| Chapter reference | Lesson title | Lesson objectives | AQA specification reference |
|---|---|---|---|
| 1.1 | Elements and compounds | ● Identify symbols of elements from the periodic table<br>● Recognise the properties of elements and compounds.<br>● Identify the elements in a compound | 4.1.1.1 |
| 1.2 | Atoms, formulae and equations | ● Learn the symbols of the first 20 elements in the periodic table.<br>● Use symbols to describe elements and compounds.<br>● Use formulae to write equations. | 4.1.1.1 |
| 1.3 | Mixtures | ● Recognise that all substances are chemicals<br>● Understand that mixtures can be separated into their components<br>● Suggest suitable separation and purification techniques for mixtures. | 4.1.1.2, 4.8.1.1 |
| 1.4 | Changing ideas about atoms | ● Learn how models of the atom changed as scientists gathered more data.<br>● Consider the data Rutherford and Marsden collected.<br>● Link their data to our model of the atom. | 4.1.1.3 |
| 1.5 | Modelling the atom | ● Explore the structure of atoms.<br>● Consider the sizes of atoms.<br>● Explore the way atomic radius changes with position in the periodic table. | 4.1.1.4; 4.1.1.5 |
| 1.6 | Relating charges and masses | ● Compare protons, neutrons and electrons.<br>● Find out why atoms are neutral.<br>● Relate the number of charged particles in atoms to their position in the periodic table. | 4.1.1.4; 4.1.1.6 |
| 1.7 | Sub-atomic particles | ● Find out what the periodic table tells us about each element's atoms.<br>● Learn what isotopes are.<br>● Use symbols to represent isotopes. | 4.1.1.5 |
| 1.8 | Electronic structure | ● Find out how electrons are arranged in atoms.<br>● Use diagrams and symbols to show which energy levels they occupy.<br>● Use number notation to represent electronic structure. | 4.1.1.7 |
| 1.9 | The periodic table | ● Explain how the electronic structure of atoms follows a pattern.<br>● Recognise that the number of electrons in an element's atoms outer shell corresponds to the element's group number.<br>● Use the periodic table to make predictions. | 4.1.2.1 |
| 1.10 | Developing the periodic table | ● Find out how the periodic table has changed over the years.<br>● Explore Mendeleev's role in its development.<br>● Consider the accuracy of Mendeleev's predictions. | 4.1.2.2 |
| 1.11 | Comparing metals and non-metals | ● Review the physical properties of metals and non-metals.<br>● Compare the oxides of metals and of non-metals.<br>● Make predictions about unknown metals and non- | 4.1.2.3 |

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| | | metals. | |
| 1.12 | Metals and non-metals | ● Explore the links between electron configurations of elements and their properties.<br>● Find out what happens to the outer electrons when metals react.<br>● Draw diagrams to show how ions form. | 4.1.2.3 |
| 1.13 | Key concept: The outer electrons | ● Review the patterns in the periodic table.<br>● Compare the trends in Group 1 and Group 7.<br>● Relate these trends to the number of outer electrons and the sizes of atoms. | 4.1.1.7 |
| 1.14 | Exploring Group 0 | ● Explore the properties of noble gases.<br>● Find out how the mass of their atoms affects their boiling points.<br>● Relate their chemical properties to their electronic structures. | 4.1.2.4 |
| 1.15 | Exploring Group 1 | ● Explore the properties of Group 1 metals.<br>● Compare their reactivity.<br>● Relate their reactivity to their electronic structures. | 4.1.2.5 |
| 1.16 | Exploring Group 7 | ● Explain why Group 7 non-metals are known as 'halogens'.<br>● Compare their reactivity.<br>● Relate their reactivity to their electronic structures. | 4.1.2.6 |
| 1.17 | Reaction trends and predicting reactions | ● Review the patterns in the periodic table.<br>● Compare the trends in Group 1 and Group 7.<br>● Relate these trends to the way atoms form ions. | 4.1.2.1 |
| 1.18 | Transition metals | ● Compare the properties of transition metals with those of Group 1 metals.<br>● Explore the uses of transition metals.<br>● Find out why they can form compounds with different colours. | 4.1.3.1, 4.1.3.2 |
| 1.19 | Maths skills: Standard form and making estimates | ● Consider the sizes of particles.<br>● Use numbers in standard form to compare sizes.<br>● Use numbers in standard form in calculations. | MS1; 4.1; 4.2; 4.3; 4.5; 4.6; 4.8; 4.9; 4.10 |
