WFA Progression Map - planning for knowledge/skills etc to build & accumulate sequentially over time

WESTON FAVELL ACADEMY

Key: *__Bold__ writing shows development or progression from previous year. *<u>Underline</u> shows cross-over of key concepts with other end-points

Faculty:Science			Subject: Triple Chemistry			
End points	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
The understanding thar matter is organised into different categories based upon structure, how the different elements are arranged and that and these give rise to distinctive properties.	Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic Demonstrate that dissolving, mixing and	3.5.1 Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles. 3.5.1 Relate the features of the particle model to the properties of materials in different states. 3.5.1 Argue for how to classify substances which behave unusually as solids, liquids or gases. 3.5.1 A substance is a solid below its melting point, a liquid between its melting and boiling points, and a gas above its boiling point. 3.5.2 Liquids have different boiling points. 3.5.1 Explain changes in states in terms of changes to the energy of particles. 3.5.1 Draw before and after diagrams of particles to explain observations about changes of state, gas pressure, and diffusion. 3.5.1 Explain unfamiliar observations about gas pressure in terms of particles.	3.5.4 The symbols of hydrogen, oxygen, nitrogen, carbon, iron, zinc, copper, sulfur, aluminium, iodine, bromine, chlorine, sodium, potassium, and magnesium. 3.5.4 Most substances are not pure elements, but compounds or mixtures containing atoms of different elements. They have different properties to the elements they contain. 3.5.4 Compare and contrast the properties of elements and compounds and give a reason for their differences. **3.5.4 Compare the properties of elements with the properties of a compound formed from them.** 3.5.4 Use particle diagrams to classify a substance as an element, mixture, or compound and as molecules or atoms. <u>3.5.4 Name simple compounds using these rules: change non-metal to –ide; mono, di, tri prefixes; and symbols of hydroxide, nitrate, sulfate, and carbonate</u>.	Define the word element, Classify familiar substances as elements or compounds. Use the Periodic Table to find the symbols or names of given elements. Describe the basic structure of an atom. Explain, including diagrams, the difference between a pure element, a mixture, and a compound. Name and give the chemical symbol of the first 20 elements in the Periodic Table. Use chemical symbols of atoms to produce the chemical formulae of a range of elements and compounds. Explain the significance of chemical symbols used in formulae and equations (including balanced). Describe familiar chemical reactions in word equations. **State that mass is conserved in a chemical reaction.** **Explain why mass is conserved in a chemical reaction.**	Describe how melting point and boiling point data can be used to identify pure substances. <u>State what a formulation I and their uses.</u> Describe the difference between pure substances, impure substances, and formulations, with definitions. <u>Explain how melting point and boiling point data can be used to determine the purity of a substance.</u> **Justify the classification of pure substances, impure substances, and formulations when data is supplied.** Explain in detail the use of formulations. Calculate percentage composition of components in a range of formulations. <u>Explain how chromatography separates solutes.</u> **<u>Calculate Rf values from given data.</u>** <u>Use a chromatogram to determine if a sample is pure or impure.</u>	

	changes of state are reversible changes Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	3.5.1 Make predictions about what will happen during unfamiliar physical processes, in terms of particles and their energy. 3.5.2 Choose the most suitable technique to separate out a mixture of substances. 3.5.2 Devise ways to separate mixtures, based on their properties. 3.5.2 Air, fruit juice, sea water and milk are mixtures. 3.5.2 Explain how substances dissolve using the particle model.	3.5.4 Name compounds using their chemical formulae. 3.5.4 Given chemical formulae, name the elements present and their relative proportions. 3.5.4 Represent atoms, molecules elements, compounds, and mixtures using particle diagrams. 3.5.4 Deduce a pattern in the formula of similar compounds and use it to suggest formulae for unfamiliar ones. 3.5.4 Use particle diagrams to predict physical properties of elements and compounds.	Describe familiar chemical reactions **Justify in detail how mass may appear to change in a chemical reaction.** Describe unfamiliar chemical reactions with more complex balanced symbol equations, including state symbols. Define mixture. Identify a mixture and a compound. List, describe and explain different separation techniques. Explain the difference between a compound and a mixture. Explain how the chemical properties of a mixture relate to the chemical it is made from. Use experimental data to explain the classification of a substance as a compound or mixture. **Suggest an appropriate separation or purification technique for an unfamiliar mixture.** State when fractional distillation would be used. Safely make a paper chromatogram. Describe the process of fractional distillation.	**Explain why different substances and different conditions will have different Rf values.** **Calculate Rf values from a chromatogram, using an appropriate number of significant figures.** **Interpret a chromatogram to identify unknown substances.** Describe how to safely carry out the laboratory test for chlorine gas. Identify hydrogen, carbon dioxide, and oxygen from a laboratory test. Explain why limewater turns milky when it reacts with carbon dioxide. Interpret results to identify a gas that is present. Explain why hydrogen 'pops' near a naked flame. **Write balanced symbol equations, including state symbols, for the reactions of limewater with carbon dioxide and hydrogen with oxygen.** Explain why a glowing splint re-ignites in oxygen. Explain why chlorine gas turns damp indicator paper colourless. Write a word equation for the reaction between sodium hydroxide and a specified metal salt solution.	

				Explain the main processes occurring in paper chromatography. **<u>Explain in detail how fractional distillation can separate miscible liquids with similar boiling points.</u>** Evaluate separation or purification techniques for a given mixture. List the significant models proposed for atoms. Identify the key parts of the plum-pudding model and the nuclear model of the atom. **Describe the differences between the plum-pudding model and the nuclear model of the atom.** **Explain how evidence from scattering experiments changed the model of the atom.** Justify why the model of the atom has changed over time. Evaluate the current model of an atom and label one State the relative charges and masses of sub-atomic particles. State that atoms have no overall charge (are neutral). Label the sub-atomic particles on a diagram of a helium atom..	Identify a metal ion from the colour of a flame or the colour of the hydroxide precipitate. Write balanced symbol equations, including state symbols, for the production of an insoluble metal hydroxide. Explain why a flame test cannot be used to identify a mixture of metal solutions. Evaluate flame tests as a method for identifying of positive metal ions. **<u>Write balanced ionic equations, including state symbols for the production of an insoluble metal hydroxide.</u>** Explain why iron(II) hydroxide solution often changes colour when it stands in air. Write a word equation for the reaction when a specific carbonate, halide, or sulfate is being tested with support. Identify the presence of carbonate, a specific halide, or sulfate ions from simple laboratory tests. Write balanced symbol equations, including state symbols for the reactions in the simple laboratory tests for carbonate, halide, or sulfate ions. Explain why it can be difficult to identify halides	

