Croxley Danes School : Key Stage 4 Curriculum Map

Subject: Chemistry **Exam Board (KS4): AQA**

Key Concepts

Atomic Structure and Periodic Table	**Structure and bonding**	**Chemical Calculations**	**Chemical Changes**	**Energy changes**	**The Rate and Extent of Chemical change**	**Organic Chemistry**	**Chemical Analysis**	**Chemistry of the Atmosphere**	**Using Resources**
What is the Croxley vision for this subject at Key Stage 4 ? Our vision for GCSE Chemistry at Key Stage 4 is to inspire curiosity and deepen students' understanding of the chemical principles that explain the world around them. We aim to develop scientific thinking, practical skills, and real-world connections that prepare students for further study and informed decision-making. Through an inclusive and engaging curriculum, we empower all learners to see themselves as capable and confident scientists.									

Key Stage 4 **Year Group: 9**

	Autumn Term	Spring Term	Summer Term
key concept		Atmosphere	Using Resources

Content: **(Know what…)**		• Describe the composition of gases in the Earth's atmosphere using percentages, fractions or ratios • Describe how early intense volcanic activity may have helped form the early atmosphere and how the oceans formed • Explain why the levels of carbon dioxide in the atmosphere changes as the oceans were formed • State the approximate time in Earth's history when algae started producing oxygen and describe the effects of a gradually increasing oxygen level • Explain the ways that atmospheric carbon dioxide levels decreased • Name some greenhouse gases and describe how they cause an increase in Earth's temperature • List some human activities that produce greenhouse gases • Evaluate arguments for and against the idea that human activities cause a rise in temperature that results in global climate change • State some potential side effects of global climate change, including discussing scale, risk and environmental implications • Define the term carbon footprint and list some actions that could reduce the carbon footprint • Describe the combustion of fuels as a major source of atmospheric pollutants and name the different gases that are released when a fuel is burned • 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	• State what humans use Earth's resources for, give some examples of natural resources that they use • Define the term finite and distinguish between finite and renewable resources • Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes • State examples of natural products that are supplemented or replaced by agricultural and synthetic products • Discuss the importance of water quality for human life, including defining potable water • Describe methods to produce potable water, including desalination of salty water or sea water and the potential problems of desalination • Required practical 8: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation. • Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals • Describe the process of sewage treatment and compare the ease of obtaining • potable water from waste water as opposed to ground or salt water • **HT ONLY**: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching • **HT ONLY**: Evaluate alternative methods for extracting metals • Describe, carry out and interpret a simple comparative life cycle assessment (LCA) of materials or products • Discuss the advantages and disadvantages of LCAs

		• Describe the properties and effects of carbon monoxide, sulfur dioxide and particulates in the atmosphere • Describe and explain the problems caused by increased amounts of these pollutants in the air	• Carry out simple comparative LCAs for shopping bags made from plastic and paper • Discuss how to reduce the consumption of raw resources and explain how reusing and recycling reduces energy use (inc environmental impacts) • **CHEM ONLY**: Define corrosion and describe rusting as an example of corrosion • **CHEM ONLY**: Describe ways to prevent corrosion, including providing coatings, sacrificial protection and explain how sacrificial protection works • **CHEM ONLY**: Describe the following alloys bronze, gold, steels and aluminium, their uses and describe the benefits of using alloys instead of pure metals • **CHEM ONLY**: Compare the properties of materials, including glass and clay ceramics, polymers and composites and explain how their properties are related to their uses • **CHEM ONLY**: Discuss the different types of polymers and how their composition affects their properties, including thermosoftening and thermosetting polymers • **CHEM ONLY**: Explain what composites are and provide examples of composites and their benefits over other types of materials • **CHEM ONLY**: Describe the Haber process, including the reactants and products, recycling of remaining hydrogen and nitrogen and the chemical equation • Chem & **HT ONLY**: For the Haber process interpret graphs of reaction conditions versus rate • **CHEM ONLY**: Apply the principles of dynamic equilibrium to the Haber process and discuss the trade-off between the rate of production and the position of equilibrium