| 2.1 | Chemical bonds | ● Describe the three main types of bonding.<br>● Explain how electrons are used in the three main types of bonding.<br>● Explain how bonding and properties are linked. | 4.2.1.1 |
| 2.2 | Ionic bonding | ● Represent an ionic bond with a diagram.<br>● Draw dot-and-cross diagrams for ionic compounds.<br>● Work out the charge on the ions of metals from the group number of the element. | 4.2.1.2 |
| 2.3 | Ionic compounds | ● Identify ionic compounds from structures.<br>● Explain the limitations of diagrams and models.<br>● Work out the empirical formula of an ionic compound. | 4.2.1.3 |
| 2.4 | Covalent bonding | ● Identify single bonds in molecules and structures.<br>● Draw dot- and-cross diagrams for small molecules.<br>● Deduce molecular formulae from models and diagrams. | 4.2.1.4 |
| 2.5 | Metallic bonding | ● Describe why metals form giant structures.<br>● Explain how metal ions are held together.<br>● Explain the delocalisation of electrons. | 4.2.1.5 |

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| 2.6 | Three states of matter | ● Use data to predict the states of substances.<br>● Explain the changes of state.<br>● Use state symbols in chemical equations. | 4.2.2.1, 4.2.2.2 |
| 2.7 | Properties of ionic compounds | ● Describe the properties of ionic compounds.<br>● Relate their melting points to forces between ions.<br>● Explain when ionic compounds can conduct electricity. | 4.2.2.3 |
| 2.8 | Properties of small molecules | ● Identify small molecules from formulae.<br>● Explain the strength of covalent bonds.<br>● Relate the intermolecular forces to the bulk properties of a substance. | 4.2.2.4 |
| 2.9 | Polymer structures | ● Recognise polymers from their unit formulae.<br>● Explain why some polymers can stretch.<br>● Explain why some plastics do not soften on heating. | 4.2.2.5 |
| 2.10 | Giant covalent structures | ● Recognise giant covalent structures from diagrams.<br>● Explain the properties of giant covalent structures.<br>● Recognise the differences in different forms of carbon. | 4.2.2.6 |
| 2.11 | Properties of metals and alloys | ● Identify metal elements and their properties, and metal alloys.<br>● Describe the purpose of a tin-lead alloy.<br>● Explain why alloys have different properties to those of elements. | 4.2.2.7, 4.2.2.8 |
| 2.12 | Diamond | ● Identify why diamonds are so hard.<br>● Explain how the properties relate to the bonding in diamond.<br>● Explain why diamond differs from graphite. | 4.2.3.1 |
| 2.13 | Graphite | ● Describe the structure and bonding of graphite.<br>● Explain the properties of graphite.<br>● Explain the similarity to metals. | 4.2.3.2 |
| 2.14 | Graphene and fullerenes | ● Describe the structure of graphene.<br>● Explain the structure and uses of the fullerenes.<br>● Explain the structure of nanotubes. | 4.2.3.3 |
| 2.15 | Nanoparticles, their properties and uses | ● Relate the sizes of nanoparticles to atoms and molecules<br>● Explain that there may be risks associated with nanoparticles.<br>● Evaluate the use of nanoparticles for specific purposes. | 4.2.4.1, 4.2.4.2 |
| 2.16 | Key concept: Sizes of particles and orders of magnitude | ● Identify the scale and measurements of length.<br>● Explain the conversion of small lengths to metres.<br>● Explain the relative sizes of electrons, nuclei and atoms. | 4.1.1.5 |
| 2.17 | Maths skills: Visualise and represent 2D and 3D shapes | ● Use two-dimensional (2D) diagrams and 3D models to:<br>○ represent atoms, molecules and ionic structure<br>○ represent giant covalent structures<br>○ calculate empirical formulae of ionic structures. | MS5; 4.2; 4.1; 4.6; 4.7 |
| 3.1 | Key concept: Conservation of mass and | ● Explore ideas about the conservation of mass.<br>● Consider what the numbers in equations stand for. | 4.3.1.1 |

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| | balanced equations | • Write balanced symbol equations. | |
| 3.2 | Relative formula mass | • Review the differences between the isotopes of an element.<br>• Distinguish between the mass of an atom and the relative atomic mass of an element.<br>• Use relative atomic masses to calculate relative formula masses. | 4.3.1.2 |