				Explain why atoms have no overall charge. Use atomic number and mass numbers of familiar atoms to determine the number of each sub-atomic particle. Use the Periodic table to find atomic number and mass number data and use it to determine the number of each sub-atomic particle in any given form. **Recognise and describe patterns in sub-atomic particles of elements listed in the Periodic Table.** Explain why we can be confident that there are no missing elements in the first 10 elements of the Periodic Table. State what an ion is. Define an isotope. State the relative sizes of an atom and its nucleus. Describe isotopes using the atomic model. Explain why ions have a charge. <u>Use atomic number and mass numbers of familiar ions to determine the number of each sub-atomic particle.</u> <u>Use the Periodic table to find atomic number and use it to determine the number of each sub-atomic particle in an ion.</u>	Evaluate the halide ion test. Write balanced ionic equations, including state symbols, for simple laboratory tests for carbonate, halide, or sulfate ions. Explain in detail how to identify a compound from the results of simple laboratory tests. **List some of the advantages and disadvantages of instrumental techniques.** **State an example of an instrumental technique.** **State a use for flame emission spectroscopy.** **Compare and contrast instrumental techniques with simple laboratory tests.** **Describe the main processes of flame emission spectroscopy.** **Explain how flame emission spectroscopy is an improvement on flame tests.** **Evaluate the use of instrumental techniques.** **Explain how metal ions emit light when in a flame.** **Interpret results from flame emission spectroscopy when data is given.**	

				Use SI units and prefixes to describe the size of an atom and its nucleus in standard form. State that electrons are found in energy levels of an atom. State the maximum number of electrons in the first three energy levels. Write the standard electronic configuration notation from a diagram for the first 20 elements. **Explain why elements in the same group react in a similar way.** Use the Periodic Table to find atomic number and determine the electronic structure for the first 20 elements. Make predictions for how an element will react when given information on another element in the same group. List the significant models for ordering the elements. State how the elements are ordered in the periodic table. Describe how the elements are arranged in groups and periods in the periodic table. Explain why the periodic table was a breakthrough in how to order elements.		

				Explain how and why the ordering of the elements has changed over time. Define a group and period in the periodic table. Describe how electronic structure is linked to the periodic table. State that noble gases are unreactive. **Describe how the electronic structure of metals and non-metals are different.** **Explain in terms of electronic structure how the elements are arranged in the periodic table.** **Explain why the noble gases are unreactive and the trend in their boiling points.** **Explain how the electronic structure of metals and non-metals affects their reactivity.** **Use the periodic table to make predictions about the electronic structure and reactions of elements.** Predict the electronic structure of stable ions for the first 20 elements. Name the first three elements in Group 1. Describe the Group 1 metals as having low densities.		

				Write word equations from descriptions of how Group 1 metals react with water. Recognise trends in supplied data. Explain why the elements in Group 1 react similarly and why the first three elements float on water. Describe how you can show that hydrogen and metal hydroxides are made when Group 1 metals react with water. Illustrate the reactions of Group 1 metals with balanced symbol equations. Explain how Group 1 metals form ions with a +1 charge when they react with non-metals. Justify how Group 1 metals are stored and the safety precautions used when dealing with them. Name the first four elements in Group 7. Recognise a halogen displacement reaction. Describe the main properties of halogens. **Recognise trends in supplied data**. Explain why the elements in Group 7 react similarly.		

				Explain how to complete a halogen displacement reaction and explain what happens in the reaction. **Illustrate the reactions of Group 7 metals with balanced symbol equations.** Explain how Group 7 non-metals form ions with a −1 charge when they react with metals. Explain in detail how to compare the reactivity of the Group 7 elements. State the trend in reactivity in Group 1 and Group 7. **Explain how electronic structure affects the trend in reactivity of Group 1 and Group 7 elements.** Use the nuclear model to explain how the outer electrons experience different levels of attraction to the nucleus. Use electronic structure to explain the trends in physical and chemical properties of Group 1 and Group 7 elements. **Apply knowledge of reactivity of Groups 1 and 7 to suggest and explain the trend in reactivity of Groups 2 and 6.** List the typical properties of transition metals and their compounds.		

				Describe how the properties of Group 1 metals compare with transition metals. Interpret the formula and names of familiar transition metal compounds. Justify the use of a transition metal or its compound in terms of its chemical properties. **<u>Suggest why Group 1 metals have different properties compared to transition metals.</u>** Identify the three states of matter and their state symbols. <u>Describe the process of melting, freezing, boiling, and condensing.</u> Use the particle model to draw a representation of how particles are arranged in the three states of matter. Use data to determine the state of a substance at a given temperature (inks to Physics). Explain, in terms of particles, the energy and temperature of a substance when it is at the melting point or boiling point. (Links to Physics) Describe the factors that affect rate of evaporation. Use the particle model to describe how energy, movement, and attraction between particles change as a substance is heated or cooled. (Links to Physics)		

				Suggest why substances have different melting and boiling points from each other. State the particles involved in ionic and covalent bonding. Describe, with an example, how a Group 1 metal atom becomes a positive ion. Describe, with an example, how a Group 7 non-metal atom becomes a negative ion. Draw dot and cross diagrams of compounds formed between Group 1 and Group 7 elements. **Explain how electron transfer allows ionic bonding to occur in the compound formed when a Group 1 metal reacts with a Group 7 non-metal.** **Draw dot and cross diagrams of unfamiliar ionic compounds. Suggest and explain the charge of a monatomic ion based on its position in the periodic table.** State that opposite charges attract. Write the charges of ions of Group 1, Group 2, Group 6, and Group 7 elements. Describe a giant ionic lattice. Explain how the position of an element in the periodic table relates to the charge on its most stable monatomic ion.		

				Explain, in terms of electronic structure, how unfamiliar elements become ions. Interpret the formulae of familiar ionic compounds to determine the number and type of each ion present. **<u>Suggest the charge on unfamiliar ions using the position of the element in the periodic table.</u>** Explain the ratio of metal and non-metal ions in compounds. Generate the formulae of a wide range of ionic compounds when the charges of the ions are given. State that ionic compounds have high melting points and can dissolve in water. State that ionic compounds can conduct electricity when molten or dissolved in water. Explain why ionic compounds have a high melting point. Describe, in terms of ions, how an ionic compound can conduct electricity. Explain the movement of ions in solution or when molten. Explain in detail why ionic compounds cannot conduct electricity when they are solid but can when molten or in solution.		

				Justify in terms of properties that a compound has ionic bonding. Apply the ionic model to make predictions of the physical properties of ionic compounds. Describe a covalent bond Recognise a covalent compound from its formula, name, or diagram showing bonds. Name familiar examples of small molecules which contain covalent bonds. Explain how a covalent bond forms in terms of electronic structure. Draw dot and cross diagrams and ball and stick diagrams for H2, Cl2, O2, N2, HCl, H2O, NH3, and CH4. Describe a double bond in a diatomic molecule. Draw dot and cross diagrams and ball and stick diagrams for unfamiliar small molecules. Suggest how double and triple covalent bonds can be formed. Suggest how the properties of a double covalent bond could be different to the properties of a single covalent bond. State that small molecules have low melting and boiling points.		

				State that small molecules do not conduct electricity. Describe an intermolecular force. Explain how the size of molecules affects melting and boiling points. **Explain why small molecules and polymers do not conduct electricity.** Identify substances that would have weak intermolecular forces. Predict the physical properties of unfamiliar covalently bonded substances. Compare and contrast the properties of substances with different bonding. Justify the use of a model to explain the physical properties of a small molecule and discuss the limitations of various molecular models. List the main physical properties of diamond and graphite. State that giant covalent structures have high melting points. Describe the structure of graphite in terms of layers of carbon atoms. Recognise the structure of diamond and graphite from		

				information provided in written or diagrammatic form. Explain the properties of diamond in terms of its bonding. Explain the properties of graphite in terms of its bonding. Use a molecular model of an unfamiliar giant covalent structure to predict and explain its physical properties. **Justify in detail a use for graphite and diamond based on their properties.** Describe the relationship between graphite and graphene. List the main physical properties of fullerenes. State the molecular formula of buckminsterfullerene. Recognise the structure of a fullerene or nanotube in diagrams and prose. Explain the structure of fullerenes. List the properties and consequent uses of fullerenes and carbon nanotubes. Describe and explain the applications of fullerenes. Use molecular models of graphene, nanotubes, and fullerenes to explain their properties.		