			• **CHEM ONLY**: Explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies • **CHEM ONLY**: Recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid • **CHEM ONLY**: Describe NPK fertilisers and the compounds they are composed of and compare the industrial production of fertilisers with the laboratory preparations
Skills: **(know how…)**		• Understanding evolution of the Earth's atmosphere • Interpreting data on greenhouse gases and climate change • Evaluating human impact on the environment Explaining pollution and acid rain formation	• Understanding life cycle assessments (LCAs) • Describing water treatment methods • Discussing renewable vs. non-renewable resources • Explaining methods of recycling and sustainable development • **CHEM ONLY**: Composition of NPK fertilisers • **CHEM ONLY**: Justifying compromised conditions used in Haber's process. • **CHEM ONLY**: Ceramics and composites. •
Key vocabulary **(5- 10 words)**		• Greenhouse gas • Climate change • Global warming • Carbon footprint • Combustion • Particulates Acid rain	• Renewable • Non-renewable • Finite resource • Sustainable • Recycle • Potable water • Desalination • Waste water treatment • Life cycle assessment (LCA) • Alloys Corrosion

End of Half term assessment		End of topic test	End of topic test + AP2
Planned trips / Clubs / links		Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime

Key Stage 4	**Year Group: 10**		
	Autumn Term 1	**Autumn Term 2**	**Spring Term 1**
key concept	Atomic Structure and the Periodic table	Atomic Structure and the Periodic table	Structure and bonding
Content: (Know what…)	• State that everything is made of atoms and recall what they are • Describe what elements and compounds are • State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds • Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols • **HT ONLY**: Write balanced half equations and ionic equations • Describe what a mixture is • Name and describe the physical processes used to separate mixtures and suggest suitable separation techniques • Describe how the atomic model has changed over time due to new	• State that everything is made of atoms and recall what they are • Describe what elements and compounds are • State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds • Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols • **HT ONLY**: Write balanced half equations and ionic equations • Describe what a mixture is • Name and describe the physical processes used to separate mixtures and suggest suitable separation techniques • Describe how the atomic model has changed over time due to new experimental evidence,	• Describe the three main types of bonds: ionic bonds, covalent bonds and metallic bonds in terms of electrostatic forces and the transfer or sharing of electrons • Describe how the ions produced by elements in some groups have the electronic structure of a noble gas and explain how the charge of an ion relates to its group number • Describe the structure of ionic compounds, including the electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams • 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

	experimental evidence, inc discovery of the atom and scattering experiments (inc the work of James Chadwick) ● Describe the difference between the plum pudding model of the atom and the nuclear model of the atom ● State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom ● State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom ● Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number ● Describe isotopes as atoms of the same element with different numbers of neutrons ● Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element ● Calculate the relative atomic mass of an element given the percentage abundance of its isotopes ● Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers ● Recall how the elements in the periodic table are arranged ● Describe how elements with similar properties are placed in the periodic table ● Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements	inc discovery of the atom and scattering experiments (inc the work of James Chadwick) ● Describe the difference between the plum pudding model of the atom and the nuclear model of the atom ● State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom ● State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom ● Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number ● Describe isotopes as atoms of the same element with different numbers of neutrons ● Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element ● Calculate the relative atomic mass of an element given the percentage abundance of its isotopes ● Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers ● Recall how the elements in the periodic table are arranged ● Describe how elements with similar properties are placed in the periodic table ● Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements ● Describe the early attempts to classify elements ● Explain the creation and attributes of Mendeleev's periodic table	● Describe covalent bonds and identify different types of covalently bonded substances, such as small molecules, large molecules and substances with giant covalent structures ● Represent covalent bonds between small molecules, repeating units of polymers and parts of giant covalent structures using diagrams ● Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane ● Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule ● Describe the arrangement of atoms and electrons in metallic bonds and draw diagrams the bonding in metals ● Name the three States of matter, identify them from a simple model and state which changes of state happen at melting and boiling points ● Explain changes of state using particle theory and describe factors that affect the melting and boiling point of a substance ● **HT ONLY**: Discuss the limitations of particle theory ● Recall what (s), (l), (g) and (aq) mean when used in chemical equations and be able to use them appropriately ● Explain how the structure of ionic compounds affects their properties, including melting and boiling points and conduction of electricity (sodium chloride structure only) ● Explain how the structure of small molecules affects their properties ● Explain how the structure of polymers affects their properties ● Explain how the structure of giant covalent structures affects their properties