| 3.3 | Mass changes when gases are in reactions | • Find out how mass can be gained or lost during a reaction.<br>• Find the mass of carbon dioxide released per gram of copper carbonate decomposed.<br>• Assess the accuracy of our measurements. | 4.3.1.3 |
| 3.4 | Chemical measurements and uncertainty | • Explore ideas about the accuracy of measurements.<br>• Consider how closely measurements reflect true values.<br>• Explore ways of estimating the uncertainty in a set of measurements. | 4.3.1.4 |
| 3.5 | Moles | • Describe the measurements of amounts of substances in moles.<br>• Calculate the amount of moles in a given mass of a substance.<br>• Calculate the mass of a given number of moles of a substance. | 4.3.2.1 |
| 3.6 | Amounts of substances in equations | • Calculate the masses of substances in a balanced symbol equation.<br>• Calculate the masses of reactants and products from balanced symbol equations.<br>• Calculate the mass of a given reactant or product. | 4.3.2.2 |
| 3.7 | Using moles to balance equations | • Convert masses in grams to amounts in moles.<br>• Balance an equation given the masses of reactants and products.<br>• Change the subject of a mathematical equation. | 4.3.2 |
| 3.8 | Concentration of solutions | • Relate mass, volume and concentration.<br>• Calculate the mass of solute in solution.<br>• Relate concentration in mol/dm$^3$ to mass and volume. | 4.3.2.5 |
| 3.9 | Key concept: Percentage yield | • Calculate the percentage yield from the actual yield.<br>• Identify the balanced equation needed for calculating yields.<br>• Calculate theoretical product amounts from reactant amounts. | 4.3.3.1 |
| 3.10 | Atom economy | • Identify the balanced equation of a reaction.<br>• Calculate the atom economy of a reaction to form a product.<br>• Explain why a particular reaction pathway is chosen. | 4.3.3.2 |
| 3.11 | Using concentrations of solutions | • Describe how to carry out titrations.<br>• Calculate concentrations in titrations in mol/dm$^3$ and in g/dm$^3$.<br>• Explain how the concentration of a solution in mol/dm$^3$ is related to the mass of the solute and | 4.3.4; 4.4.2.5 |

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| | | the volume of the solution. | |
| 3.12 | Amounts of substance in volumes of gases | ● Explain that the same amount of any gas occupies the same volume at room temperature and pressure (rtp).<br>● Calculate the volume of a gas at rtp from its mass and relative formula mass.<br>● Calculate the volumes of gases from a balanced equation and a given volume of a reactant or product. | 4.3.5 |
| 3.13 | Key concept: Amounts in chemistry | ● Use atomic masses to calculate formula masses.<br>● Explain how formula mass relates to the number of moles.<br>● Explain how the number of moles relates to other quantities. | 4.3 |
| 3.14 | Maths skills: Change the subject of an equation | ● Use equations to demonstrate conservation.<br>● Rearrange the subject of an equation.<br>● Carry out multi-step calculations. | MS3; 4.3 |
| 4.1 | Metal oxides | ● Explore what happens when metals burn or corrode.<br>● Classify chemical changes as oxidation or reduction.<br>● Review the properties of metal oxides. | 4.4.1.1 |
| 4.2 | Reactivity series | ● Compare the reactivity of metals.<br>● Observe some reactions between metal atoms and metal ions.<br>● Consider why some metals are more reactive than others. | 4.4.1.2 |
| 4.3 | Extraction of metals | ● Find out where metals come from.<br>● Extract iron from its oxide using carbon.<br>● Consider how other metals are extracted from their ores. | 4.4.1.3 |
| 4.4 | Oxidation and reduction in terms of electrons | ● Observe some reactions between metal atoms and metal ions.<br>● Learn to write ionic equations and half equations.<br>● Classify half equations as oxidation or reduction. | 4.4.1.4 |
| 4.5 | Reaction of metals with acids | ● React an acid and a metal to make a salt.<br>● Predict the formulas of salts.<br>● Write balanced symbol equations and half equations. | 4.4.2.1 |
| 4.6 | Neutralisation of acids and salt production | ● React an acid and an alkali to make a salt.<br>● Predict the formulae of salts.<br>● Write balanced symbol equations. | 4.4.2.2 |