				Justify in detail a use for graphene, nanotubes, and fullerenes, based on their properties. State that metals form a giant structure. Recognise metallic bonding in diagrams. Describe metallic bonding. Recognise and represent metallic bonding diagrammatically. Explain how metal atoms form giant structures. Evaluate different models of metallic bonding. List the physical properties of metals. Describe the structure of a pure metal. **Explain key physical properties of metals using the model of metallic bonding.** Describe why metals are alloyed. Explain in detail, including labelled diagrams, how alloying affects the structure and bonding in metals and its effect on properties. Justify in detail why alloys are more often used than pure metals.		

				State a definition of nanoscience. Describe how surface area to volume ratio increases as particle size decreases. Recognise that the negative indices in standard form used in nanoscience represent very small numbers. Describe the size of nanoparticles. Explain why surface area to volume ratio increases as particle size decreases. Convert lengths into standard form. Classify a particle as coarse, fine, or nanoparticle based on its size. **Quantitatively explain the relationship between surface area to volume ratio and particle size and its effect on properties.** Convert standard form into a variety of length units. State and evaluate the use of nanoparticles in sun cream and their other uses. List the advantages and disadvantages of using nanoparticles. Explain why nanoparticles can have new applications.		

				Decide and justify in detail why nanotechnology research should continue.		
	NC/Spec coverage See above	NC/Spec coverage The particle model Separating mixtures	NC/Spec coverage Elements Periodic table	NC/Spec coverage Atomic structure Bonding	NC/Spec coverage Chemical analysis Links to Quantitative chemistry and Rates of reaction	NC/Spec coverage
The understanding that different elements interact in predictable ways to form compounds. Appreciating that they do this in predictable ways, with predictable energy, "amounts" and rates of reaction.	Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic Demonstrate that dissolving, mixing and changes of state are reversible changes Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	3.6.2 Acids and alkalis can be corrosive or irritant and require safe handling. 2.13 Identify risks, hazards and identify control measures. 3.6.2 Acids have a pH below 7, neutral solutions have a pH of 7, alkalis have a pH above 7. 3.6.2 Identify the best indicator to distinguish between solutions of different pH, using data provided. 3.6.2 Use data and observations to determine the pH of a solution and explain what this shows. 3.6.2 Hydrochloric, sulfuric and nitric acid are strong acids. 3.6.2 Ethanoic (acetic) and citric acid are weak acids. 3.6.2 Deduce the hazards of different alkalis and acids using data about their concentration and pH. 3.6.2 Explain how neutralisation reactions are used in a range of situations.	3.6.4 Chemical reactions can be described by a model in which atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved. 3.6.4 Write word equations from information about chemical reactions. 3.6.4 Use particle diagrams to show what happens in a reaction. 2.13 Identify control measures. 3.6.4 Combustion is a reaction with oxygen in which energy is transferred to the surroundings as heat and light. 3.6.4 Chemical changes can be described by a model in which atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved. 3.6.4 Write word equations from information about chemical reactions. 3.6.4 Predict the products of the combustion or thermal	**Define exothermic and endothermic reactions.** State that energy is conserved in a chemical reaction. Safely complete a calorimetry experiment for a reaction that takes place in solution. **State a use of an exothermic reaction and an endothermic reaction.** Write word equations for familiar reactions. Explain how an energy change from a chemical reaction can be used. **Write balanced symbol equations for familiar reactions.** Suggest a chemical reaction for a specific purpose based on the energy change for the reaction. Evaluate in detail the uses of exothermic and endothermic reactions. Define activation energy. Sketch a generic reaction profile diagram for an exothermic or endothermic reaction.	Use the periodic table to identify the relative atomic mass for the first 20 elements. Calculate the relative formula mass for familiar and unfamiliar compounds when the formula is supplied and is without brackets or a formula. Use the periodic table to find the relative atomic mass of all elements. State the units for the "amount" of substance. Explain why relative atomic masses may not be a whole number. Explain why some elements have the same relative atomic mass as each other. Use balanced symbol equations to calculate reacting masses. Explain why chemical equations must be balanced. Identify the limiting reactant in a chemical reaction. **Explain the effect of a limiting reactant on the amount of product made.**	**State the purpose of the Haber process.** **State the conditions for the Haber process.** **Write a word equation to describe the Haber process.** **Describe how the raw materials are turned into the reactants for the Haber process.** **Describe how the Haber process is a reversible reaction.** **Describe the Haber process with the help of a balanced symbol equation including state symbols.** **Evaluate the Haber process using atom economy and LCA to determine its environmental impact.** **Explain how costs are kept to a minimum in the Haber process** **.** Explain, with the use of balanced symbol equations, where the reactants come from for the Haber process. **Explain the effect of changing temperature on**

		3.6.2 Describe a method for how to make a neutral solution from an acid and alkali. 3.6.2 Devise an enquiry to compare how well indigestion remedies work. 3.6.2 Estimate the pH of an acid based on information from reactions. 3.6.2 Given the names of an acid and an alkali, work out the name of the salt produced when they react. Know that neutralisation reactions produce a salt and water. 3.6.1 Iron, nickel and cobalt are magnetic elements. 3.6.1 Mercury is a metal that is liquid at room temperature. 3.6.1 Bromine is a non-metal that is liquid at room temperature. 3.6.1 Identify an unknown element from its physical and chemical properties. 3.6.1 Justify the use of specific metals and non-metals for different applications, using data provided. 3.6.1 Describe an oxidation, displacement, or metal–acid	decomposition of a given reactant and show the reaction as a word equation. 3.6.4 Compare the pros and cons of fuels in terms of their products of combustion. 3.6.4 Devise a general rule for how a set of compounds reacts with oxygen or thermally decomposes. 3.6.4 Thermal decomposition is a reaction in which a single reactant is broken down into simpler products by heating. 3.6.4 Chemical changes can be described by a model in which atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved. 3.6.4 Explain why a reaction is an example of combustion or thermal decomposition. 3.6.4 Use particle diagrams to show what happens in a reaction. 3.6.4 Predict the products of the combustion or thermal decomposition of a given reactant and show the reaction as a word equation. 3.6.4 Devise a general rule for how a set of compounds reacts with oxygen or thermally decomposes.	Label activation energy on a reaction profile diagram. Generate a specific reaction profile diagram for a given chemical reaction when its energy change is also supplied. Identify bonds broken in reactants and new bonds made in products of a reaction. Explain why chemical reactions need activation energy to start them. Use the particle model to explain how a chemical reaction occurs. **Explain energy change in terms of the balance between bond making and bond breaking** **.** **State when fractional distillation would be used.** Safely make a paper chromatogram. Explain, using the particle model, how reactants become products in a chemical reaction. Explain why bond breaking is endothermic and bond making is exothermic. Define bond energy and identify all the bonds that break and are made in a chemical reaction. Calculate the energy needed to break the reactant bonds and	Explain the effect of a limiting reactant on the amount of product made. **State the definition of theoretical yield, actual yield, and percentage yield.** **Calculate percentage yield when actual yield and theoretical yield are given.** **Calculate percentage yield when the actual yield is given and the mass of the limiting reactant is given.** **List reasons why actual yield is often lower than theoretical yield.** **Calculate the percentage yield using a variety of units and conversions.** **Justify why percentage yield can never be above 100%.** **Calculate the formula mass of substances when the formula is given.** **Balance simple equations** **State a definition of atom economy** **Calculate the atom economy for a given chemical reaction.** **Explain why using reactions with high atom economy is important.** **Evaluate different reactions to decide the best production method of a chemical.**	**the yield of the Haber process.** **Explain the effect of changing pressure on the yield of the Haber process.** **Explain why the conditions used in the Haber process are a compromise.** **Justify why the conditions used in the Haber process are a compromise.** **Explain the effect of an iron catalyst on the rate and position of equilibrium in the Haber process.** **Use data to predict and explain the effect on the equilibrium and rate of reaction of changing conditions in the Haber process.**

