Programme of study for Chemistry Year 10

Autumn (1st term)	Autumn (2nd term)	Spring (1st term)	Spring (2nd Term)	Summer (1st term)	Summer (2nd term)
Topic / Big Question: Energy changes Bonding	Topic / Big Question: Quantitative chemistry Chemical changes .	Topic / Big Question: Continue with Chemical changes Energy changes (chemical cells and fuel cells) Rate of reaction	Topic / Big Question: Continue with rate of reaction Organic chemistry	Topic / Big Question: Continue with organic chemistry Chemistry of the atmosphere	Topic / Big Question: Chemistry of the atmosphere
Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures	Skills (students should be able to do): AO1: Demonstrate knowledge and understanding of: scientific ideas; scientific techniques and procedures. AO2: Apply knowledge and understanding of: scientific ideas; scientific enquiry, techniques and procedures. AO3: Analyse information and ideas to: interpret and evaluate; make judgments and draw conclusions; develop and improve experimental procedures

Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):
Energy changes: distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings evaluate uses and applications of exothermic and endothermic reactions given appropriate information. Limited to measurement of temperature change. Calculation of energy changes or ΔH is not required. draw simple reaction profiles (energy level diagrams) for exothermic and endothermic reactions showing the relative energies of reactants and products, the activation energy and the overall energy change, with a curved line to show the energy as the reaction proceeds	Quantitative chemistry: Students should understand the use of the multipliers in equations in normal script before a formula and in subscript within a formula. Students should be able to calculate the percentage by mass in a compound given the relative formula mass and the relative atomic masses. Students should be able to explain any observed changes in mass in non-enclosed systems during a chemical reaction given the balanced symbol equation for the reaction and explain these changes in terms of the particle model. represent the distribution of results and make estimations of uncertainty use the range of a set of measurements about the mean as a measure of uncertainty.	Continue with chemical changes key outcomes Energy changes: Students should be able to interpret data for relative reactivity of different metals and evaluate the use of cells. Students do not need to know details of cells and batteries other than those specified. evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries (HT only) write the half equations for the electrode reactions in the hydrogen fuel cell. Rate of reaction: calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken draw, and interpret, graphs showing the	Continue with rate of reaction outcomes. Organic chemistry: Students should be able to recognise substances as alkanes given their formulae in these forms. Students do not need to know the names of specific alkanes other than methane, ethane, propane and butane. Students should be able to explain how fractional distillation works in terms of evaporation and condensation. Knowledge of the names of other specific fractions or fuels is not required. Students should be able to recall how boiling point, viscosity and flammability change with increasing molecular size. The combustion of hydrocarbon fuels releases energy. During combustion, the carbon and hydrogen in the fuels are oxidised. The complete combustion of a	Continue with organic chemistry outcomes. Chemistry of the atmosphere: Students should be able to, given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere. describe the main changes in the atmosphere over time and some of the likely causes of these changes describe and explain the formation of deposits of limestone, coal, crude oil and natural gas. Students should be able to describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter. evaluate the quality of evidence in a report about global climate change given appropriate information describe uncertainties in the evidence base recognise the importance of peer review of results and of communicating	Chemistry of the atmosphere: Students should be able to, given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere. describe the main changes in the atmosphere over time and some of the likely causes of these changes describe and explain the formation of deposits of limestone, coal, crude oil and natural gas. Students should be able to describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter. evaluate the quality of evidence in a report about global climate change given appropriate information describe uncertainties in the evidence base recognise the importance of peer review of results and of communicating results to a wide range of audiences.