| 4.7 | Soluble salts | ● React an acid and a metal to make a salt.<br>● Predict the formulae of salts.<br>● Write balanced symbol equations and half equations. | 4.4.2.3 |
| 4.8 | Required practical: Preparing a pure, dry sample of a soluble salt from an insoluble oxide | ● React a carbonate with an acid to make a salt.<br>● Describe each step in the procedure.<br>● Determine the purity of the product. | 8.2.1; 4.4.2.3 |

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| | or carbonate | | |
| 4.9 | pH and neutralisation | ● Estimate the pH of solutions.<br>● Identify weak and strong acids and alkalis.<br>● Investigate pH changes when a strong acid neutralises a strong alkali. | 4.4.2.4 |
| 4.10 | Required practical: Finding the reacting volumes of solutions of acid and alkali by titration | ● Use an acid to neutralise a known volume of alkali.<br>● Use a burette to determine the volume of an acid needed.<br>● Use the results to determine the concentration of an alkali. | 4.4.2.5 |
| 4.11 | Strong and weak acids | ● Explore the factors that affect the pH of an acid.<br>● Find out how the pH changes when an acid is diluted.<br>● Find out how the concentrations of solutions are measured. | 4.4.2.6 |
| 4.12 | The process of electrolysis | ● Explore what happens when a current passes through a solution of ions.<br>● Find out what an electrolyte is and what happens when it conducts electricity.<br>● Find out how electricity decomposes compounds. | 4.4.3.1 |
| 4.13 | Electrolysis of molten ionic compounds | ● Look in detail at the electrolysis of lead bromide.<br>● Communicate the science behind the extraction of elements from molten salts.<br>● Write balanced half equations for electrolysis reactions. | 4.4.3.2 |
| 4.14 | Using electrolysis to extract metals | ● Review the connection between the reactivity series and the ways metals are extracted.<br>● Consider how aluminium is extracted from aluminium oxide.<br>● Learn the oxidation and reduction reactions involved. | 4.4.3.3 |
| 4.15 | Electrolysis of aqueous solutions | ● Investigate the products formed when copper sulfate is electrolysed<br>● Predict what products other solutions will give<br>● Write half equations for reactions at electrodes | 4.4.3.4, 4.4.3.5 |
| 4.16 | Required practical: Investigating what happens when aqueous solutions are electrolysed using inert electrodes | ● Devise a hypothesis.<br>● Devise an investigation to test your hypothesis.<br>● Decide whether the evidence supports your hypothesis. | 8.2.3, 4.4.3.4 |
| 4.17 | Key concept: Electron transfer, oxidation and reduction | ● Review ion formation.<br>● Classify half equations as oxidation or reduction.<br>● Review patterns in reactivity. | 4.2.1.2; 4.4.1.4; 4.4.1.2 |

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| 4.18 | Maths skills: Make order of magnitude calculations | ● Explore the factors that affect the acidity of rain.<br>● Find out how acid concentrations are compared.<br>● Explore the link between hydrogen ion concentration and pH. | MS1; 4.5; 4.2; 4.3; 4.6; 4.8; 4.10 |
| 5.1 | Key concept: Endothermic and exothermic reactions | ● Explore the temperature changes produced by chemical reactions.<br>● Consider how reactions are used to heat or cool their surroundings.<br>● Investigate how these temperature changes can be controlled. | 4.5.1.1; 4.5.1.2; 4.5.1.3 |
| 5.2 | Required practical: Investigate the variables that affect temperature changes in reacting solutions such as acid plus metals, acid plus carbonates, neutralisations, displacement of metals | ● Devise a hypothesis.<br>● Devise an investigation to test your hypothesis.<br>● Decide whether the evidence supports your hypothesis. | 8.2.4; 4.5.1.1 |
| 5.3 | Reaction profiles | ● Use diagrams to show the energy changes during reactions.<br>● Show the difference between exothermic and endothermic reactions using energy profiles.<br>● Find out why many reactions start only when energy or a catalyst is added. | 4.5.1.2 |
| 5.4 | Energy change of reactions | ● Identify the bonds broken and formed during a chemical reaction.<br>● Consider why some reactions are exothermic and others are endothermic.<br>● Use bond energies to calculate overall energy changes. | 4.5.1.3 |