		reaction with a word equation. 3.6.1 Use particle diagrams to represent oxidation, displacement and metal-acid reactions. 3.6.1 Identify an unknown element from its physical and chemical properties. 3.6.1 Deduce the physical or chemical changes a metal has undergone from its appearance. 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. 3.6.1 Use particle diagrams to represent oxidation, displacement and metal–acid reactions. 3.6.1 Deduce the physical or chemical changes a metal has undergone from its appearance. 3.6.1 Justify the use of specific metals and non-metals for different applications, using data provided. 3.6.1 Place an unfamiliar metal into the reactivity series based on information about its reactions. 3.6.1 Deduce a rule from data about which reactions will occur or not, based on the reactivity series.	3.6.4 Explain observations about mass in a chemical or physical change. 3.6.4 Use known masses of reactants or products to calculate unknown masses of the remaining reactant or product. 3.6.4 Use the mass of reactant in an equation to determine the mass of product, for example, magnesium and oxygen. 3.6.4 Balance a symbol equation. 6.3.3 State that during a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic. 6.3.3 Use experimental observations to distinguish exothermic and endothermic reactions. 6.3.3 Use energy data to select a reaction for a chemical hand warmer or cool pack. 3.6.3 Investigate a phenomenon that relies on an exothermic reaction. 6.3.3 State that during a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing	the energy released when the product bonds are made. Calculate the energy change for a reaction, including the correct unit. Explain in terms of bond energies how a reaction is either exothermic or endothermic. Describe a simple cell. Describe a battery Give an example of a non-rechargeable battery Explain how potential difference can be changed in a cell. Interpret data from an electrochemical cell to determine the reactivity of the metals involved. Explain why non-rechargeable batteries stop working. **Describe an electrochemical cell with half equations and ionic equations.** **Explain why the reactions in an electrochemical cell are redox reactions and determine which species is oxidised or reduced in an electrochemical cell.** Evaluate the use of non-rechargeable cells. Describe a hydrogen fuel cell. State some uses for hydrogen fuel cells.	**Explain why the sum of the formula masses of the reactants is the same as the sum of the formula masses of the products.** **Describe what the concentration of a solution is**. **Calculate the concentration of a solution in g/dm3 when given the mass of solute in g and volume of solution in dm3.** **Explain how concentration of a solution can be changed.** **Calculate the mass of solute (in g) in a solution when given the concentration in g/dm3 and volume in dm3 or cm3.** **Calculate the mass of a chemical when any volume and concentration is given.** **Explain the concentration of a solution in terms of particles.** **Accurately read the volume on a burette to 1 decimal place.** **Identify concordant results** **Calculate a titre.** Describe how an indicator can be used to determine the end point. Explain how accuracy can be improved in a titration. Justify the use of a pipette and burette for a titration, evaluating the errors involved in reading these instruments.	

		3.6.1 Use experimental results to suggest an order of reactivity of various metals. 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. 3.6.1 Use particle diagrams to represent oxidation, displacement and metal-acid reactions.	energy). If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic. 6.3.3 Use a diagram of relative energy levels of particles to explain energy changes observed during a change of state. 6.3.3 State that during a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, the reaction is endothermic. 6.3.3 Use a diagram of relative energy levels of particles to explain energy changes. 6.3.3 Predict whether a chemical reaction will be exothermic or endothermic given data on bond strengths.	State that hydrogen fuel cells could be an alternative to rechargeable cells and batteries. Explain how a hydrogen fuel cell produces electricity. List the advantages and disadvantages of hydrogen fuel cells. Explain why hydrogen fuel cells are an alternative to rechargeable cells and batteries. Describe the reactions in fuel cells using balanced symbol and half equations. **Evaluate the use of hydrogen fuel cells instead of rechargeable cells and batteries.** **Determine and explain which species is oxidised and which is reduced in a hydrogen fuel cell.**	Explain how precise results are obtained in a titration. Justify the use of an indicator in an acid–base titration. **Calculate the concentration of a solution in mol/dm3 when given the volume/mass of solute in moles and volume of solution in dm3.** **Calculate the amount of acid or alkali needed in a neutralisation reaction.** **Calculate the unknown concentration of a reactant in a neutralisation reaction when the volumes are known and the concentration of one reactant is also known.** **Extract data from given information to perform multi-step calculations independently.** **Calculate the amount in moles of gas in a given volume at room temperature and pressure.** **Convert units** **Suggest how the volume of gas would change when temperature or pressure was changed.** **Calculate the moles or volume of a gaseous substance involved in a chemical reaction.** Recall a definition for rate of reaction.	

					Safely describe and follow a method to monitor rate of reaction. State the units for rate of reaction Explain how there can be different units for measuring rate of reaction. Calculate the mean rate of reaction. Calculate the rate of reaction at a specific time. Plot and use a graph to calculate the gradient to measure the initial rate of reaction. Justify a chosen method for a given reaction to monitor the rate of reaction. Explain why there is more than one unit for rate of reaction. Describe how surface area of a solid can be increased. State that chemical reactions can only occur when a collision occurs with enough energy. List the factors that can affect the rate of a chemical reaction. Describe how changing the surface area changes the rate of reaction. Describe what the activation energy of a reaction is.	