	• Describe the early attempts to classify elements • Explain the creation and attributes of Mendeleev's periodic table • Identify metals and non-metals on the periodic table, compare and contrast their properties • Explain how the atomic structure of metals and non-metals relates to their position in the periodic table • Describe Nobel gases (group 0) and explain their lack of reactivity • Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons • Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions • Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity • Describe the reactions of group 7 halogens with metals and non-metals • **CHEM ONLY**: Describe the properties of transition metals and compare them with group 1 elements, including melting points and densities, strength and hardness, and reactivity (for CR, Mn Fe, Co, Ni & Cu)	• Identify metals and non-metals on the periodic table, compare and contrast their properties • Explain how the atomic structure of metals and non-metals relates to their position in the periodic table • Describe Nobel gases (group 0) and explain their lack of reactivity • Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons • Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions • Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity • Describe the reactions of group 7 halogens with metals and non-metals • **CHEM ONLY**: Describe the properties of transition metals and compare them with group 1 elements, including melting points and densities, strength and hardness, and reactivity (for CR, Mn Fe, Co, Ni & Cu) •	• Explain how the structure of metals and alloys affects their properties, including explaining why they are good conductors • Explain why alloys are harder than pure metals in terms of the layers of atoms • Explain the properties of graphite, diamond and graphene in terms of their structure and bonding • Describe the structure of fullerenes, and their uses, including Buckminsterfullerene and carbon nanotubes • **CHEM ONLY:** Compare the dimensions of nanoparticles to other particles and explain the effect of their surface area to volume ratio on their properties • **CHEM ONLY:** Discuss the applications of nanoparticles and their advantages and disadvantages, including uses in medicine, cosmetics, fabrics and the development of catalysts

Skills: (know how…)	• **Describing reactivity trends of elements in group 1** • **Comparing reactivity between elements in group 1** • **Observing behaviour of elements in group 1 when reacting with water** • **Subtraction of number of protons from mass number to work out the amount of neutrons in an atom of an element** • **Correctly apply the rule of 2 and 8 when filling shells/energy levels with electrons** **Working out RAM**	• **Describing reactivity trends of elements in group 1** • **Comparing reactivity between elements in group 1** • **Observing behaviour of elements in group 1 when reacting with water** • **Subtraction of number of protons from mass number to work out the amount of neutrons in an atom of an element** • **Correctly apply the rule of 2 and 8 when filling shells/energy levels with electrons** **Working out RAM**	• **Drawing dot and cross diagrams for ionic, covalent, and metallic bonds.** • **Explaining the properties of substances based on structure and bonding.** • **Comparing melting/boiling points and conductivity of different substances.** • **Identifying different types of structures: simple molecules, giant lattices, fullerenes, nanoparticles.** • **Accurately drawing models to represent molecules (2D)**
Key vocabulary (5- 10 words)	**Mass number** **Isotope** **Group** **Period** **Halogens** **Noble gases** **Proton** **Neutron.** **Electron** **Nucleus**	**Mass number** **Isotope** **Group** **Period** **Halogens** **Noble gases** **Proton** **Neutron.** **Electron** **Nucleus**	**Ionic bond** **Covalent bond** **Metallic bond** **Giant ionic lattice** **Simple molecular** **Giant covalent structure** **Polymers** **Nanoparticles** **Fullerenes**
End of Half term assessment	End of topic test	End of topic test +AP1	End of topic test
Planned trips / Clubs / links	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime
Key Stage 4	**Year Group: 10**		

	Spring 2	Summer 1	Summer 2
Key Concept	Structure and bonding	Quantitative Chemistry	Chemical Changes
Content: **(Know what…)**	• Describe the three main types of bonds: ionic bonds, covalent bonds and metallic bonds in terms of electrostatic forces and the transfer or sharing of electrons • Describe how the ions produced by elements in some groups have the electronic structure of a noble gas and explain how the charge of an ion relates to its group number • Describe the structure of ionic compounds, including the electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams • 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 • Describe covalent bonds and identify different types of covalently bonded substances, such as small molecules, large molecules and substances with giant covalent structures • Represent covalent bonds between small molecules, repeating units of polymers and parts of giant covalent structures using diagrams • Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen,	• State that mass is conserved and explain why, including describing balanced equations in terms of conservation of mass • Explain the use of the multipliers in equations in normal script before a formula and in subscript within a formula • Describe what the relative formula mass (Mr) of a compound is and calculate the relative formula mass of a compound, given its formula • Calculate the relative formula masses of reactants and products to prove that mass is conserved in a balanced chemical equation • Explain observed changes of mass during chemical reactions in non-enclosed systems using the particle model when given the balanced symbol equation • Explain why whenever a measurement is made there is always some uncertainty about the result obtained • **HT ONLY:** State that chemical amounts are measured in moles (mol) and explain what a mol is with reference to relative formula mass and Avogadro's constant • **HT ONLY:** Use the relative formula mass of a substance to calculate the number of moles in a given mass of the substance • **HT ONLY:** Calculate the masses of reactants and products when given a balanced symbol equation • **HT ONLY:** Use moles to write a balanced equation when given the masses of reactants	• Describe how metals react with oxygen and state the compound they form, define oxidation and reduction • Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and use the reactivity series to predict the outcome of displacement reactions • Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids • Relate the reactivity of metals to its tendency to form positive ions and be able to deduce an order of reactivity of metals based on experimental results • Recall what native metals are and explain how metals can be extracted from the compounds in which they are found in nature by reduction with carbon • Evaluate specific metal extraction processes when given appropriate information and identify which species are oxidised or reduced • **HT ONLY:** Describe oxidation and reduction in terms of loss and gain of electrons • **HT ONLY:** Write ionic equations for displacement reactions, and identify which species are oxidised and reduced from a symbol or half equation • **HT ONLY:** Explain in terms of gain or loss of electrons that the reactions between acids and some metals are redox reactions, and identify which species are oxidised and which are reduced (Mg, Zn, Fe + HCl & H2SO4)

	nitrogen, hydrogen chloride, water, ammonia and methane ● Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule ● Describe the arrangement of atoms and electrons in metallic bonds and draw diagrams the bonding in metals ● Name the three States of matter, identify them from a simple model and state which changes of state happen at melting and boiling points ● Explain changes of state using particle theory and describe factors that affect the melting and boiling point of a substance ● **HT ONLY**: Discuss the limitations of particle theory ● Recall what (s), (l), (g) and (aq) mean when used in chemical equations and be able to use them appropriately ● Explain how the structure of ionic compounds affects their properties, including melting and boiling points and conduction of electricity (sodium chloride structure only) ● Explain how the structure of small molecules affects their properties ● Explain how the structure of polymers affects their properties ● Explain how the structure of giant covalent structures affects their properties ● Explain how the structure of metals and alloys affects their properties, including explaining why they are good conductors	and products (inc changing the subject of the equation) ● **HT ONLY:** Explain the effect of limiting the quantity of a reactant on the amount of products in terms of 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 ● **CHEM ONLY:** Explain why it is not always possible to obtain the calculated or expected amount of a product ● **CHEM ONLY:** Calculate the theoretical amount of a product and percentage yield of a product using the formula % yield = mass of product made/max theoretical mass of product x 100 ● **Chem & HT ONLY:** Calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction ● **CHEM ONLY:** Describe atom economy as a measure of the amount of reactants that end up as useful products ● **CHEM ONLY:** Calculate the percentage atom economy of a reaction to form a desired product using the equation % atom economy =RfM of desired product/sum of RfM of all reactants x 100 ● **Chem & HT ONLY:** Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data **Chem & HT ONLY:** Calculate the amount of solute (in moles or grams) in a solution from its concentration in mol/dm3	● Explain that acids can be neutralised by alkalis, bases and metal carbonates and list the products of each of these reactions ● Predict the salt produced in a neutralisation reaction based on the acid used and the positive ions in the base, alkali or carbonate and use the formulae of common ions to deduce the formulae of the salt ● Describe how soluble salts can be made from acids and how pure, dry samples of salts can be obtained ● Required practical 1: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution ● Recall what the pH scale measures and describe the scale used to identify acidic, neutral or alkaline solutions ● Define the terms acid and alkali in terms of production of hydrogen ions or hydroxide ions (in solution), define the term base ● Describe the use of universal indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions ● **CHEM ONLY:** Describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids to find the reacting volumes accurately ● **Chem & HT ONLY:** Calculate the chemical quantities in titrations involving concentrations in mol/dm3 and in g/dm3 ● **CHEM ONLY:** Required practical 2: determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration ● **HT ONLY:** Use and explain the terms dilute and concentrated (in terms of amount of substance)