| 5.5 | Cells and batteries | ● Make simple cells and measure their voltages.<br>● Consider the importance of cells and batteries.<br>● Find out how larger voltages can be produced. | 4.5.2.1 |
| 5.6 | Fuel cells | ● Find out how fuel cells work.<br>● Compare and contrast the uses of hydrogen fuel cells, batteries and rechargeable cells.<br>● Learn what reactions take place inside hydrogen fuel cells. | 4.5.2.2 |
| 5.7 | Maths skills: Recognise and use expressions in decimal form | ● Read scales in integers and using decimals.<br>● Calculate the energy change during a reaction.<br>● Calculate energy transferred for comparison. | MS2; 4.2; 4.3; 4.4; 4.8; 4.10 |
| 6.1 | Measuring rates | ● Measure the volume of gas given off during a reaction.<br>● Use the results to measure the reaction rate. | 4.6.1.1 |

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| | | ● Explore how the rate changes during the reaction. | |
| 6.2 | Key concept: Limiting reactants and molar masses | ● Recognise when one reactant is in excess.<br>● Consider how this affects the amount of product made.<br>● Explore ways of increasing the amount of product. | 4.3.2.4 |
| 6.3 | Calculating rates | ● Find out how to calculate rates of reaction.<br>● Use graphs to compare reaction rates.<br>● Use tangents to measure rates that change. | 4.6.1.1 |
| 6.4 | Factors affecting rates | ● Measure the time taken to produce a specific amount of product.<br>● See how a reactant's temperature or concentration can affect this time.<br>● Investigate the effect of breaking up a solid reactant into smaller pieces. | 4.6.1.2 |
| 6.5 | Required practical: Investigate how changes in concentration affect the rates of reactions by a method involving the production of a gas and a method involving a colour change | ● Devise a hypothesis.<br>● Devise an investigation to test a hypothesis.<br>● Decide whether the evidence supports a hypothesis. | 8.2.5; 4.6.1.2 |
| 6.6 | Factors increasing the rate | ● Interpret graphs.<br>● Consider what determines the reaction rate.<br>● Explore the effect of changing the amounts of reactants used. | 4.6.1.2 |
| 6.7 | Collision theory | ● Find out about the collision theory.<br>● Use collision theory to make predictions about reaction rates.<br>● Relate activation energies to collision theory. | 4.6.1.3 |
| 6.8 | Catalysts | ● Investigate catalysts.<br>● Find out how catalysts work.<br>● Learn how they affect activation energy. | 4.6.1.4 |
| 6.9 | Reversible reactions and energy changes | ● Investigate reversible reactions.<br>● Explore the energy changes in a reversible reaction.<br>● Find out how reaction conditions affect reversible reactions. | 4.6.2.1; 4.6.2.2 |
| 6.10 | Equilibrium | ● Recognise reactions that can reach equilibrium.<br>● Find out what happens to the reactants and products at equilibrium.<br>● Use Le Chatelier's principle to make predictions. | 4.6.2.3 |
| 6.11 | Changing concentration and equilibrium | ● Distinguish between reactants and products.<br>● Explore how changing their concentrations affects reversible reactions.<br>● Use Le Chatelier's principle to make predictions about changing concentrations. | 4.6.2.4; 4.6.2.5 |
| 6.12 | Changing | ● Distinguish between exothermic and endothermic | 4.6.2.6 |

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| | temperature and equilibrium | forward reactions.<br>● Explore how changing the temperature affects reversible reactions.<br>● Use Le Chatelier's principle to make predictions about changing temperatures. | |
| 6.13 | Changing pressure and equilibrium | ● Recognise the number of product and reactant molecules in a reaction.<br>● Explore how changing the pressure affects reversible reactions.<br>● Use Le Chatelier's principle to make predictions about changing pressures. | 4.6.2.7 |
| 6.14 | Maths skills: Use the slope of a tangent as a measure of rate of change | ● Practice drawing graphs.<br>● Use graphs to compare reaction rates.<br>● Use tangents to measure rates that change. | MS4; 4.2; 4.6; 4.8; 4.10 |
| 7.1 | Crude oil, hydrocarbons and alkanes | ● Describe why crude oil is a finite resource.<br>● Identify the hydrocarbons in the series of alkanes.<br>● Explain the structure and formulae of the alkanes. | 4.7.1.1 |