					Calculate the surface area to volume ratio. Use collision theory to explain in detail how increasing surface area increases the rate of reaction. Use a graph to calculate the rate of reaction at specific times in a chemical reaction. Explain why many collisions do not lead to a chemical reaction. Describe how temperature affects the rate of reaction. Safely complete an experiment on how temperature affects the rate of a reaction. Use collision theory to explain how changing temperature alters the rate of reaction. **Calculate mean rates of reaction.** **Use a graph to calculate the rate of reaction at specific times in a chemical reaction.** **Calculate 1 / t and plot a graph with a more meaningful line of best fit.** **Describe how changing concentration affects the rate of reaction.** **Describe how changing pressure affects the rate of gas phase reactions.** Use collision theory to explain how changing concentration or	

					pressure alters the rate of reaction. Explain how to change gas pressure. Interpret a rate of reaction graph, including calculating the rate of reaction at specific times in a chemical reaction. Explain why changing pressure has no effect on the rate of reaction for some reactions. Justify quantitative predictions and evaluate in detail their investigation into the effect of concentration on rate of reaction. Define a catalyst Describe how adding a catalyst affects the rate of reaction. Describe and carry out a method to safely investigate which catalyst is best for a reaction. **Use collision theory to explain how adding a catalyst alters the rate of reaction.** Explain, with an example, the industrial use of a catalyst. Calculate the mean rate of reaction. Use a reaction profile diagram to explain in detail the effect of adding a catalyst.	

					Justify the use of catalysts in industry and in household products. Explain what an enzyme is and how it works. Define a reversible reaction. Write a word equation for a familiar reversible reaction. State an example of a reversible reaction. Explain, using a familiar example, how a reaction can be reversible. Describe a familiar reversible reaction using a balanced symbol equation. Predict the observations of a familiar reversible reaction when the conditions are changed. Describe an unfamiliar reversible reaction, using a balanced symbol equation with state symbols. Justify the use of reversible reactions in the lab and items available in the home. Justify the classification of a reaction as reversible. **State whether a reversible reaction is exothermic or endothermic in the reverse direction if the forward direction is stated.**	

					<u>Write a word equation for the reversible reaction of dehydration/hydration of copper sulfate.</u> **<u>Explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction.</u>** Generate balanced symbol equations for reversible reactions from information provided. Make predictive observations of familiar reversible reactions when information is supplied. Explain in detail the energy changes in an equilibrium system. Suggest and explain a simple laboratory test which could be completed using a reversible reaction. Make predictive observations of unfamiliar reversible reactions when information is supplied. Define a dynamic equilibrium and describe how to reach it Describe a closed system Describe how rate of the forward reaction compares to rate of the backward reaction in a dynamic equilibrium. Describe Le Chatelier's Principle.	

					Explain dynamic equilibrium. Explain why the concentration of chemicals in a dynamic equilibrium remains constant. **<u>Predict the effect on the rate of forward and reverse reactions by applying the Le Chatelier's Principle when the conditions of a dynamic equilibrium are changed.</u>** Explain how changing conditions for a system at dynamic equilibrium affects the rate of the forward and reverse reactions. Predict the effect on yield of changing temperature, concentration, or pressure I a given equilibrium system. Explain why changing pressure has no effect on some systems. Justify, in detail, the compromise conditions chosen in given industrial processes.	
	NC/Spec coverage	NC/Spec coverage Metals and non-metals Acids and alkalis	NC/Spec coverage Types of reaction Chemical energy	NC/Spec coverage Bonding Chemical changes Energy changes	NC/Spec coverage Rates of reaction Links to quantitative	NC/Spec coverage Earth's resources
Understand that Carbon compounds give rise to homologous series which have specific properties and structures				Describe examples of exothermic and endothermic reactions. Explain, using observations from calorimetry, how to classify a reaction as exothermic or endothermic. Explain in detail how to carry out a calorimetry experiment. Describe the composition of crude oil.	State a definition of an alkene. Name the first four alkenes. State the product of a combustion and an addition reaction of an alkene. Draw the displayed structural formulae for the first four alkenes.	Define a monomer and a polymer. State some uses of poly(ethene) and poly(propene). **<u>Write a word equation for the formation of poly(ethene) and poly(propene).</u>**

				State a definition of a hydrocarbon. State a definition of an alkane. Describe how to separate crude oil into fractions in a school laboratory. Classify a hydrocarbon as an alkane. State the names and describe the first four alkanes. Explain why fractional distillation is used to separate crude oil into fractions. **Apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane.** Classify and justify the classification of a chemical as an alkane. Name the different fractions from crude oil. State a use for each fraction from crude oil. Describe how the trend in colour, viscosity, flammability, and boiling point changes as the length of the hydrocarbon chain changes. Describe how the properties of a fraction of crude oil make it appropriate for its use. Explain in detail how fractional distillation is used to separate crude oil into fractions.	Draw the displayed structural formulae for the products of the addition reactions between alkenes and hydrogen, water (steam), or a halogen. **Predict the word and balanced symbol equations for the complete combustion of an alkene when the number of carbon atoms is given.** **Predict the word and balanced symbol equations to describe reactions between alkenes and hydrogen, water (steam), or a halogen.** Compare and contrast the reactivity of alkanes and alkenes. Predict the general formula of an alkene. Recognise the functional group in an alcohol and a carboxylic acid. Name for the first four primary alcohols and the first four carboxylic acids. Name ethyl ethanoate from its formula. Classify an organic compound as an alcohol, a carboxylic acid, or an ester. Draw the structural and displayed formulae for the first four primary alcohols and the first four carboxylic acids.	Describe how monomers become polymers. Draw the monomer for an addition polymer when the structure of the polymer is given. Draw an addition polymer structure when the structure of the monomer is given. Explain why monomers for addition polymers must be unsaturated. **Explain the process of addition polymerisation in detail, including using balanced symbol equations and the concept of atom economy.** Explain how the repeating unit of a polymer relates to the monomer. Describe condensation polymerisation. **Draw a simplified structure of the monomers for a condensation polymer when the structure of the polymer is given.** **Draw a simplified structure of a condensation polymer when the structure of the monomers are given.** **Predict the products of condensation polymerisation.** **Explain the process of condensation**

				Explain how chain length affects the properties of crude oil fractions. Make predictions about the properties of crude oil fractions from the fraction's hydrocarbon chain length. Define complete and incomplete combustion. Write a word equation to describe the complete combustion of a hydrocarbon. Write a word equation to describe the incomplete combustion of a hydrocarbon. Explain the differences between complete and incomplete combustion. Write balanced symbol equations for the complete and incomplete combustion of hydrocarbons. Explain how to test for the products of complete combustion. Justify the use of a given fuel over another. Explain in detail how the production of carbon monoxide in incomplete combustion can be lethal. Use balanced symbol equations to calculate amounts of reactants or products in a combustion reaction. Define the process of cracking.	Draw the structural and displayed formulae for ethyl ethanoate. Predict the structure for primary alcohols or carboxylic acids when the number of carbon atoms is given. Suggest a general formula for a homologous series. Suggest why an organic acid is not an alcohol even though it contains an –OH functional group. State that fermentation can be used to make ethanol. List some chemical properties of the first four alcohols. Recognise the formula and structure of ethanol and state some of its uses. **Describe fermentation to make aqueous solutions of ethanol, including a word equation.** Describe the reactions of alcohols, including using word equations. Explain the relationship between ethanol and ethanoic acid. Explain why solutions of ethanol have a pH of 7. Describe complete combustion reactions of a range of alcohols using balanced symbol equations.	**polymerisation in detail, including using equations.** Compare and contrast in detail, giving appropriate examples, the two methods of polymerisation. State an example of a natural polymer. Describe the relationship between sugar as a monomer and starch or cellulose as a polymer. Describe the relationship between amino acids as a monomer and protein as a polymer. Identify the monomer from the structural formula of a polymer. Describe the structure of an amino acid. Predict the products of condensation polymerisation. **Explain in detail the process of condensation polymerisation with natural monomers, including using equations.** Explain how amino acids react together in an acid– State that DNA is an example of a natural polymer. State what DNA stands for.