use reaction profiles to identify reactions as exothermic or endothermic explain that the activation energy is the energy needed for a reaction to occur. Students should be able to calculate the energy transferred in chemical reactions using bond energies supplied. Bonding: Students should be able to explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons. Students should be able to draw dot and cross diagrams for ionic compounds formed by metals in Groups 1 and 2 with non-metals in Groups 6 and 7. The charge on the ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 relates to the group number of the element in the periodic table.	Students should understand that the measurement of amounts in moles can apply to atoms, molecules, ions, electrons, formulae and equations, for example that in one mole of carbon (C) the number of atoms is the same as the number of molecules in one mole of carbon dioxide (CO2). Students should be able to use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa. calculate the masses of substances shown in a balanced symbol equation calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant or product. Students should be able to balance an equation given the masses of reactants and products.	quantity of product formed or quantity of reactant used up against time. draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction (HT only) calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time. Students should be able to recall how changing these factors affects the rate of chemical reactions. predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio use simple ideas about proportionality when using collision theory to explain the effect of a	hydrocarbon produces carbon dioxide and water. Students should be able to write balanced equations for the complete combustion of hydrocarbons with a given formula. Knowledge of trends in properties of hydrocarbons is limited to: boiling points viscosity flammability. Students should be able to balance chemical equations as examples of cracking given the formulae of the reactants and products. Students should be able to give examples to illustrate the usefulness of cracking. They should also be able to explain how modern life depends on the uses of hydrocarbons. describe the reactions and conditions for the addition of hydrogen, water and halogens to alkenes draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions	results to a wide range of audiences. describe briefly four potential effects of global climate change discuss the scale, risk and environmental implications of global climate change. describe actions to reduce emissions of carbon dioxide and methane give reasons why actions may be limited. describe how carbon monoxide, soot (carbon particles), sulfur dioxide and oxides of nitrogen are produced by burning fuels predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used. Students should be able to describe and explain the problems caused by increased amounts of these pollutants in the air.	describe briefly four potential effects of global climate change discuss the scale, risk and environmental implications of global climate change. describe actions to reduce emissions of carbon dioxide and methane give reasons why actions may be limited. describe how carbon monoxide, soot (carbon particles), sulfur dioxide and oxides of nitrogen are produced by burning fuels predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used. Students should be able to describe and explain the problems caused by increased amounts of these pollutants in the air.

Students should be able to work out the charge on the ions of metals and non-metals from the group number of the element, limited to the metals in Groups 1 and 2, and non-metals in Groups 6 and 7. deduce that a compound is ionic from a diagram of its structure in one of the specified forms describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure. Students should be familiar with the structure of sodium chloride but do not need to know the structures of other ionic compounds. draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen,	Students should be able to change the subject of a mathematical equation. Students should be able to explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams. calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution (HT only) explain how the mass of a solute and the volume of a solution is related to the concentration of the solution. calculate the percentage yield of a product from the actual yield of a reaction (HT only) calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction. calculate the atom economy of a reaction to form a desired	factor on the rate of a reaction. Students should be able to explain catalytic action in terms of activation energy. Students do not need to know the names of catalysts other than those specified in the subject content. Students should be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. Students should be able to interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium. Students should be able to interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium. Students should be able to interpret appropriate given data to predict the effect of pressure	with hydrogen, water, chlorine, bromine and iodine. describe what happens when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent recall the main uses of these alcohols. Students should know the conditions used for fermentation of sugar using yeast. Students should be able to recognise alcohols from their names or from given formulae. Students do not need to know the names of individual alcohols other than methanol, ethanol, propanol and butanol. Students are not expected to write balanced chemical equations for the reactions of alcohols other than for combustion reactions. describe what happens when any of the first four carboxylic acids react with carbonates, dissolve in water, react with alcohols (HT only) explain why carboxylic acids are weak		

nitrogen, hydrogen chloride, water, ammonia and methane represent the covalent bonds in small molecules, in the repeating units of polymers and in part of giant covalent structures, using a line to represent a single bond describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent molecules or giant structures deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule. Explain metallic bonding and relate to properties of metals. Predict the states of substances at different temperatures given appropriate data explain the different temperatures at which changes of state occur in terms of energy	product from the balanced equation (HT only) explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products. Students should be able to explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution. calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product change the subject of a mathematical equation. Chemical changes:	changes on given reactions at equilibrium.	acids in terms of ionisation and pH (see Strong and weak acids (HT only)). Students should be able to recognise carboxylic acids from their names or from given formulae. recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group C=C in the monomers draw diagrams to represent the formation of a polymer from a given alkene monomer relate the repeating unit to the monomer. Students should be able to explain the basic principles of condensation polymerisation by reference to the functional groups in the monomers and the repeating units in the polymers. Students should be able to name the types of monomers from which these naturally occurring polymers are made.		

transfers and types of bonding recognise that atoms themselves do not have the bulk properties of materials (HT only) explain the limitations of the particle theory in relation to changes of state when particles are represented by solid inelastic spheres which have no forces between them. Students should be able to include appropriate state symbols in chemical equations for the reactions in this specification. Students should be able to use the idea that intermolecular forces are weak compared with covalent bonds to explain the bulk properties of molecular substances. Students should be able to recognise polymers from diagrams showing their bonding and structure. Students should be able to recognise giant covalent structures	Students should be able to explain reduction and oxidation in terms of loss or gain of oxygen. recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids and where appropriate, to place these metals in order of reactivity explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion deduce an order of reactivity of metals based on experimental results. interpret or evaluate specific metal extraction processes when given appropriate information identify the substances which are oxidised or reduced in terms of gain or loss of oxygen. write ionic equations for displacement reactions identify in a given reaction, symbol equation or half				

from diagrams showing their bonding and structure. Students should be able to explain why alloys are harder than pure metals in terms of distortion of the layers of atoms in the structure of a pure metal. Students should be able to explain the properties of diamond in terms of its structure and bonding. Students should be able to explain the properties of graphite in terms of its structure and bonding. Students should know that graphite is similar to metals in that it has delocalised electrons. recognise graphene and fullerenes from diagrams and descriptions of their bonding and structure give examples of the uses of fullerenes, including carbon nanotubes. Students should be able to compare 'nano' dimensions to typical	equation which species are oxidised and which are reduced. explain in terms of gain or loss of electrons, that these are redox reactions identify which species are oxidised and which are reduced in given chemical equations. Knowledge of reactions limited to those of magnesium, zinc and iron with hydrochloric and sulfuric acids. predict products from given reactants use the formulae of common ions to deduce the formulae of salts. Students should be able to describe how to make pure, dry samples of named soluble salts from information provided. describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution use the pH scale to identify acidic or alkaline solutions.				

dimensions of atoms and molecules. given appropriate information, evaluate the use of nanoparticles for a specified purpose explain that there are possible risks associated with the use of nanoparticles.	describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately (HT Only) calculate the chemical quantities in titrations involving concentrations in mol/dm3 and in g/dm3 . use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids. describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH (whole numbers only). Higher Tier students should be able to write half equations for the reactions occurring at the electrodes during electrolysis, and may be required to complete				

	and balance supplied half equations. Students should be able to predict the products of the electrolysis of binary ionic compounds in the molten state. explain why a mixture is used as the electrolyte explain why the positive electrode must be continually replaced. Students should be able to predict the products of the electrolysis of aqueous solutions containing a single ionic compound.				
Autumn Term – centrally planned, standardised and teacher marked piece(s) of work Required practical for chemical changes Bonding end of topic test		Spring Term – centrally planned, standardised and teacher marked piece(s) of work Titration required practical Chemical changes end of topic test		Summer Term – centrally planned, standardised and teacher marked piece(s) of work End of year exam Rates of reaction required practical	

Building understanding: Rationale / breakdown for your sequence of lessons:

Energy Changes
Starting with Energy Changes introduces students to foundational concepts, such as exothermic and endothermic reactions, conservation of energy, and energy transfer. Understanding these energy changes prepares students for later topics, as energy is integral to all chemical reactions.

Bonding
After learning about energy changes in reactions, Bonding is introduced to explain how atoms connect to form compounds. Understanding ionic, covalent, and metallic bonding allows students to grasp why substances have specific properties and behaviours, such as melting points, conductivity, and solubility. We cover ionic, covalent, and metallic bonds, relating them to energy changes and linking back to the energy required or released in bond formation. This topic lays the groundwork for understanding why substances react differently based on bond types, which is essential for quantitative chemistry and reaction rates.

Quantitative Chemistry

Quantitative Chemistry introduces stoichiometry and chemical calculations, allowing students to quantify reactants and products, and understand conservation of mass in reactions. This builds on their knowledge of bonding and energy changes, giving them tools to calculate precise amounts involved in reactions. In this topic we focus on moles, molar mass, and balanced chemical equations. Reinforce the link between bonding, energy changes, and how much of each substance participates in or is produced by a reaction. These calculations prepare students for understanding reaction rates, yields, and efficiencies in later topics

Chemical Changes

With a foundation in bonding and quantitative skills, students can now explore Chemical Changes, covering different types of chemical reactions and properties of acids, bases, salts, and redox reactions. This topic allows students to apply quantitative skills to practical chemical reactions and further explore the factors influencing these reactions. This topic introduces key reactions, such as neutralization and precipitation, and build on quantitative skills by calculating reactants and products. Link these changes to bonding and energy transformations, helping students make connections between theoretical concepts and real-life chemical processes.

(Energy changes) Chemical Cells and Fuel Cells

With an understanding of chemical changes, we go back to energy changes so students can now delve into Chemical Cells and Fuel Cells, exploring how chemical reactions can generate electricity. This topic highlights practical applications of chemical energy transformations and prepares students for further study of reaction rates and efficiency. Energy changes introduce the principles of chemical cells and fuel cells, emphasising how redox reactions and energy transfers are harnessed for power. Students can apply their knowledge of quantitative chemistry and bonding to calculate energy efficiency and understand electrode reactions.

Rate of reaction

At this stage, students have a solid understanding of reactions, energy changes, and quantitative relationships, making them ready to study Rate of reaction. Here, they learn about reaction kinetics and equilibrium, understanding how reaction rates can be controlled and optimised in industrial and environmental processes.

Organic Chemistry

With knowledge of bonding, chemical changes, and reaction rates, students are prepared to study Organic Chemistry. This topic explores carbon-based compounds, their reactions, and industrial significance, especially in fuels and polymers. Organic Chemistry is a critical part of applied chemistry, so understanding reaction conditions and bond types helps students appreciate its societal impact. In this topic students are introduced to hydrocarbons, functional groups, and polymerisation, building on bonding and reaction kinetics to explain these compounds' diverse structures and uses. This sets the stage for understanding both the benefits and challenges of organic compounds, particularly in relation to environmental impact.

Chemistry of the Atmosphere

Ending with Chemistry of the Atmosphere allows students to synthesise their understanding of chemical reactions, bonding, organic chemistry, and energy changes within the context of real-world environmental issues. This topic ties together concepts from earlier topics and encourages students to think about the implications of human activities on atmospheric chemistry.

Home – Learning:

Revision workbooks for all units are given to students to complete throughout the duration of unit delivery.

Reading / High Quality Text:

Students are encouraged to prior reading on topics. In lessons students are taught how to construct answers through use of writing frames and exemplar answers where extended writing is required and command words and keywords that are relevant to the topic are consistently assessed in lessons through questioning and exam practice.

Chemguide online reading resource is excellent for GCSE Chemistry students: https://www.chemguide.co.uk/gcsebook.html

Numeracy:

Recognise and use expressions in decimal form: Recognise and use expressions in standard form; Use ratios, fractions and percentages; Make estimates of the results of simple calculations.
Handling data: Use an appropriate number of significant figures; Find arithmetic means; Construct and interpret frequency tables and diagrams, bar charts and histograms; Make order of magnitude calculations
Algebra: Understand and use the symbols: =, <>, >, ∝ , ~ ;Change the subject of an equation; Substitute numerical values into algebraic equations using appropriate units for physical quantities
Graphs: Translate information between graphical and numeric form; Understand that y = mx + c represents a linear relationship; Plot two variables from experimental or other data; Determine the slope and intercept of a linear graph; interpret graphs to show changes in level of greenhouse gases. Use of tables to interpret materials for resources.

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

Chemistry related trips are arranged during science week.

SMSC:

Chemistry of the Atmosphere:
Spiritual: This topic can inspire awe about the natural balance in the Earth's atmosphere, the role of greenhouse gases, and the delicate systems that sustain life. It invites students to reflect on the interdependence of natural systems.
Moral and Social: Discussing global warming, pollution, and the greenhouse effect highlights human responsibility for environmental stewardship.

Energy changes:
Moral and Social: Discussing energy changes, like exothermic and endothermic reactions, opens up conversations on energy sources (e.g., fossil fuels vs. renewable energy) and their impact on climate change.

Chemical changes:
Moral and Social: Discuss the impact of chemical manufacturing on society and the environment, including pollution and sustainable practices. For example, the production of acids and alkalis has environmental risks, so students could explore the moral responsibility of chemical industries to minimise waste and prevent pollution.

Bonding:

Social: Looking at the role of Bonding in Everyday Life. Bonding explains why materials have specific properties, like conductivity in metals or hardness in diamonds. Discussing these properties in the context of everyday materials—such as kitchen utensils, electronic devices, and clothing fabrics—helps students appreciate how bonding affects daily life and society.

Rate and extent of chemical changes:
Social and Cultural: Consider how improving reaction rates can make processes more efficient, benefitting society by reducing waste and costs in industries like pharmaceuticals, food production, and energy.

Quantitative chemistry:
Spiritual: Quantitative chemistry involves precise calculations and predictable patterns in chemical reactions. This precision can inspire a sense of wonder and curiosity about the order and structure of the natural world. For instance, understanding how atoms combine in exact ratios to form compounds can encourage students to appreciate the underlying structure and interconnectedness in nature.

Organic chemistry:
Cultural: The history of organic chemistry includes discoveries from diverse cultures worldwide, such as natural dyes and medicinal compounds, fostering cultural respect and awareness.