| 7.2 | Fractional distillation and petrochemicals | ● Describe how crude oil is used to provide modern materials.<br>● Explain how crude oil is separated by fractional distillation.<br>● Explain why the boiling points of the fractions are different. | 4.7.1.2 |
| 7.3 | Properties of hydrocarbons | ● Describe how different hydrocarbon fuels have different properties.<br>● Identify the properties that influence the use of fuels.<br>● Explain how the properties are related to the size of the molecules. | 4.7.1.3 |
| 7.4 | Combustion | ● Describe the process of complete combustion.<br>● Balance equations showing the combustion of hydrocarbons.<br>● Explain the consequences of incomplete combustion. | 4.7.1.3 |
| 7.5 | Cracking and alkenes | ● Describe the usefulness of cracking.<br>● Balance chemical equations as examples of cracking.<br>● Explain why modern life depends on the uses of hydrocarbons. | 4.7.1.4 |
| 7.6 | Structure and formulae of alkenes | ● Describe the difference between an alkane and an alkene.<br>● Draw the displayed structural formulae for the first four members of the alkenes.<br>● Explain why alkenes are called unsaturated molecules. | 4.7.2.1 |
| 7.7 | Reactions of alkenes | ● Describe the addition reactions of alkenes.<br>● Draw the full displayed structural formulae of the products alkenes make.<br>● Explain how alkenes react with hydrogen, water and the halogens. | 4.7.2.2 |
| 7.8 | Alcohols | ● Recognise alcohols from their name or from given formulae. | 4.7.2.3 |

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| | | ● Describe the conditions used for the fermentation of sugar using yeast.<br>● Write balanced chemical equations for the combustion of alcohols. | |
| 7.9 | Carboxylic acids | ● Describe the reactions of carboxylic acids.<br>● Recognise carboxylic acids from their formulae.<br>● Explain the reaction of ethanoic acid with an alcohol. | 4.7.2.4 |
| 7.10 | Addition polymerisation | ● Recognise addition polymers and monomers from diagrams.<br>● Draw diagrams of the formation of a polymer from an alkene.<br>● Relate the repeating unit of the polymer to the monomer. | 4.7.3.1 |
| 7.11 | Condensation polymerisation | ● Explain the basic principles of condensation polymerisation.<br>● Explain the role of functional groups in producing a condensation polymer.<br>● Explain the structure of the repeating units in a condensation polymer. | 4.7.3.2 |
| 7.12 | Amino acids | ● Describe the functional group of an amine.<br>● Identify the two functional groups of an amino acid.<br>● Explain how different amino acids build proteins. | 4.7.3.3 |
| 7.13 | DNA and other naturally occurring polymers | ● Describe the components of natural polymers.<br>● Explain the structure of proteins and carbohydrates.<br>● Explain how a molecule of DNA is constructed. | 4.7.3.4 |
| 7.14 | Key concept: Intermolecular forces | ● Identify the bonds within a molecule and the forces between molecules.<br>● Explain changes of state.<br>● Explain how polymer structure determines its ability to stretch. | 4.2.2.4; 4.2.2.5; 4.7 |
| 7.15 | Maths skills: Visualise and represent 3D models | ● Use three-dimensional (3D) models to represent hydrocarbons, polymers and large biological molecules. | MS5; 4.7; 4.1; 4.2; 4.6 |
| 8.1 | Pure substances | ● Describe, explain and exemplify processes of separation.<br>● Suggest separation and purification techniques for mixtures.<br>● Distinguish pure and impure substances using melting point and boiling point data. | 4.1.1.2; 4.8.1.1 |
| 8.2 | Formulations | ● Identify formulations given appropriate information.<br>● Explain the particular purpose of each chemical in a mixture.<br>● Explain how quantities are carefully measured for formulation. | 4.8.1.2 |
| 8.3 | Chromatography | ● Explain how to set up chromatography paper.<br>● Distinguish pure from impure substances.<br>● Interpret chromatograms and calculate $R_f$ values. | 4.8.1.3 |
| 8.4 | Required practical: Investigate how paper | ● Describe the safe and correct manipulation of chromatography apparatus and how accurate measurements are achieved.<br>● Make and record measurements used in paper | 8.2.6; 4.8.1.3 |