				Generate a word equation to describe cracking. Recognise and give examples of alkenes. Describe the process of cracking, including conditions. Generate a balanced symbol equation to describe cracking. Describe a chemical test to show an alkene is present. Use examples to explain the process of cracking and why it is so important to the petrochemical industry. Explain the similarities and differences between alkanes and alkenes. Explain, using balanced symbol equations, the reaction between bromine water and an alkene.	Plan an investigation to determine the relative energy transferred to the surroundings by the combustion of different alcohols. Recognise a carboxylic acid from its name or formula. List some chemical properties of carboxylic acids. Describe an ester and state some uses of this class of compounds. Describe why carboxylic acids are acidic. **<u>Use word equations to describe the reactions of carboxylic acids with metal carbonates and with alcohols.</u>** Describe how to make an ester. Explain, using ionic equations, why carboxylic acids are weak acids. Predict the products of the reactions of a range of carboxylic acids with metal carbonates and with alcohols. Explain the term volatile in terms of molecular forces.	Name the type of monomers used to make DNA. Describe the main structure of DNA. Describe the importance of DNA for living systems. Sketch the shape of a DNA strand. Explain the shape of the DNA polymer. Explain how nucleotides form DNA. Explain the purpose of DNA.
	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage Energy changes Crude oil & fuels	NC/Spec coverage Organic chemistry	NC/Spec coverage Earth's resources Polymers
Appreciate that the evolution of the Earth's atmosphere has been and remains		3.7.1 The three rock layers inside Earth are the crust, the mantle and the core.	3.7.3 Greenhouse gases reduce the amount of energy lost from the Earth through radiation and therefore the temperature has been rising	Describe the Earth's early atmosphere.	**<u>Define electrolysis.</u>** **Write a word equation to describe the electrolysis of a molten ionic compound.**	List some human uses of the Earth's resources. Give examples of a finite and a renewable resource.

an ongoing due to a number of processes which provide resources we use today		3.7.1 Explain why a rock has a particular property based on how it was formed. 3.7.1 Identify the causes of weathering and erosion and describe how they occur. 3.7.1 Predict planetary conditions from descriptions of rocks on other planets. 3.7.1 Identify circumstances that indicate fast processes of change on Earth and those that indicate slower processes. 3.7.1 Construct a labelled diagram to identify the processes of the rock cycle. 3.7.1 Describe similarities and differences between the rock cycle and everyday physical and chemical processes. 3.7.1 Model the processes that are responsible for rock formation and link these to the rock features. 3.7.1 Suggest how ceramics might be similar to some types of rock. 3.7.2 Describe how space exploration and observations of stars are affected by the scale of the universe. 3.7.2 Explain the choice of particular units for measuring distance. 3.7.2 Describe the appearance of planets or	as the concentration of those gases has risen. 3.7.3 Scientists have evidence that global warming caused by human activity is causing changes in climate. 3.7.3 Methane and carbon dioxide are greenhouse gases. Earth's atmosphere contains around 78% nitrogen, 21% oxygen, <1% carbon dioxide, plus small amounts of other gases. **3.7.3 Describe how human activities affect the carbon cycle.** **3.7.3 Evaluate claims that human activity is causing global warming or climate change.** 3.7.3 Carbon is recycled through natural processes in the atmosphere, ecosystems, oceans, and the Earth's crust (such as photosynthesis and respiration) as well as human activities (burning fuels). 3.7.3 Use a diagram to explain how carbon is recycled in the environment and through living things. 3.7.3 Scientists have evidence that global warming caused by human activity is causing changes in climate.	Describe how oxygen was formed in the development of the atmosphere. State the composition, including formulae, of the Earth's early atmosphere. Describe a theory for the development of the Earth's atmosphere. Explain, using word equations, how gases were formed in the atmosphere and how oceans were formed. Use a theory to explain in detail how the atmosphere developed. Explain the limits of the theory for the development of the Earth's atmosphere and why it has changed. Use balanced symbol equations to explain how gases were formed in the atmosphere and explain how oceans were formed. State that the levels of carbon dioxide have decreased in the atmosphere. List the names and symbols of the gases in dry air. **State where methane and ammonia in the atmosphere may have come from.** **Describe how the proportion of carbon dioxide in the early atmosphere was reduced.**	**Describe electrolysis in terms of movement of ions.** **Write a balanced symbol equation including state symbols for the overall electrolysis of a molten ionic compound.** **Predict the products at each electrode for the electrolysis of a molten ionic compound.** **Explain why electrolysis can only occur when an ionic compound is molten or in aqueous solution.** **Describe electrolysis with half equations at the electrodes.** **Explain the classification of the reactions at each electrode as oxidation or reduction.** State that oxygen can be produced at the anode when some solutions are electrolysed. State that hydrogen can be produced at the cathode when some solutions are electrolysed. Write a word equation to describe electrolysis of a solution. Describe electrolysis of solutions in terms of movement of ions. **<u>Write a balanced symbol equation including state symbols for the overall electrolysis of a solution</u>**.	State an example of a natural product that is supplemented or replaced by agricultural or synthetic products. Describe and classify a resource as finite or renewable when information is given. Explain the use of natural, sustainable, and finite resources. Interpret information from different formats including graphs, charts, tables, and prose. Understand data and interpret information using orders of magnitude to compare. Explain the role of chemistry in improving agricultural and industrial processes. Draw conclusions consistent with information provided from graphs, charts, tables, and prose and evaluate the validity of the data. Describe why potable water is important. List the key processes to make drinking water. Safely distil salty water Explain why the method of obtaining potable water depends on the local conditions.