	• Explain why alloys are harder than pure metals in terms of the layers of atoms • Explain the properties of graphite, diamond and graphene in terms of their structure and bonding • Describe the structure of fullerenes, and their uses, including Buckminsterfullerene and carbon nanotubes • **CHEM ONLY:** Compare the dimensions of nanoparticles to other particles and explain the effect of their surface area to volume ratio on their properties **CHEM ONLY:** Discuss the applications of nanoparticles and their advantages and disadvantages, including uses in medicine, cosmetics, fabrics and the development of catalysts	• **Chem & HT ONLY:** Calculate the concentration of a solution when it reacts completely with another solution of a known concentration • **Chem & HT ONLY:** Describe how to carry out titrations of strong acids and strong alkalis and calculate quantities in titrations involving concentrations in mol/dm^3 and g/dm^3 **Chem & HT ONLY:** Explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution Chem & **HT ONLY**: Explain what the volume of one mole of any gas at room temperature is Chem & **HT ONLY**: Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass	and weak and strong (in terms of the degree of ionisation) in relation to acids • **HT ONLY:** Explain how the concentration of an aqueous solution and the strength of an acid affects the pH of the solution and how pH is related to the hydrogen ion concentration of a solution • Describe how ionic compounds can conduct electricity when dissolved in water and describe these solutions as electrolytes • Describe the process of electrolysis • Describe the electrolysis of molten ionic compounds and predict the products at each electrode of the electrolysis of binary ionic compounds • Explain how metals are extracted from molten compounds using electrolysis and use the reactivity series to explain why some metals are extracted with electrolysis instead of carbon • Describe the electrolysis of aqueous solutions and predict the products of the electrolysis of aqueous solutions containing single ionic compounds • Required practical 3: investigate what happens when aqueous solutions are electrolysed using inert electrodes • **HT ONLY:** Describe the reactions at the electrodes during electrolysis as oxidation and reduction reactions and write balanced half equations for these reactions

Skills: (Know how…)	• **Drawing dot and cross diagrams for ionic, covalent, and metallic bonds.** • **Explaining the properties of substances based on structure and bonding.** • **Comparing melting/boiling points and conductivity of different substances.** • **Identifying different types of structures: simple molecules, giant lattices, fullerenes, nanoparticles.** • **Accurately drawing models to represent molecules (2D)**	• Calculating relative formula masses (Mr). • Applying the mole concept in chemical equations. • Performing calculations involving mass, moles, volume, and concentration. • Interpreting balanced equations and identifying limiting reactants. • Working out percentage yield and atom economy. **(CHEM ONLY)**	• Predicting reactivity using the reactivity series. • Writing balanced ionic and half-equations for redox reactions. • Designing and interpreting experiments involving acids, alkalis, and neutralisation. • Extracting metals using reduction or electrolysis. • Identifying products from reactions of acids (e.g. salt, water, hydrogen).
Key vocabulary (5- 10 words)	**Ionic bond** **Covalent bond** **Metallic bond** **Giant ionic lattice** **Simple molecular** **Giant covalent structure** **Polymers** **Nanoparticles** **Fullerenes**	**Relative atomic mass (Ar)** **Relative formula mass** **Mole** **Concentration** **Empirical formula** **Limiting reactant** **Yield (Chemistry only)** **Percentage yield (Chemistry only)** **Atom economy (Chemistry only)**	
End of Half term assessment	End of topic	Mock	End of topic test
Planned trips / Clubs / links	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime

Key Stage 4	**Year Group: 11**		
	Autumn Term 1	**Autumn Term 2**	**Spring Term 1**
key concept	Energy Changes	The Rate and Extent of Chemical changes	Organic Chemistry

Content: (Know what…)	• Describe how energy is transferred to or from the surroundings during a chemical reaction • Explain exothermic and endothermic reactions on the basis of the temperature change of the surroundings and give examples of everyday uses • Required practical 4: investigate the variables that affect temperature changes in reacting solutions • Describe what the collision theory is and define the term activation energy • Interpret and draw reaction profiles of exothermic and endothermic reactions, inc identifying the relative energies of reactants and products, activation energy and overall energy change • **HT ONLY:** Explain the energy changes in breaking and making bonds and calculate the overall energy change using bond energies • **CHEM ONLY:** Describe what a simple cell and a battery is and how they produce electricity • **CHEM ONLY:** Describe why alkaline batteries are non-rechargeable, state why some cells are rechargeable and evaluate the use of cells • **CHEM ONLY**: Describe fuel cells and compare fuel cells to rechargeable cells and batteries • **CHEM ONLY**: Describe the overall reaction in a hydrogen fuel cell • **Chem & HT ONLY:** Write half equations for the electrode reactions in a hydrogen fuel cell	• Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm3/s or mol/s • Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction • **HT ONLY**: Calculate the gradient of a tangent to the curve on the graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction • Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts • Required practical 5: investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity • Use collision theory to explain changes in the rate of reaction, including discussing activation energy • Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems • Draw and interpret reaction profiles for catalysed reactions • Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: A + B ⇌ C + D • Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction • Describe the State of dynamic equilibrium of a reaction as the point when the forward and	• Describe why crude oil is a finite resource. • Identify the hydrocarbons in the series of alkanes. • Explain the structure and formulae of the alkanes. • Use 3D models to represent hydrocarbons, polymers and large biological molecules. • Describe how crude oil is used to provide modern materials. • Explain how crude oil is separated by fractional distillation. • Explain why the boiling points of the fractions are different. • Describe how different hydrocarbon fuels have different properties. • Identify the properties that influence the use of fuels. • Explain how the properties are related to the size of the molecules. • Describe the process of complete combustion. • Balance equations showing the combustion of hydrocarbons. • Explain the consequences of incomplete combustion. • Describe the usefulness of cracking. • Balance chemical equations as examples of cracking. • Explain why modern life depends on the uses of hydrocarbons. • **CHEM ONLY** Describe the difference between an alkane and an alkene. • **CHEM ONLY** Draw the displayed structural formulae for the first four members of the alkenes. • **CHEM ONLY** Explain why alkenes are called unsaturated molecules. • **CHEM ONLY** Describe the addition reactions of alkenes.

		reverse reactions occur at exactly the same rate ● **HT ONLY**: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions ● **HT ONLY**: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction	● **CHEM ONLY** Draw the full displayed structural formulae of the products alkenes make. ● **CHEM ONLY** Explain how alkenes react with hydrogen, water and the halogens. ● **CHEM ONLY** Recognise alcohols from their name or from given formulae. ● **CHEM ONLY** Describe the conditions used for the fermentation of sugar using yeast. ● **CHEM ONLY** Write balanced chemical equations for the combustion of alcohols. ● **CHEM ONLY** Describe the reactions of carboxylic acids. ● **CHEM ONLY** Recognise carboxylic acids from their formulae. ● **CHEM ONLY** Explain the reaction of ethanoic acid with an alcohol. ● **CHEM ONLY** Recognise addition polymers and monomers from diagrams. ● **CHEM ONLY** Draw diagrams of the formation of a polymer from an alkene. ● **CHEM ONLY** Relate the repeating unit of the polymer to the monomer. ● **CHEM ONLY** Explain the basic principles of condensation polymerisation. ● **CHEM ONLY** Explain the role of functional groups in producing a condensation polymer. ● **CHEM ONLY** Explain the structure of the repeating units in a condensation polymer. ● **CHEM ONLY** Identify the two functional groups of an amino acid. ● **CHEM ONLY** Explain how amino acids build proteins. ● **CHEM ONLY** Describe the components of natural polymers. ● **CHEM ONLY** Explain the structure of proteins and carbohydrates. ● **CHEM ONLY** Explain how a molecule of DNA is constructed.

			• Recognise the strong covalent bonds within molecules. • Recognise the weak intermolecular forces between molecules. • Describe the effects of weak intermolecular forces on properties of substances.
Skills: **(know how…)**	• Interpreting energy profile diagrams. • Identifying whether a reaction is exothermic or endothermic. • Calculating bond energy changes using data. • Designing practicals to measure temperature changes in reactions.	• Measuring and calculating rates of reaction. • Interpreting graphs of rate vs time. • Explaining how surface area, temperature, concentration, and catalysts affect rate. • Understanding and applying collision theory. • Explaining changes in equilibrium (Le Chatelier's Principle).	• Naming and identifying alkanes, alkenes, and other simple organic molecules • Understanding and describing fractional distillation of crude oil • Drawing and interpreting structural/formulae of hydrocarbons • Addition reactions of alkenes • CHEM ONLY: Test of alkene, alcohol, ester and carboxylic acid. • **CHEM ONLY:** Understanding **addition polymerisation** of alkenes. • **CHEM ONLY:** Drawing polymers from monomers and vice versa. • **CHEM ONLY:** Naming and recognizing **alcohols** and **carboxylic acids.** • **CHEM ONLY:** Understanding reactions of fermentation and oxidation of alcohol, reactions of carboxylic acids with carbonates, **esterification** to form esters. • •

Key vocabulary (5- 10 words)	• **Exothermic** • **Endothermic** • **Activation energy** • **Reaction profile** • **Bond energy**	• **Rate of reaction** • **Catalyst** • **Collision theory** • **Reversible reaction** • **Dynamic equilibrium** • **Le Chatelier's Principle**	• Hydrocarbon • Alkane • Alkene • Saturated • Unsaturated • Fractional distillation • Cracking • Isomer • Combustion • Functional group •
End of Half term assessment	End of topic test	Mock exam	End of topic test
Planned trips / Clubs / links	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime
Key Stage 4	**Year Group: 11**		
	Spring 2	**Summer 1**	**Summer 2**
Key Concept	Chemical Analysis	Revision	

Content: **(Know what…)**	• Define a pure substance and identify pure substances and mixtures from data about melting and boiling points • Describe a formulation and identify formulations given appropriate information • Describe chromatography, including the terms stationary phase and mobile phase and identify pure substances using paper chromatography • Explain what the Rf value of a compound represents, how the Rf value differs in different solvents and interpret and determine Rf values from chromatograms • Required practical 6: investigate how paper chromatography can be used to separate and tell the difference between coloured substances (inc calculation of Rf values) • Explain how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine • **CHEM ONLY**: Identify some metal ions from the results of flame tests and describe how to conduct a flame test • **CHEM ONLY**: Describe how sodium hydroxide solution can be used to identify some metal ions and identify metal ions from the results of their reactions with sodium hydroxide solution • **CHEM ONLY**: Write balanced equations for the reactions between sodium hydroxide solution and some metal ions to produce insoluble hydroxides • **CHEM ONLY**: Describe how to identify carbonates using limewater		

	• **CHEM ONLY**: Describe how to identify negative ions, including halide ions using silver nitrate and sulfate ions using barium chloride • Required practical 7: use of chemical tests to identify the ions in unknown single ionic compounds • **CHEM ONLY**: State the advantages of using instrumental methods to identify elements and compounds compared to chemical tests • **CHEM ONLY**: Describe the process of and how to use flame emission spectroscopy to identify metal ions; interpret the results of a flame emission spectroscopy tests		
Skills: **(Know how…)**	• Using chemical tests to identify gases • Understanding chromatography (e.g., Rf values) • Analysing purity and formulations • **CHEM ONLY**: Using precipitation reactions to identify metal ions • **CHEM ONLY:** Understanding the advantages of instrumental analysis methods like flame emission spectroscopy. • **CHEM ONLY**: Carrying out and interpreting flame tests and test tube reactions.		

Key vocabulary (5- 10 words)	• Pure substance • Formulation • Mixture • Chromatography • Rf value •		
End of Half term assessment	Mock		
Planned trips / Clubs / links	Science drop-in clinic every Thursday lunchtime	Science drop-in clinic every Thursday lunchtime	