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| | chromatography can be used in forensic science to identify an ink mixture used in a forgery | chromatography.<br>● Calculate $R_f$ values. | |
| 8.5 | Test for gases | ● Recall the tests for four common gases.<br>● Identify the four common gases using these tests.<br>● Explain why limewater can be used to detect carbon dioxide. | 4.8.2.1; 4.8.2.2; 4.8.2.3; 4.8.2.4 |
| 8.6 | Flame tests | ● Carry out flame-test procedures.<br>● Identify the colours of flames of ions.<br>● Identify species from the results of the tests. | 4.8.3.1 |
| 8.7 | Metal hydroxides | ● Recognise the precipitate colour of metal hydroxides.<br>● Explain how to use sodium hydroxide to test for metal ions.<br>● Write balanced equations for producing insoluble metal hydroxides. | 4.8.3.2 |
| 8.8 | Tests for anions | ● Identify the tests for carbonates.<br>● Explain the tests for halides and sulfates.<br>● Identify anions and cations from the results of tests. | 4.8.3.3; 4.8.3.4; 4.8.3.5 |
| 8.9 | Required practical: Use chemical tests to identify the ions in unknown single ionic compounds | ● Describe how to carry out experiments safely using the correct manipulation of apparatus for the qualitative analysis of ions.<br>● Make and record observations using flame tests and precipitation methods.<br>● Identify unknown ions in chemical compounds. | 8.2.7; 4.8.3.5 |
| 8.10 | Instrumental methods | ● Identify advantages of instrumental methods compared with the chemical tests.<br>● Describe some instrumental techniques.<br>● Explain the data provided by instrumental techniques. | 4.8.3.6 |
| 8.11 | Flame emission spectroscopy | ● Describe flame emission spectroscopy.<br>● Identify the advantages of instrumental methods compared with the chemical tests.<br>● Interpret an instrumental result using a reference set. | 4.8.3.7 |
| 8.12 | Maths skills: Use an appropriate number of significant figures | ● Measure distances on chromatograms<br>● Calculate $R_f$ values<br>● Record $R_f$ values to an appropriate number of significant figures | MS2; 4.8; 4.1; 4.2; 4.6 |
| 9.1 | Proportions of gases in the atmosphere | ● Review the composition of the atmosphere.<br>● Measure the percentage of oxygen in the atmosphere.<br>● Consider why it stays the same. | 4.9.1.1 |
| 9.2 | The Earth's early atmosphere | ● Explore the origins of the Earth's atmosphere.<br>● Consider the evidence that ideas about the early atmosphere are based on.<br>● Consider the strength of the evidence these ideas are based on. | 4.9.1.2 |

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| 9.3 | How oxygen increased | ● Explore the processes that changed the oxygen concentration in the atmosphere.<br>● Consider the role of algae.<br>● Consider why oxygen levels in the atmosphere didn't rise when oxygen was first produced. | 4.9.1.3 |
| 9.4 | How carbon dioxide decreased | ● Explore the processes that changed the amount of carbon dioxide in the atmosphere.<br>● Find out what ice cores tell us about the atmosphere.<br>● Explore how carbon dioxide levels have changed over time. | 4.9.1.4 |
| 9.5 | Key concept: Greenhouse gases | ● Review the greenhouse effect.<br>● Explain how greenhouse gases trap heat.<br>● Consider the consequences of adding greenhouse gases to the atmosphere. | 4.9.2.1 |
| 9.6 | Human activities | ● Consider the factors that affect the quality of scientific reports.<br>● Consider the reliability of computer models.<br>● Find out what peer review involves. | 4.9.2.2 |
| 9.7 | Global climate change | ● Explore the consequences of climate change.<br>● Consider the risks to human health.<br>● Judge the seriousness of these consequences. | 4.9.2.3 |
| 9.8 | Carbon footprint and its reduction | ● Find out what a 'carbon footprint' is.<br>● Consider factors that contribute to our carbon footprints.<br>● Explore ways of reducing our carbon footprints. | 4.9.2.4 |
| 9.9 | Limitations on carbon footprint reduction | ● Review the uncertainties about carbon emissions.<br>● Consider factors that limit our ability to reduce our carbon footprints.<br>● Decide which factors are most important. | 4.9.2.4 |