		moons from diagrams showing their position in relation to the Earth and Sun. 3.7.2 Describe how space exploration and observations of stars are affected by the scale of the universe. 3.7.2 Make deductions from observation data of planets, stars and galaxies. 3.7.2 Explain why places on the Earth experience different daylight hours and amounts of sunlight during the year. 3.7.1 Predict patterns in day length, the Sun's intensity or an object's shadow at different latitudes. 3.7.2 Relate observations of changing day length to an appropriate model of the solar system. 3.7.2 Describe the appearance of moons from diagrams showing their position in relation to the Earth and Sun. 3.7.2 Compare explanations from different periods in history about the motion of objects and structure of the Universe.	3.7.3 Describe how human activities affect the carbon cycle. 3.7.3 Describe how global warming can impact on climate and local weather patterns. 3.7.3 Compare the relative effects of human-produced and natural global warming. 3.7.3 Evaluate the implications of a proposal to reduce carbon emissions. 3.7.3 Investigate the contribution that natural and human chemical processes make to our carbon dioxide emissions. 3.7.4 Most metals are found combined with other elements, as a compound, in ores. The more reactive a metal, the more difficult it is to separate it from its compound. Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals. 3.7.4 Describe how Earth's resources are turned into useful materials or recycled. 3.7.4 Justify the choice of extraction method for a metal, given data about reactivity. 3.7.4 Suggest factors to take into account when deciding whether extraction of a metal is possible.	State the composition of dry air. Use word equations to show how carbon dioxide can form sedimentary rocks. Use a theory to explain in detail how the early atmosphere developed to form the atmosphere today. Explain why the composition of the Earth's atmosphere has not changed much for 200 million years. Use balanced symbol equations to explain how carbon dioxide forms sedimentary rock and how methane and ammonia were removed from the atmosphere. Describe the greenhouse effect. Name three greenhouse gases State some human activities that affect the proportion of greenhouse gases in the atmosphere. Explain the greenhouse effect Explain how greenhouse gases increase the temperature of the atmosphere. Explain how human activity can change the proportion of greenhouse gases in the atmosphere.	Predict the products at each electrode for the electrolysis of a molten ionic compound or its solution. Explain how hydrogen ions and hydroxide ions can be present in solutions, including a balanced symbol equation with state symbols, for the reversible reaction in which water ionises. Describe electrolysis with half equations at the electrodes. Explain the classification of reactions at the electrodes as oxidation or reduction. State that aluminium can be extracted from aluminium oxide using electrolysis. Write a word equation to describe the electrolysis of aluminium oxide. **Describe the electrolysis of aluminium oxide.** **Explain why electrolysis is an expensive metal extraction method and illustrate this with the extraction of aluminium.** **Explain why cryolite is added to aluminium oxide in the industrial extraction of aluminium.** Explain why electrolysis is used to extract aluminium from compounds. Describe electrolysis with half equations at the electrodes.	Explain reasons for filtration and sterilisation in water treatment. Describe and explain in detail how to safely distil salty water. Explain the difference between pure water and potable water. Justify the choice of potable water supply in a given scenario. Explain in detail why desalination is not often used to generate safe clean drinking water and justify when it is used. List what is removed from waste water before it can be released. State the main processes in sewage treatment. State uses of sewage slurry. Explain why waste water should be treated before it is released into the environment. Describe the main processes in sewage treatment. Explain uses of sewage slurry. Evaluate the ease of obtaining potable water from waste, ground, or salt water.

			3.7.4 Suggest ways in which waste products from industrial processes could be reduced. 3.7.4 Predict the method used for extracting metal based on its position in the reactivity series. 3.7.4 There is only a certain quantity of any resource on Earth, so the faster it is extracted, the sooner it will run out. Recycling reduces the need to extract resources. 3.7.4 Explain why recycling of some materials is particularly important. 3.7.4 Describe how Earth's resources are turned into useful materials or recycled. 3.7.4 Suggest ways in which changes in behaviour and the use of alternative materials may limit the consumption of natural resources. 3.7.4 Use data to evaluate proposals for recycling materials.	Justify why scientists, as well as the public, disagree about the cause of climate change. Explain the difference between global warming and the greenhouse effect. Evaluate evidence to suggest if global warming is man-made or natural. List some of the possible outcomes of climate change. State a definition for carbon footprint. List some ways to reduce a carbon footprint. Explain the possible effects of global climate change and why they are difficult to predict. Explain possible methods to reduce greenhouse gas emissions. Explain some of the problems in trying to reduce greenhouse gas emissions. Evaluate the scale, risk, and environmental impact of global climate change. Justify why reducing greenhouse gas emissions can be difficult to achieve. Evaluate the use of products, services, or events in terms of their carbon footprint.	Explain the classification of the reactions at each electrode as oxidation or reduction. State the products of the electrolysis of brine and a use for each. Safely electrolyse a solution, with guidance provided. Describe how to electrolyse brine in terms of ions moving Predict the products of electrolysis of a solution. Plan and carry out an electrolysis investigation. Explain the electrolysis of brine using half equations, classifying reactions at the electrode as oxidation or reduction. **<u>Evaluate in detail an investigation they have planned and carried out, commenting on their methodology and quality of the data collected.</u>** **Compare and contrast the electrolysis of a compound in solution with its electrolysis as a molten compound.**	Explain in detail how and why waste water is processed before it is released into the environment. Evaluate the uses of sewage slurry. Describe the processes of phytomining and bioleaching. Write balanced symbol equations to explain metal extraction techniques. Explain the need for new ways of extracting metals (in particular copper). Explain in detail how phytomining and bioleaching extract metals. **<u>Write ionic equations to explain metal extraction techniques and identify the species being oxidised or reduced.</u>** Evaluate biological methods of metal extraction. State the different stages of an LCA in the correct order. Carry out an LCA for shopping bags made from plastic or paper with support. Explain the importance of LCA and how it can be misused.

						Carry out LCAs for different products when data is supplied. Explain the limits of LCAs. Evaluate products in detail using LCAs. List some products that can be reused or recycled. Describe how metal can be reused and recycled. Describe how glass can be reused and recycled. Explain the importance of reusing and recycling products. Explain why some recycling can be difficult. Evaluate ways of reducing the use of limited resources when information is given. Evaluate the environmental, economic, and social impacts of reusing and recycling products. Evaluate ways of reducing the use of limited resources. Suggest ways of minimising the environmental impact of exploiting raw materials. **Define the term corrosion.** **State what is required for iron to rust.**

						List some ways to prevent rusting. **Describe an experiment to investigate the conditions required for rusting to occur.** **With the help of equations, describe the process of rusting.** **Explain how different corrosion prevention techniques work.** **Explain in detail why corrosion is a problem.** **Write balanced equations to describe rusting and identify species that are oxidised and reduced.** **Evaluate rust prevention techniques and suggest which is best for a specific purpose.** **State the difference between a metal before and after being alloyed.** State the elements in steel and bronze. List some common examples of alloys and their uses. Explain in detail why pure metals are often alloyed before they are used. Describe how different amounts of carbon affect the properties of iron.

						Identify an appropriate purpose for an alloy when given data on its properties. Explain the term carat. Use data on the properties of unfamiliar alloys to explain a suitable alloy for a given purpose. Evaluate an alloy in terms of its properties and uses. Describe the properties of a thermosetting and thermosetting plastics. Describe the difference between LD and HD poly(ethene). Explain how thermosetting plastics and thermosetting plastics are different in terms of structure and bonding. Describe the different conditions used to make poly(ethene). Explain how the structure of poly(ethene) affects its properties and therefore its uses. Explain in detail, giving examples, how the properties of plastics can be changed. When data about the properties of plastics is given, suggest a suitable plastic for a given purpose.

						Evaluate a plastic in terms of its properties and uses. Describe how to make soda-lime glass and borosilicate glass. Describe how to make clay ceramics. State examples of clay ceramics and composites. Describe what a composite is. Explain the difference between a composite and an advanced composite. Compare quantitatively the physical properties of glass and clay ceramics, polymers, composites, and metals. Explain the properties of ceramics and composites in terms of structure and bonding. When data about the properties of a material is provided, classify it and suggest a suitable material for a given purpose. Evaluate materials in terms of their properties and uses. State the purpose of the Haber process. State the conditions for the Haber process. Write a word equation to describe the Haber process.

