ Provide text that caters to the reading ages of individual learners <p><i>SEND support (K) and EHCP (E= stated) – for pupils with IEPs targets in their pupil past-ports are used to inform planning</i></p>
<p>Literacy in Chemistry:</p> <ol style="list-style-type: none"> 1. Response to six markers (two-week cycle) <ul style="list-style-type: none"> ○ Teacher provide detailed feedback to a six marker response with focus on; content, use of key terms, SPAG, presentation, command words and coherence, logical reasoning ○ Student respond and improve their work 2. Frayers model 3. Writing descriptions/observation during experiments 4. Lesson key terms provided during lessons 5. Claim –Evidence –Reasoning 6. Read and translate information into other formats 	<p>Reflection:</p> <p>Students are encouraging to reflect and to evaluate their own and others' which work fosters reflective learning and helps them understand how to improve. The following strategies are employed:</p> <ul style="list-style-type: none"> ○ Peer on peer/self-assessment during lesson ○ Teacher feedback and student respond to improve ○ End of unit/end of topic assessments are used to help student reflect and improve 	<p>Numeracy Skills:</p> <p>Experimental skills: Practical sessions are used to develop the following skills:</p> <ul style="list-style-type: none"> ○ Choosing appropriate graph, identifying variables and controls ○ Collecting and Recording data, interpreting and describing trends and drawing conclusions ○ Observing safety protocols and setting up apparatus safely ○ Carrying out repeats, testing reliability of test data and identifying anomalous data ○ Drawing conclusions ○ Calculating averages/mean

3.1.2.1 Relative atomic mass and relative molecular mass

Week 1: 3.1.1.1 Fundamental particles				
Learning Outcome	Activities		Skills	Resources
Week 2: 09/09/24 to 15/09/24				
Students should be able to: <ul style="list-style-type: none"> describe the structure of atoms in terms of protons, neutrons and electrons recall the relative mass and relative charge of protons, neutrons and electrons. 	<ul style="list-style-type: none"> Students research how the model of the atom changed over time (examples of key contributions could include the Ancient Greeks, Dalton, Thompson, Rutherford, Bohr, Chadwick) - understanding of atomic structure - Evaluate how and why atomic structure model developed over time). Rich question – How can we tell what is inside an atom if we can't see it 			RSC timeline: http://www.rsc.org/chemsoc/timeline RSC: Chemists in a social & historical context: http://www.rsc.org/learn-chemistry/resource/res00001332/the-atom-detectives?cmpid=CMP00002843 RI Christmas Lecture – section on atomic structure http://www.rsc.org/learn-chemistry/resource/res00001119/ri-christmas-lectures-2012-atomic-structure
Week 2: 3.1.1.2 Mass number and isotopes				
Students should be able to: define atoms and ions in terms of numbers of protons, neutrons and electrons, as well as atomic number and mass number (including isotopes) <ul style="list-style-type: none"> describe how a time of flight mass spectrometer works identify elements and calculate relative atomic mass from mass spectroscopy data 	<ul style="list-style-type: none"> Students identify atoms and ions from numbers of protons, neutrons and electrons, and vice versa Students determine the relative atomic mass of elements using isotope abundance data (this could include data for elements found in meteorites to show some difference) quoting answers to a suitable number of significant figures for data provided - Use an appropriate number of significant figures to find relative masses Find arithmetic means to find relative masses. Students look at the mass spectra of compounds to determine the relative formula mass 			RSC: Build an atom simulation: http://www.rsc.org/learn-chemistry/resource/res00001433/build-an-atom-simulation-rsc-funded RSC Spectral School: http://www.rsc.org/learn-chemistry/collections/spectroscopy Isotope data: http://www.chem.ualberta.ca/~massspec/atomic_mass_abund.pdf Data on isotopes in meteorites: 'The Elements: Their Origin, Abundance, and Distribution' by P. A. Cox

<ul style="list-style-type: none"> • find the relative formula mass of compounds from mass spectroscopy data. 				AQA Time of flight mass spectrometry Teachers' Notes and Student guide:
Week 3: 3.1.1.3 Electron configuration				
<p>16/09/24 to 20/09/24</p> <p>Students should be able to:</p> <ul style="list-style-type: none"> • give the electron structure of atoms and ions up to Z=36 in terms of s, p and d sub-shells • explain how data from ionisation energies provides evidence for electron structure. 	<p>Students write the electron structure of atoms and ions with Z=1-36</p> <p>Demonstrate knowledge and understanding of scientific ideas).</p> <p>Students research values of first ionisation energies for elements Z=1–36 and plot them on a graph and then explain trends</p> <p>Plot two variables from experimental or other data Students write explanations for trends in ionisation energies down a group and across a period Demonstrate knowledge and understanding of scientific ideas).</p> <p>Students determine which Group an element is in using successive ionisation energy data.</p>			
Week 3: Revision – End of unit assessments – Reflections – Targets – GAP analysis				

3.1.2 Amount of substance

Prior learning	Retrieval :	Inclusivity and Differentiations:
<p><u>Prior Knowledge]</u></p> <p>GCSE Chemistry</p> <ul style="list-style-type: none"> - Relative atomic mass, relative molecular mass, relative formula mass (although this is revisited here). - Writing formulae (elements, common compounds and ionic compounds). - Balancing equations (although this is revisited here). - Moles (although this is revisited here). - Calculations involving Masses (although this is revisited here). - Concentration of solutions (Separate Science - although this is revisited here). - Empirical and molecular formulae (although this is revisited here). 	<p><u>Retrieval:</u></p> <p>Starter- Retrieval at the start of each lesson/ Quizzes to retrieve previous knowledge/ opportunities in the lesson to link new knowledge to previous knowledge.</p> <p><u>Strategies:</u></p> <ul style="list-style-type: none"> ○ Spaced retrieval (to combats the forgetting curve) ○ Retrieval mats/grids ○ Draw it !..label it! ○ Free recall Concept mapping ○ Peer teaching <p><u>Afl strategies:</u></p> <p>Low/high stake Quizzes, Targeted Questioning, Peer Talk and responses Peer Assessment & Self-Assessment, Thumb signs pose-pause –pounce, exit and self-peer assessment etc.</p>	<p><u>Inclusivity and Differentiations:</u></p> <p>To ensure we provide a supportive environment and meet the individual learning needs of our SEND students we adopt the following strategies in our science lessons:</p> <ul style="list-style-type: none"> ○ Chunk information into manageable bite sized tasks ○ Provide Visual /multisensory aids to help students develop understanding ○ Provide tiered activities/HW that allows all learners to make progress at their own pace ○ Flexible groupings to provide effective collaboration ○ Provide text that caters to the reading ages of individual learners <p><i>SEND support (K) and EHCP (E= stated) – for pupils with IEPs targets in their pupil past-ports are used to inform planning</i></p>
Literacy in Chemistry:	Reflection:	Numeracy Skills:
<p>7. Response to six markers (two-week cycle)</p> <ul style="list-style-type: none"> ○ Teacher provide detailed feedback to a six marker response with focus on; content, use of key terms, SPAG, presentation, command words and coherence, logical reasoning ○ Student respond and improve their work <p>8. Frayers model</p> <p>9. Writing descriptions/observation during experiments</p> <p>10. Lesson key terms provided during lessons</p> <p>11. Claim –Evidence –Reasoning</p> <p>12. Read and translate information into other formats</p>	<p>Students are encouraging to reflect and to evaluate their own and others' which work fosters reflective learning and helps them understand how to improve. The following strategies are employed:</p> <ul style="list-style-type: none"> ○ Peer on peer/self-assessment during lesson ○ Teacher feedback and student respond to improve ○ End of unit/end of topic assessments are used to help student reflect and improve 	<p>Experimental skills:</p> <p>Practical sessions are used to develop the following skills:</p> <ul style="list-style-type: none"> ○ Choosing appropriate graph, identifying variables and controls ○ Collecting and Recording data, interpreting and describing trends and drawing conclusions ○ Observing safety protocols and setting up apparatus safely ○ Carrying out repeats, testing reliability of test data and identifying anomalous data ○ Drawing conclusions ○ Calculating averages/mean

3.1.2.1 Relative atomic mass and relative molecular mass

Week 4: Relative atomic mass and relative molecular mass and Avogadro's constant			
Learning Outcome	Activities	Required practical	Skills
<p>23/09/24 to 27/09/24</p> <p>3.1.2.1 Relative atomic mass and relative molecular mass</p> <p>Students should be able to:</p> <ul style="list-style-type: none"> define relative atomic mass (A_r) define relative molecular mass (M_r) <p>determine relative molecular mass (M_r) of a substance using relative atomic mass (A_r) values.</p> <p>Electronic config</p>	<ul style="list-style-type: none"> The relative mass of different substances is calculated from the formula The mass of everyday objects could be measured relative to a specific object of known Determine the relative formula mass (M_r) of substances using relative atomic mass values <p>Extension task: Students could research why ^{12}C was chosen as the standard</p>		
<p>23/09/24 to 29/09/24</p> <p>3.1.2.2 The mole and Avogadro constant</p> <p>Students should be able to carry out calculations:</p> <ul style="list-style-type: none"> using the Avogadro constant using mass of substance, M_r, and amount in moles using concentration, volume and amount of substance in a solution. 	<ul style="list-style-type: none"> Students calculate the mass (in g) of atoms/ions using the masses sub atomic particles, quoting answers to a suitable number of significant figures for data provided Students practice doing calculations involving Avogadro constant, involving mass, M_r and moles, and involving concentration, volume and amount of substance and quoting the final results to the appropriate number of significant figures for data provided <p>Use an appropriate number of significant figures to find relative masses). Students find the concentration of NaCl in intravenous saline (9 g per dm^3), glucose in</p> <p>Extension: Students research how Avogadro determined the value of his constant</p>	<p>Practical opportunity:</p> <p>Students measure out 1 mole (and other mole quantities) of different substances (e.g. sucrose, salt, water)</p>	<p>Student weigh and calculate the number of mole in an iron nail</p>

<p>Week 5: 31/09/24 to 06/10/24</p> <p>2: 3.1.2.3: The ideal gas equation</p> <p>Students should be able to carry out calculations:</p> <ul style="list-style-type: none"> • Using the ideal gas equation. 	<p>Students will need to rearrange the ideal gas equation, work in appropriate units and quote answers to an appropriate number of significant figures</p> <p>Recognise and make use of appropriate units in ideal gas calculations</p> <p>Change the subject of the ideal gas equation; Substitute numerical values into the ideal gas equation using appropriate units for physical quantities).</p> <p>Recognise and make use of appropriate units in ideal gas calculations</p> <p>Change the subject of the ideal gas equation; Substitute numerical values into the ideal gas equation using appropriate units for physical quantities</p> <p>Recognise and make use of appropriate units in ideal gas calculations</p> <p>Change the subject of the ideal gas equation; Substitute numerical values into the ideal gas equation using appropriate units for physical quantities).</p>	<p>Students find the mass of argon inside a gas cylinder (23 MPa pressure, 146 × 23 cm dimensions</p>	<p>Data processing: Process and analyse data</p>

Week 5: Empirical and molecular formula – Ionic equation - Balancing equation

3.1.2.4 Empirical and molecular formula

Students should be able to:

- explain the difference between empirical and molecular formulae
- carry out calculations:
- to find empirical formula from data giving composition by mass or percentage by mass
- to find molecular formula from the empirical formula and relative molecular mass.
- process & analyse data using appropriate mathematical skills).
- Students find empirical formulae (and molecular formulae where relevant) from data
- Use ratios, fractions and percentages).

Practical opportunity:

- Students find the empirical formula of a metal oxide (eg magnesium oxide or copper oxide)

- process & analyse data using appropriate mathematical skills).

Students find empirical formulae (and molecular formulae where

Use ratios, fractions and percentages).

**Week 6
07/09/24 to 13/10/24**

3.1.2.5 Balanced equations and associated calculations

Students should be able to:

- write balanced equations
- write ionic equations
- carry out calculations for reactions involving:
 - masses,
 - percentage yields,
 - atom economies,
 - volumes of gases,
 - concentrations & volumes of solutions,
- give economic, ethical and environmental advantages for society and industry of processes with a high atom economy.

Students balance equations, including ones where formulae are given and some where they are not.

Students write ionic equations from given equations

Students practise calculations to find masses, percentage yields, atom economies, volumes of gases, concentrations & volumes of solutions

Use an appropriate number of significant figures; Substitute numerical values into algebraic equations using appropriate units for physical quantities).

Practical opportunity:

the yield for the conversion of magnesium to magnesium oxide
Process and analyse data using appropriate mathematical skills).

Practical opportunity:

Students find the Mr of a hydrated salt (eg copper sulphate or magnesium sulphate) by

Apply knowledge and understanding
Process and analyse data using appropriate mathematical skills).

Process and analyse data using appropriate mathematical skills).
Process and analyse data using appropriate mathematical skills);
Consider margins of

<p><u>Week 6</u></p> <p>3.1.2.5 Balanced equations and associated calculations students should be able to:</p> <ul style="list-style-type: none"> • atom economies, • volumes of gases, • concentrations & volumes of solutions, • give economic, ethical and environmental advantages for society and industry of processes with a high atom economy. <p><u>Week 7 Student should be able to:</u> Use laboratory apparatus for a variety of experimental techniques including titration, using burette and pipette;</p> <p>14/10/24 to 20/10/24</p> <p>Week 8</p>	<p>:</p> <p>Students use equation to calculate masses, percentage yields, atom economies, volumes of gases, concentrations & volumes of solutions.</p> <p>To understand the importance of processes having a high atom economy for society and industry.</p> <p>Students balance equations, including ones where formulae are given and some where they are not</p> <p>Students write ionic equations from given equations</p> <p>Students practise calculations to find masses, percentage yields, atom economies, volumes of gases, concentrations & volumes of solutions Substitute numerical values into algebraic equations using appropriate units for physical quantities).</p>	<p>heating to constant mass</p> <p>Practical opportunity: Students find the percentage conversion of a Group 2 carbonate to its oxide by heat</p> <p>Practical opportunity: the yield for the conversion of magnesium to magnesium oxide</p> <p>Required practical 1 - Make up a volumetric solution and carry out a simple acid–base titration the concentration of ethanoic acid in vinegar</p>	<p>error, accuracy and precision of data;</p> <p>Process and analyse data using appropriate mathematical skills).</p> <ul style="list-style-type: none"> • Process and analyse data using appropriate mathematical skills
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3.1.3 Bonding

<p>Prior Knowledge]</p> <p>GCSE Chemistry</p> <ul style="list-style-type: none"> - Structure and bonding - properties of ionic and covalent compounds - ions and metallic bonding 	<p>Retrieval:</p> <p>Starter- Retrieval at the start of each lesson/ Quizzes to retrieve previous knowledge/ opportunities in the lesson to link new knowledge to previous knowledge.</p> <p>Strategies:</p> <ul style="list-style-type: none"> ○ Spaced retrieval (to combats the forgetting curve) ○ Retrieval mats/grids ○ Draw it !..label it! ○ Free recall Concept mapping ○ Peer teaching 	<p>Inclusivity and Differentiations:</p> <p>To ensure we provide a supportive environment and meet the individual learning needs of our SEND students we adopt the following strategies in our science lessons:</p> <ul style="list-style-type: none"> ○ Chunk information into manageable bite sized tasks ○ Provide Visual /multisensory aids to help students develop understanding ○ Provide tiered activities/HW that allows all learners to make progress at their own pace ○ Flexible groupings to provide effective collaboration ○ Provide text that caters to the reading ages of individual learners <p><i>SEND support (K) and EHCP (E= stated) – for pupils with IEPs targets in their pupil past-ports are used to inform planning</i></p>
<p>Literacy in Chemistry:</p>	<p>Reflection:</p>	<p>Numeracy Skills:</p>
<p>13. Response to six markers (two-week cycle)</p> <ul style="list-style-type: none"> ○ Teacher provide detailed feedback to a six marker response with focus on; content, use of key terms, SPAG, presentation, command words and coherence, logical reasoning ○ Student respond and improve their work <p>14. Frayers model</p> <p>15. Writing descriptions/observation during experiments</p> <p>16. Lesson key terms provided during lessons</p> <p>17. Claim –Evidence –Reasoning</p> <p>18. Read and translate information into other formats</p>	<p>Students are encouraging to reflect and to evaluate their own and others' which work fosters reflective learning and helps them understand how to improve. The following strategies are employed:</p> <ul style="list-style-type: none"> ○ Peer on peer/self-assessment during lesson ○ Teacher feedback and student respond to improve ○ End of unit/end of topic assessments are used to help student reflect and improve 	<p>Experimental skills:</p> <p>Practical sessions are used to develop the following skills:</p> <ul style="list-style-type: none"> ○ Choosing appropriate graph, identifying variables and controls ○ Collecting and Recording data, interpreting and describing trends and drawing conclusions ○ Observing safety protocols and setting up apparatus safely ○ Carrying out repeats, testing reliability of test data and identifying anomalous data ○ Drawing conclusions ○ Calculating averages/mean

3.1.3.1 Ionic bonding

Week 9: 3.1.1.1 Understanding ionic bonding				
Learning Outcome	Activities	Practical	Skills	Date
<p>11/11/24 – 17/11/24</p> <p>Students should be able to:</p> <ul style="list-style-type: none"> describe the structure of ionic compounds explain the properties of ionic compounds using an understanding of ionic bonding predict the formula of simple ions based on the position of the element in the Periodic Table and knowledge of common compound ions write the formula of ionic compounds. 	<ul style="list-style-type: none"> Students explain the properties of ionic compounds Students write the formula of ionic compounds, including those with common compound ions <p>Rich question: Which of the following ionic compounds have the highest and lowest melting points: sodium chloride, potassium chloride; magnesium chloride – explain your reasoning?</p>			
Week 9 3.1.3.2 Nature of covalent and dative covalent bonds				
<p>Students should be able to:</p> <ul style="list-style-type: none"> describe the nature of covalent bonds, including co-ordinate and multiple bonds represent molecules by diagrams where lines represent each covalent bond, with an arrow to represent a co-ordinate bond describe the structure of molecular substances explain the properties of molecular substances. 	<ul style="list-style-type: none"> Students describe differences between ionic and covalent bonding Students describe similarities and differences between covalent and co-ordinate bonds Students draw diagrams of molecules showing covalent and co-ordinate bonds as lines/arrows respectively (“stick” diagrams) Students explain the properties of molecular substances <p>Rich question: The ammonium ion has three covalent N–H bonds and one co-ordinate N–H bond – how does the strength of the covalent bonds compare to the co-ordinate bond – explain your reasoning?</p>			

Week 9: 3.1.3.3 Metallic bonding				
Students should be able to: <ul style="list-style-type: none"> describe the nature of metallic bonding describe the structure of metals explain the properties of metals. 	<ul style="list-style-type: none"> Students describe differences between metallic, ionic and covalent bonding Students explain the properties of metals Rich question: Which metals have the highest and lowest melting points – sodium, potassium, magnesium – explain your reasoning?			
Week 10 3.1.3.4 - Bonding and physical properties				
18/11/24 – 24/11/24 Students should be able to: <ul style="list-style-type: none"> describe and explain the properties of ionic, molecular, giant covalent and metallic substances, in terms of melting/boiling points and conductivity describe in detail and draw the structures of diamond, graphite, ice, iodine, magnesium and sodium chloride. 	<ul style="list-style-type: none"> Students create a summary table to describe and explain the structure and properties of ionic, molecular, giant covalent and metallic substances Students sketch the structures of diamond, graphite, ice, iodine, magnesium and sodium chloride as solids and label the diagrams to explain their melting/boiling points and conductivity <p>Students determine which type of structure a substance has from its properties using data and/or experimentally (eg to test solubility, conductivity and ease of melting)</p>	Practical opportunity: Investigate the melting point, solubility and conductivity of substances with different structure types		
Week 10 3.1.3.5 Shapes of simple molecules and ions				
Students should be able to: Work out, name and sketch the shape of molecules and ions with up to six electron pairs surrounding the central atom, including bond angles explain using VSEPR theory why molecules and ions have the shapes that they do, including the effect on the bond angles of the great repulsion by lone (non-bonding) pairs.	<ul style="list-style-type: none"> Make models of molecular shapes Use balloons to represent electron pairs to demonstrate shapes Deduce, sketch and name the shapes of given molecules and ions, including bond angles Use angles and shapes in regular 2D and 3D structures; Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects; Understand the symmetry of 2D and 3D shapes).		Predicting Molecular Shapes: Using VSEPR theory, students predict the geometry of molecules based on bonding. Interpreting Data: Students analyse diagrams, graphs, and experimental data to make	

			conclusions about bonding and structures.	
Week 11: 3.1.3.6 Bond polarity				
Week 11 25/11/24 – 30/11/24	<ul style="list-style-type: none"> • Predict and explain the trend in electronegativity down a group and across a period • • Predict whether covalent bonds are polar or not • Predict whether molecules have permanent dipoles or not • Understand the symmetry of 2D and 3D shapes 		Making prediction Identifying Patterns: analyse e data to make predictions.	
Students should be able to: <ul style="list-style-type: none"> • define and understand the concept of electronegativity • understand why some covalent bonds are polar and deduce whether a bond is polar • understand why some molecules are polar and deduce whether a molecule has a permanent dipole. 			Data Interpretation: This involves looking at qualitative and quantitative data and making sense of it in order to forecast possible outcomes.	
Week 11: 3.1.3.7 Forces between molecules				
Students should be able to: <ul style="list-style-type: none"> • understand that there are three types of intermolecular force • explain how each of the intermolecular forces arise • explain how the melting points are influenced by these intermolecular forces • explain the anomalous nature of ice and how its low density can be explained through a knowledge of hydrogen bonding. 	Students produce a summary to compare the three types of intermolecular force Students explain trends in Group 4, 5, 6 and 7 hydrides (to show relative strength of the three types of force and the effect of Mr on van der Waals' forces) Students explain why ice floats on water by reference to hydrogen bonding Rich question – Why is there no hydrogen bonding between molecules of HCl gas even though Cl is more electronegative than N yet NH ₃ has hydrogen bonding?	Practical opportunity: Students could try to deflect jets of various liquids from burettes to investigate the presence of different types and relative size of intermolecular forces	Student develop written research and communication skills Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances;	
Week 11: Revision – End of unit assessments – Reflections – Targets –GAP analysis				

3.1.4 Energetics

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Required practical
<p>Week 12 02/12/24 – 08/12/24</p> <p>Know that reactions can be exothermic or endothermic.</p> <p>Know what an enthalpy change and is and about standard conditions.</p> <p>Define standard enthalpies of formation and combustion.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> define enthalpy change and standard conditions define standard enthalpy changes of combustion and formation. 	<ul style="list-style-type: none"> Students list examples of endothermic and exothermic reactions Students draw enthalpy profiles for exothermic and endothermic reactions Write balanced chemical equations, to include state symbols, to represent the changes shown by standard enthalpy changes of formation and combustion 	

3.1.4.1 Enthalpy change

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Required Practical
<p>Know that reactions can be exothermic or endothermic.</p> <p>Know what an enthalpy change and is and about standard conditions.</p> <p>Define standard enthalpies of formation and combustion.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> define enthalpy change and standard conditions define standard enthalpy changes of combustion and formation. 	<ul style="list-style-type: none"> Students list examples of endothermic and exothermic reactions Students draw enthalpy profiles for exothermic and endothermic reactions Write balanced chemical equations, to include state symbols, to represent the changes shown by standard enthalpy changes of formation and combustion 	

3.1.4.2 Calorimetry

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Required practical
Understand and be able to use the equation $q = mc\Delta T$ to calculate molar enthalpy changes.	Students should be able to: <ul style="list-style-type: none"> recall the equation $q = mc\Delta T$ Calculate ΔH for reactions using calorimetry experiment data. 	<ul style="list-style-type: none"> Students calculate molar enthalpy changes using provided data from calorimetry experiments Use an appropriate number of significant figures; Substitute numerical values into algebraic equations using appropriate units for physical quantities). 	Required practical 2 Measurement of an enthalpy change. <ul style="list-style-type: none"> Practical opportunity: Students find ΔH for a reaction by calorimetry eg <ul style="list-style-type: none"> dissolution of potassium chloride dissolution of sodium carbonate neutralising NaOH with HCl displacement reaction between $\text{CuSO}_4 + \text{Zn}$ Combustion of alcohols

3.1.4.3 Applications of Hess's law

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Assessment opportunities
Week 13 09/12/24 – 15/12/24 Understand Hess's law. Use Hess's law to calculate enthalpy changes using enthalpies of formation and combustion.	Students should be able to: <ul style="list-style-type: none"> Recall the equation $q = mc\Delta T$ Calculate ΔH for reactions using calorimetry experiment data 	<ul style="list-style-type: none"> Students calculate Hess's law plus enthalpies of formation and enthalpies of combustion - Use appropriate apparatus to record a range of measurements (to include mass, time, volume of solutions, temperature Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined; Plot two variables from experimental data; Plot and interpret graphs; - Process and analyse data using appropriate mathematical skills; - Consider margins of error, accuracy and precision of data).	<ul style="list-style-type: none"> Practical opportunity: Students could be asked to find ΔH for a reaction using Hess's law and calorimetry, then present data in appropriate ways. Examples of reactions could include: <ul style="list-style-type: none"> thermal decomposition of NaHCO_3 hydration of MgSO_4 Enthalpy of formation of CaCO_3

3.1.4.4 Bond enthalpies

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Required Practical
<p>Understand the term mean bond enthalpy.</p> <p>Use mean bond enthalpies to calculate approximate values for ΔH for reactions</p> <p>Understand why most bond enthalpies are mean values.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none">• calculate enthalpy changes using mean bond enthalpies• understand why most bond enthalpies are mean values.	<ul style="list-style-type: none">• Students calculate ΔH for reactions using mean bond enthalpies	<ul style="list-style-type: none">•
End of unit assessments -			

3.1.5 Kinetics

3.1.5.1 Collision theory

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
Week 14 16/12/24 – 22/12/24 Collision theory.	Students should be able to: <ul style="list-style-type: none">explain that reactions can only take place when particles collide with energy greater than or equal to the activation energy.	<ul style="list-style-type: none">Students should be able to explain why reacts do or do not take place using collision theory	

3.1.5.2 Maxwell–Boltzmann distribution

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
Drawing Maxwell–Boltzmann distribution curves.	Students should be able to: <ul style="list-style-type: none">draw and interpret Maxwell–Boltzmann distribution curves.	<ul style="list-style-type: none">Students draw and Maxwell–Boltzmann curves at different temperatures, pressures and number of particles, identifying the most probable energy and particles with $E \geq E_a$ on between graphical, numerical and algebraic forms).	

3.1.5.3 Effect of temperature on reaction rate

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
Understand how and why temperature affects the rate of chemical reactions.	Students should be able to: <ul style="list-style-type: none">define the term rate of reactionexplain how and why temperature affects the rate of reactions using Maxwell–Boltzmann distributions.	<ul style="list-style-type: none">Use Maxwell–Boltzmann curves to explain why a small increase in temperature leads to a large increase in reaction rateStudents could investigate how knowledge and understanding of the factors that affect the rate of chemical reaction have changed methods of storage and cooking of foodPractical opportunity: Students could investigate the effect of temperature on the rate of reaction of sodium thiosulfate and hydrochloric acid by an initial rate method.	Required practical 3 Investigation of how the rate of a reaction changes with temperature.

3.1.5.4 Effect of concentration and pressure

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
<p>06/01/25 – 12/01/25</p> <p>Understand how and why concentration and pressure affect the rate of chemical reactions.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain how and why concentration of solutions affects the rate of reactions. • explain how and why pressure of gases affects the rate of reactions. 	<ul style="list-style-type: none"> • Use collision theory, including diagrams, to explain why an increase in solution concentration leads to an increase in reaction rate • Use collision theory, including diagrams, to explain why an increase in gas pressure leads to an increase in reaction rate • Students could investigate the effect of changing the concentration of acid on the rate of a reaction of calcium carbonate and hydrochloric acid by a continuous monitoring method 	

3.1.5.5 Effect of catalysts

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
<p>Understand how and why a catalyst affects the rate of chemical reactions.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • state what a catalyst is • explain how and why a catalyst affects the rate of reactions. 	<ul style="list-style-type: none"> • Use a Maxwell–Boltzmann curve to explain how a catalyst increases the rate of a reaction. • Students could research the use of catalysts in catalytic converters in cars. 	<p>Practical opportunity: Students could use Co^{2+} as a catalyst in the oxidation of potassium sodium tartrate by hydrogen peroxides, including corrosive, irritant, flammable and toxic substances).</p>

3.1.6.1 Chemical equilibria and Le Chatelier's principle

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
<p>Week 15 06/01/25 – 12/01/25</p> <p>Understand how reversible reactions can reach a state of dynamic equilibrium.</p> <p>Understand Le Chatelier's principle.</p> <p>Understand why a compromise temperature and pressure may be used for a reversible reaction in an industrial process.</p> <p>Understand the effect of a catalyst on an equilibrium.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> describe what is meant the term dynamic equilibrium explain how changes in temperature, pressure and concentration affect the position of a system at equilibrium explain why compromise conditions of temperature and pressure may be used for a reversible reaction in an industrial process. 	<ul style="list-style-type: none"> Predict and explain the effect of changes in temperature, pressure and concentration on the position of an equilibrium Students explain how conditions in temperature and pressure are a compromise in examples of industrial processes 	<ul style="list-style-type: none"> Practical opportunity: Students carry out test-tube equilibrium shifts to show the effect of concentration and temperature (eg $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ with concentrated HCl).

3.1.6.2 Equilibrium constant K_c for homogeneous systems

Learning objective	Learning outcome	Learning activity with opportunity to develop skills	Practical
<p>Week 16 13/01/25 – 19/01/25</p> <p>Write an expression for and calculate K_c including units.</p> <p>Predict the effect, if any, of changes in conditions on the value of K_c.</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> write an expression for K_c for a homogeneous equilibrium, including its units calculate the moles and concentration of reagents at equilibrium calculate the value of K_c predict qualitatively how the value of K_c will change, if at all, as the position of an equilibrium moves as conditions are changed. 	<ul style="list-style-type: none"> Write expressions for K_c and derive units for a variety of equilibria. Calculate the moles and concentration of reagents at equilibrium given initial quantities and the quantity of one reagent at equilibrium Calculate K_c from data. Students predict qualitatively how the value of K_c will change, if at all, as the position of an equilibrium moves as conditions are changed. 	<p>Practical opportunity:</p> <p>Students set up a reaction between ethanol and ethanoic acid with acid catalyst and leave to reach equilibrium before titrating and using the results to determine K_c.</p>

Assessments – Practical – Buffer – feedback – Reflections

Christmas break

3.1.7 Oxidation, reduction and redox equations

	Learning outcome	Learning activity with opportunity to develop skills	Practical
<p>Week 17 20/01/25 – 26/01/25</p> <p>3.1.7 Oxidation, reduction and redox equations</p>	<p>Students should be able to:</p> <ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">•	

3.2 - Inorganic Chemistry

3.2.1 Periodicity

	Learning outcome	Practical
<p>Week 18 27/01/25 – 31/01/25</p> <p>3.2.1.2 Physical properties of Period 3 elements</p>	<p>Students should be able to:</p> <ul style="list-style-type: none">• explain the trends in atomic radius and first ionisation energy• explain the melting point of the elements in terms of their structure and bonding.	
<p>3.2.2 Group 2, the alkaline earth metals</p>	<p>Students should be able to:</p> <ul style="list-style-type: none">• explain the trends in atomic radius and first ionisation energy• explain the melting point of the elements in terms of their structure and bonding. <p>The reactions of the elements Mg–Ba with water.</p> <p>The use of magnesium in the extraction of titanium from TiCl_4</p> <p>The relative solubilities of the hydroxides of the elements Mg–Ba in water.</p> <p>$\text{Mg}(\text{OH})_2$ is sparingly soluble.</p> <p>The use of $\text{Mg}(\text{OH})_2$ in medicine and of $\text{Ca}(\text{OH})_2$ in agriculture.</p> <p>The use of CaO or CaCO_3 to remove SO_2 from flue gases.</p> <p>The relative solubilities of the sulfates of the elements Mg–Ba in water.</p> <p>BaSO_4 is insoluble.</p> <p>The use of acidified BaCl_2 solution to test for sulfate ions.</p> <p>The use of BaSO_4 in medicine.</p>	

<p>Week 19 03/02/25 – 09/02/25</p> <p>3.2.3 Group 7(17), the halogens</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain the trend in electronegativity • explain the trend in the boiling point of the elements in terms of their structure and bonding. <p>The trend in oxidising ability of the halogens down the group, including displacement reactions of halide ions in aqueous solution.</p> <p>The trend in reducing ability of the halide ions, including the reactions of solid sodium halides with concentrated sulfuric acid.</p> <p>The use of acidified silver nitrate solution to identify and distinguish between halide ions.</p> <p>The trend in solubility of the silver halides in ammonia.</p> <p>Students should be able to explain why:</p> <ul style="list-style-type: none"> • silver nitrate solution is used to identify halide ions • the silver nitrate solution is acidified • ammonia solution is added. 	
<p>3.2.3.2 Uses of chlorine and chlorate(I)</p>	<p>The reaction of chlorine with water to form chloride ions and chlorate(I) ions.</p> <p>The reaction of chlorine with water to form chloride ions and oxygen.</p> <p>Appreciate that society assesses the advantages and disadvantages when deciding if chemicals should be added to water supplies.</p> <p>The use of chlorine in water treatment.</p> <p>Appreciate that the benefits to health of water treatment by chlorine outweigh its toxic effects.</p>	
<p>Week 20 10/02/25 – 16/02/25</p> <p>Revision – End of unit assessments</p>		<p>Required practical 4</p> <p>Carry out simple test-tube reactions to identify:</p> <ul style="list-style-type: none"> • cations – Group 2, NH₄⁺ • anions – Group 7 (halide ions), OH⁻, CO₃²⁻, SO₄²⁻

3.3 Organic chemistry

3.3.1 Introduction to organic chemistry

	Learning outcome	Practical
<p>Week 21/03/25 – 28/02/25</p> <p>3.3.1.1 Nomenclature</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> 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. 	
<p>3.3.1.2 Reaction mechanisms</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> write balanced equations for the steps in a freeradical mechanism. <p>Other mechanisms:</p> <ul style="list-style-type: none"> the formation of a covalent bond is shown by a curly arrow that starts from a lone electron pair or from another covalent bond the breaking of a covalent bond is shown by a curly arrow starting from the bond. <p>Students should be able to:</p> <ul style="list-style-type: none"> outline mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs. 	
<p>Week 22</p> <p>03/03/25 – 09/03/25</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> define the term structural isomer draw the structures of chain, position and functional 	

3.3.1.3 Isomerism	<p>group isomers</p> <ul style="list-style-type: none"> define the term stereoisomer draw the structural formulas of <i>E</i> and <i>Z</i> isomers apply the CIP priority rules to <i>E</i> and <i>Z</i> isomers. 	
3.3.2 Alkanes		
3.3.2.1 Fractional distillation of crude oil		
<p>Week 23 10/03/25 – 16/03/25</p> <p>3.3.2.2 Modification of alkanes by cracking</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> explain the economic reasons for cracking alkanes. 	
3.3.2.3 Combustion of alkanes	<p>Students should be able to:</p> <ul style="list-style-type: none"> explain why sulfur dioxide can be removed from flue gases using calcium oxide or calcium carbonate. 	
<p>3.3.2.4 Chlorination of alkanes</p> <p>Week 24 17/03/25 – 23/03/25</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> explain this reaction as a free-radical substitution mechanism involving initiation, propagation and termination steps. 	
3.3.3 Halogenoalkanes		
3.3.3.1 Nucleophilic substitution	<p>Students should be able to:</p> <ul style="list-style-type: none"> outline the nucleophilic substitution mechanisms of these reactions explain why the carbon–halogen bond enthalpy influences the rate of reaction. 	
<p>Week 25 24/03/25 – 30/03/25</p> <p>3.3.3.2 Elimination</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> explain the role of the reagent as both nucleophile and base outline the mechanisms of these reactions 	
3.3.3.3 Ozone depletion	<p>Students should be able to:</p> <ul style="list-style-type: none"> use equations, such as the following, to explain how chlorine atoms catalyse decomposition of ozone: $\text{Cl}\cdot + \text{O}_3 \rightarrow \text{ClO}\cdot + \text{O}_2$ and $\text{ClO}\cdot + \text{O}_3 \rightarrow 2\text{O}_2 + \text{Cl}\cdot$ 	

<p>Week 26 31/03/25 – 04/04/25 3.3.4 Alkenes</p>		
<p>3.3.4.1 Structure, bonding and reactivity</p>		
<p>3.3.4.2 Addition reactions of alkenes</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • outline the mechanisms for these reactions • explain the formation of major and minor products by reference to the relative stabilities of primary, secondary and tertiary carbocation intermediates. 	
<p>Week 27 21/04/25 – 27/04/25 3.3.4.3 Addition polymers</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • draw the repeating unit from a monomer structure • 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 	
<p>3.3.5 Alcohols</p>		
<p>Week 28 28/04/25 – 02/05/25 3.3.5.1 Alcohol production</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • 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 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. 	

<p>Week 29 05/05/25 – 11 /05/25</p> <p>3.3.5.2 Oxidation of alcohols</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • write equations for these oxidation reactions (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. 	<p>Required practical 6 Tests for alcohol, aldehyde, alkene and carboxylic acid.</p>
<p>Week 30 -32 05/05/25 – 18 /05/25</p> <p>3.3.5.3 Elimination</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • outline the mechanism for the elimination of water from alcohols. 	<p>Required practical 5 Distillation of a product from a reaction.</p>
<p>Week 33 -34 19/05/25 – 08/06/25</p> <p>3.3.6.2 Mass spectrometry</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • use precise atomic masses and the precise molecular mass to determine the molecular formula of a compound. 	
<p>Week 35 -36 09/06/25 – 22/06/25</p> <p>3.3.6.3 Infrared spectroscopy</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • use infrared spectra and the Chemistry Data Sheet or Booklet to identify particular bonds, and therefore functional groups, and also to identify impurities. 	
<p>23/06/25 – 18/07/25</p> <p>Buffer - RP</p> <p>Mock – As revision</p>		