| 9.10 | Atmospheric pollutants from fuels | ● Explore the products formed when fuels burn.<br>● Distinguish between complete and incomplete combustion.<br>● Write equations for complete and incomplete combustion. | 4.9.3.1 |
| 9.11 | Properties and effects of atmospheric pollutants | ● Review the hazards associated with air pollutants.<br>● Investigate correlations between pollutant emissions and deaths from asthma.<br>● Consider whether these support the hypothesis that air pollution makes asthma worse. | 4.9.3.2 |
| 9.12 | Maths skills: Use ratios, fractions and percentages | ● Consider ways of comparing the amounts of gases in the atmosphere.<br>● Review what balanced symbol equations show.<br>● Compare the yields in chemical reactions. | MS1; 4.9; 4.1; 4.2; 4.3; 4.5; 4.6; 4.8; 4.10 |
| 10.1 | Key concept: Using the Earth's resources and sustainable development | ● Give examples of natural products replaced by synthetics.<br>● Give examples of products replaced by agricultural products.<br>● Distinguish between finite and renewable resources. | 4.10.1.1 |
| 10.2 | Potable water | ● Distinguish between potable water and pure water.<br>● Describe the differences in treatment of ground water and salty water. | 4.10.1.2 |

| Chapter reference | Lesson title | Lesson objectives | AQA specification reference |
|---|---|---|---|
| | | ● Explain what is needed to provide potable water for all. | |
| 10.3 | Required practical: Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation | ● Describe how safety is managed, apparatus is used and accurate measurements are made.<br>● Recognise when sampling techniques need to be used and made representative.<br>● Carry out a procedure to produce potable water from salt solution.<br>● Evaluate methods and suggest possible improvements and further investigations. | 8.2.3; 4.10.1.2 |
| 10.4 | Waste water treatment | ● Explain how waste water is treated.<br>● Describe how sewage is treated.<br>● Compare the ease of treating waste water, groundwater and salt water. | 4.10.1.3 |
| 10.5 | Alternative methods of metal extraction | ● Describe the process of phytomining.<br>● Describe the process of bioleaching.<br>● Evaluate alternative biological methods of metal extraction. | 4.10.1.4 |
| 10.6 | Life cycle assessment and recycling | ● Describe the components of a Life Cycle Assessment (LCA).<br>● Interpret LCAs of materials or products from information.<br>● Carry out a simple comparative LCA for shopping bags. | 4.10.2.1 |
| 10.7 | Ways of reducing the use of resources | ● Describe ways of recycling and reusing materials.<br>● Explain why recycling, reusing and reducing are needed.<br>● Evaluate ways of reducing the use of limited resources. | 4.10.2.2 |
| 10.8 | Corrosion and its prevention | ● Show that air and water are needed for rusting.<br>● Describe experiments on rusting and interpret the results.<br>● Explain methods for preventing corrosion. | 4.10.3.1 |
| 10.9 | Alloys as useful materials | ● Describe the composition of common alloys.<br>● Interpret the composition of other alloys from data.<br>● Evaluate the uses of other alloys. | 4.10.3.2 |
| 10.10 | Ceramics, polymers and composites | ● Compare the properties of materials quantitatively.<br>● Compare glass, ceramics, polymers, composites and metals.<br>● Select materials by relating their properties to uses. | 4.10.3.3 |
| 10.11 | Haber process | ● Apply principles of dynamic equilibrium to the Haber process.<br>● Use graphs to explain the trade-off between rate and equilibrium.<br>● Explain how commercially used conditions relate to cost | 4.10.4.1 |
| 10.12 | Production and use of NPK fertilisers | ● Describe how to make a fertiliser in the laboratory.<br>● Explain how fertilisers are produced industrially.<br>● Compare the industrial production of fertilisers with laboratory preparation. | 4.10.4.2 |
| 10.13 | Maths skills: | ● Represent information from pie charts numerically. | MS4; 4.10; 4.2; |

| Chapter reference | Lesson title | Lesson objectives | AQA specification reference |
|---|---|---|---|
| | Translate information between graphical and numerical form | ● Represent information from graphs numerically.<br>● Represent numeric information graphically. | 4.6; 4.8 |