						Describe how the raw materials are turned into the reactants for the Haber process. **Describe how the Haber process is a reversible reaction.** **Describe the Haber process with the help of a balanced symbol equation including state symbols.** **Evaluate the Haber process using atom economy and LCA to determine its environmental impact.** **Explain how costs are kept to a minimum in the Haber process.** **Explain, with the use of balanced symbol equations, where the reactants come from for the Haber process.** **Explain the effect of changing temperature on the yield of the Haber process.** **Explain the effect of changing pressure on the yield of the Haber process.** **Explain why the conditions used in the Haber process are a compromise.** **Justify why the conditions used in the Haber process are a compromise.**

						<u>Explain the effect of an iron catalyst on the rate and position of equilibrium in the Haber process.</u> Use data to predict and explain the effect on the equilibrium and rate of reaction of changing conditions in the Haber process. State what a fertiliser is. Identify the fertiliser produced from a reaction. Write a word equation for the formation of the chemicals in NPK fertilisers. Explain the importance of fertilisers for agriculture. Describe in detail how fertilisers are produced in the laboratory. Write balanced symbol equations for the reactions to make components of NPK fertilisers. Evaluate different processes to make NPK fertilisers. Write ionic equations for reactions to make fertilisers. Calculate the concentration of an ammonia solution from the results of a titration. Name the elements in NPK fertilisers.

						Describe where the raw materials for NPK fertilisers come from. Name and give the formulae of the chemicals in NPK fertilisers. Describe production of fertilisers in industry. Compare and contrast the industrial and laboratory production of fertilisers. Write balanced symbol equations for the reactions to make components of NPK fertilisers. Evaluate the composition of fertilisers. Evaluate different processes to make NPK fertilisers. Write ionic equations to illustrate the reactions to make NPK fertilisers.
	NC/Spec coverage	NC/Spec coverage Earths structure Universe	NC/Spec coverage Climate Earth resources Enquiry processes	NC/Spec coverage Earth's early atmosphere Crude oil and fuels	NC/Spec coverage Organic Chemical amalysis	NC/Spec coverage Earth's resources
Have an appreciation of the importance of practical chemistry and have the skills to investigate hypotheses	Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including	2.3 Judge whether the conclusion is supported by the data. 3.5.2 Use the solubility curve of a solute to explain observations about solutions. 3.5.2 Analyse and interpret solubility curves. 3.5.2 Use techniques to separate mixtures.	2.3 Make a conclusion and explain it **2.1 Identify patterns in data.** 2.5 Use scientific vocabulary accurately, showing that you know its meaning, and use appropriate units and correct chemical nomenclature.	Explain in detail how multi-step separation techniques work. **Every required practical**	Describe how to calculate Rf values. Describe a use of chromatography. Safely carry out testing for carbonates, halides, and sulfate ions. Safely carry out the laboratory test for hydrogen, oxygen, carbon dioxide, and chlorine.	Describe and safely carry out a method to make a paper chromatogram. **Every required practical**

	through filtering, sieving and evaporating Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic Demonstrate that dissolving, mixing and changes of state are reversible changes Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	3.5.2 Suggest a combination of methods to separate a complex mixture and justify the choices. 2.9 Carry out the method carefully and consistently 3.5.2 Choose the most suitable technique to separate out a mixture of substances. 3.5.2 Suggest a combination of methods to separate a complex mixture and justify the choices. 2.9 Carry out the method carefully and consistently. 3.5.2 Use evidence from chromatography to identify unknown substances in mixtures. 2.9 Gather data, minimising errors. 2.9 Decide whether the conclusion of the experiment agrees with your prediction. 2.6 Describe the evidence for an idea. 2.6 Explain why evidence supports an idea. 2.13 Identify risks and hazards. 2.13 Identify control measures.	3.5.4 Investigate changes in mass for chemical and physical processes. 6.3.3 Use energy data to select a reaction for a chemical hand warmer or cool pack.		Calculate Rf values from a chromatogram, using an appropriate number of significant figures. Interpret a chromatogram to identify unknown substances. Safely carry out a flame test. Safely carry out testing for metal ions using sodium hydroxide. **<u>Every required practical</u>**	

		2.12 Make an experimental prediction. 2.9 Gather data, minimising errors. 2.12 Decide whether the conclusion of the experiment agrees with your prediction. 2.4 Select a good way to display data.				
	NC/Spec coverage	NC/Spec coverage Every unit Enquiry processes	NC/Spec coverage Every unit Enquiry processes	NC/Spec coverage Every unit	NC/Spec coverage Every unit	NC/Spec coverage Every unit
Use calculations and data analysis		2.4 Select a good way to display data. 2.4 Draw line graphs to display relationships. relationships. 2.6 Suggest a scientific idea that might explain the observation. 2.9 Identify the independent variable. 2.9 Decide how to measure the dependent variable. 2.9 Identify control variables. 2.9 Control the variables. 2.9 Describe how controlling variables is important in providing evidence for a conclusion. 2.10 Write a fair test enquiry question. 2.10 Make a conclusion and explain it.	3.6.4 Balance a symbol equation. 6.3.3 State that during a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic.		Calculate the concentration of a solution in mol/dm3 when given the volume/mass of solute in moles and volume of solution in dm3. Calculate the amount of acid or alkali needed in a neutralisation reaction. Calculate the unknown concentration of a reactant in a neutralisation reaction when the volumes are known and the concentration of one reactant is also known. Extract data from given information to perform multi-step calculations independently. Calculate the amount in moles of gas in a given volume at room temperature and pressure. Convert units	Calculate the number of moles or mass of a substance from data supplied. Explain why chemical equations must be balanced. **Calculate the relative formula mass for one substance when the relative formula masses are given for all the other substances in a balanced symbol equation.** Interpret balanced symbol equations in terms of mole ratios.

		2.9 Prepare a table with space to record all measurements. 2.9 Prepare a table with space to record all measurements. 2.10 Write a fair test enquiry question. 2.11 Decide how to vary the independent variable between planned values. 2.11 Decide how to measure the dependent variable. 2.11 Identify control variables. 2.11 Control the variables. 2.11 Describe how controlling variables is important in providing evidence for a conclusion.			Calculate the moles or volume of a gaseous substance involved in a chemical reaction. State the units for the "amount" of substance. Use balanced symbol equations to calculate reacting masses. Explain the effect of a limiting reactant on the amount of product made. State the definition of theoretical yield, actual yield, and percentage yield. Calculate percentage yield when actual yield and theoretical yield are given. Calculate percentage yield when the actual yield is given and the mass of the limiting reactant is given. Calculate the percentage yield using a variety of units and conversions. Justify percentage yield Calculate the formula mass of substances when the formula is given. Balance simple equations State a definition of atom economy Calculate the atom economy for a given chemical reaction. Describe what the concentration of a solution is.	

					<u>Calculate the concentration of a solution in g/dm3 when given the mass of solute in g and volume of solution in dm3.</u> Calculate the mass of solute (in g) in a solution when given the concentration in g/dm3 and volume in dm3 or cm3. Calculate the mass of a chemical when any volume and concentration is given. Accurately read the volume on a burette to 1 decimal place. Identify concordant results. Calculate a titre.	
	NC/Spec coverage	NC/Spec coverage Is incorporated throughout. Enquiry Processes.	NC/Spec coverage Is incorporated throughout. Enquiry Processes.	NC/Spec coverage	NC/Spec coverage Quantitative chemistry Links to Chemical analysis and energy changes	NC/Spec coverage Links with quantitative chemistry
	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage
	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage