| **This 3-Year Scheme of Work offers a flexible approach for KS4. The suggested timings are based on three science lessons per fortnight (assuming a two week timetable of two lessons one week and one lesson in the other) but can be tailored to suit the needs of a particular class or group of students. Lessons are assumed to be sessions of 40-60 minutes. The teaching scheme is scheduled to finish in the second term of Year 11 to allow time for revision and GCSE examinations in the summer term.****Please note that some of these lessons only require partial coverage or are shorter than others and therefore sometimes there are more than three lessons in a fortnight. The maths skills spreads are numbered as the last spread in a chapter but can be used at any appropriate point according to the needs of your students.** |
| --- |
| **Year** | **Term** | **Week** | **Student Book spread number** | **Lesson title** | **Learning objectives** | **OCR specification reference** | **Lesson resources (on CD ROM)** | **Collins Connect resources** |
| **Chapter 1: Particles (7 lessons)** |
| 9 | 1 | 1/2 | 1.1 | Three states of matter | * Use data to predict the states of substances.
* Explain the changes of state.
* Use state symbols in chemical equations.
 | C1.1a–c | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 1 | 1/2 | 1.2 | Changing ideas about atoms | * Learn how models of the atom changed as scientists gathered more data.
* Consider the data Rutherford and Marsden collected.
* Link their data to our model of the atom.
 | C1.2a | Worksheets 1, 2 and 3;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 9 | 1 | 1/2 | 1.3 | Modelling the atom | * Explore the structure of atoms.
* Consider the sizes of atoms.
* Explore the way atomic radius changes with position in the periodic table.
 | C1.2b | Worksheet;Technician’s notes;Presentation;Graph plotter | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 3/4 | 1.4 | Key concept: Sizes of particles and orders of magnitude  | * Identify the scale and measurements of length.
* Explain the conversion of small lengths to metres.
* Explain the relative sizes of electrons, nuclei and atoms.
 | C1.2c | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 1 | 3/4 | 1.5 | Relating charges and masses | * Compare protons, neutrons and electrons.
* Find out why atoms are neutral.
* Relate the number of charged particles in atoms to their position in the periodic table.
 | C1.2d | Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 3/4 | 1.6 | Subatomic particles | * Find out what the periodic table tells us about each element’s atoms.
* Learn what isotopes are.
* Use symbols to represent isotopes.
 | C1.2e | Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 1 | 5/6 | 1.7 | Maths skills: Standard form and making estimates | * Consider the sizes of particles.
* Use numbers in standard form to compare sizes.
* Use numbers in standard form in calculations.
 | CM1.2 | Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 9 | 1 | 5/6 | **Assessment** | End of chapter test Student BookEnd of chapter test Collins Connect |
| **Chapter 2: Elements, compounds and mixtures (28 lessons)** |
| 9 | 1 | 5/6 | 2.1 | Key concept: Pure substances | * Describe, explain and exemplify processes of separation.
* Suggest separation and purification techniques for mixtures.
* Distinguish pure and impure substances using melting point and boiling point data.
 | C2.1a, b | Practical sheets 1 and 2;Worksheets 1 and 2;Technician’s notes 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 7/8 | 2.2 | Relative formula mass | * Review the differences between the isotopes of an element.
* Distinguish between the mass of an atom and the relative atomic mass of an element.
* Use relative atomic masses to calculate relative formula masses.
 | C2.1c | Worksheets 1, 2 and 3;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 7/8 | 2.3 | Mixtures | * Recognise that all substances are chemicals.
* Understand that mixtures can be separated into their components.
* Suggest suitable separation and purification techniques for mixtures.
 | C2.1d | Worksheets 1 and 2;Practical sheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 7/8 | 2.4 | Formulations | * Identify formulations given appropriate information.
* Explain the particular purpose of each chemical in a mixture.
* Explain how quantities are carefully measured for formulation.
 | C2.1e | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 9/10 | 2.5 | Chromatography | * Explain how to set up chromatography paper.
* Distinguish pure from impure substances.
* Interpret chromatograms and calculate Rf values.
 | C2.1f–k | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 9 | 1 | 9/10 | 2.6 | Practical: Investigate how paper chromatography can be used in forensic science to identify an ink mixture used in a forgery | * Describe the safe and correct manipulation of chromatography apparatus and how accurate measurements are achieved.
* Make and record measurements used in paper chromatography.
* Calculate Rf values.
 | PAG | Practical sheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework qu Quick starterHomework worksheetHomework quiz iz |
| 9 | 1 | 9/10 | 2.7 | Maths skills: Use an appropriate number of significant figures | * Measure distances on chromatograms.
* Calculate Rf values.
* Record Rf values to an appropriate number of significant figures.
 | CM2.1 | Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 11/12 | 2.8 | Comparing metals and non-metals | * Review the physical properties of metals and non-metals.
* Compare the oxides of metals and of non-metals.
* Make predictions about unknown metals and non-metals.
 | C2.2a | Worksheet;Practical sheet;Technician’s notes;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 11/12 | 2.9 | Electron structure  | * Find out how electrons are arranged in atoms.
* Use diagrams and symbols to show which energy levels they occupy.
* Relate each element’s electron configuration to its position in the periodic table.
 | C2.2c | Worksheets 1, 2 and 3;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 1 | 11/12 | 2.10 | Metals and non-metals | * Explore the links between electron configurations of elements and their properties.
* Find out what happens to the outer electrons when metals react.
* Draw diagrams to show how ions form.
 | C2.2b | Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 1/2 | 2.11 | Chemical bonds | * Describe the three main types of bonding.
* Explain how electrons are used in the three main types of bonding.
* Explain how bonding and properties are linked.
 | C2.2d–h | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 1/2 | 2.12 | Ionic bonding | * Represent an ionic bond with a diagram.
* Draw dot-and-cross diagrams for ionic compounds.
* Work out the charge on the ions of metals from the group number of the element.
 |  | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 1/2 | 2.13 | Ionic compounds | * Identify ionic compounds from structures.
* Explain the limitations of diagrams and models.
* Work out the empirical formula of an ionic compound.
 |  | Practical sheet;Worksheets 1, 2 and 3;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 3/4 | 2.14 | Properties of ionic compounds | * Describe the properties of ionic compounds.
* Relate their melting points to forces between ions.
* Explain when ionic compounds can conduct electricity.
 |  | Practical sheets 1 and 2;Worksheet;Technician’s notes 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 3/4 | 2.15 | Properties of small molecules | * Identify small molecules from formulae.
* Explain the strength of covalent bonds.
* Relate the intermolecular forces to the bulk properties of a substance.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 3/4 | 2.16 | Covalent bonding | * Identify single bonds in molecules and structures.
* Draw dot-and-cross diagrams for small molecules.
* Deduce molecular formulae from models and diagrams.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 5/6 | 2.17 | Giant covalent structures | * Recognise giant covalent structures from diagrams.
* Explain the properties of giant covalent structures.
* Recognise the differences in different forms of carbon.
 |  | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 5/6 | 2.18 | Polymer structures | * Recognise polymers from their unit formulae.
* Explain why some polymers can stretch.
* Explain why some plastics do not soften on heating.
 |  | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 5/6 | 2.19 | Metallic bonding | * Describe that metals form giant structures.
* Explain how metal ions are held together.
* Explain the delocalisation of electrons.
 |  | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 7/8 | 2.20 | Properties of metals and alloys | * Identify metal elements and their properties, and metal alloys.
* Describe the purpose of a tin–lead alloy.
* Explain why alloys have different properties to those of elements.
 |  | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizSlideshow 1Slideshow 2 |
| 9 | 2 | 7/8 | 2.21 | Key concept: The outer electrons | * Review the patterns in the periodic table.
* Compare the trends in Group 1 and 7.
* Relate these trends to the number of outer electrons and the sizes of atoms.
 |  | Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 7/8 | **Assessment** | End of teaching block test Collins Connect |  |  |  |
| 9 | 2 | 9/10 | 2.22 | The periodic table | * Explain how the electronic structure of atoms follows a pattern.
* Recognise that the number of electrons in an element’s atoms outer shell corresponds to the element’s group number.
* Use the periodic table to make predictions.
 | C2.2i | Worksheets 1, 2 and 3;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 9/10 | 2.23 | Developing the periodic table | * Find out how the periodic table has changed over the years.
* Explore Mendeleev’s role in its development.
* Consider the accuracy of Mendeleev’s predictions.
 |  | Worksheets 1 and 2;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 2 | 9/10 | 2.24 | Diamond | * Identify why diamonds are so hard.
* Explain how the properties relate to the bonding in diamond.
* Explain why diamond differs from graphite.
 | C2.3a–f | Worksheet | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 2 | 11/12 | 2.25 | Graphite | * Describe the structure and bonding of graphite.
* Explain the properties of graphite.
* Explain the similarity to metals.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 11/12 | 2.26 | Fullerenes and graphene | * Describe the structure of graphene.
* Explain the structure and uses of the fullerenes.
* Explain the structure of nanotubes.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 9 | 2 | 11/12 | 2.27 | Nanoparticles, their properties and uses | * Relate the sizes of nanoparticles to atoms and molecules.
* Explain that there may be risks associated with nanoparticles.
* Evaluate the use of nanoparticles for a specific purpose.
 | C2.3g–j | Worksheets 1, 2 and 3;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 3 | 1/2 | 2.28 | Maths skills: Using ratios inmixture, empirical formulae andbalanced equations | * Consider ways of comparing the amounts of gases in the atmosphere.
* Review what balanced symbol equations show.
* Compare the yields in chemical reactions.
 | CM1 | Worksheets 1and 2Technician’s notesPresentation | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 1/2 | **Assessment** | End of chapter test Student BookEnd of chapter test Collins Connect |
| **Chapter 3: Chemical reactions (27 lessons)** |
| 9 | 3 | 1/2 | 3.1 | Elements and compounds | * Identify symbols of elements from the periodic table.
* Recognise the properties of elements and compounds.
* Identify the elements in a compound.
 | C3.1a | Worksheets 1 and 2;Practical sheet;Technician notes | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 3/4 | 3.2 | Atoms, formulae and equations | * Learn the symbols of the first 20 elements in the periodic table.
* Use symbols to describe elements and compounds.
* Use formulae to write equations.
 | C3.1b, c | Worksheets 1, 2 and 3;Practical sheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 3 | 3/4 | 3.3 | Moles | * Describe the measurements of amounts of substances in moles.
* Calculate the amount of moles in a given mass of a substance.
* Calculate the mass of a given number of moles of a substance.
 | C3.1g–i | Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 9 | 3 | 3/4 | 3.4 | Key concept: Conservation of mass and balanced equations | * Explore ideas about the conservation of mass.
* Consider what the numbers in equations stand for.
* Write balanced symbol equations.
 | Key ConceptC3.1d–f | Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 3 | 5/6 | 3.5 | Key concept: Amounts in chemistry | * Use atomic masses to calculate formula masses.
* Explain how formula mass relates to the number of moles.
* Explain how the number of moles relates to other quantities.
 | Key Concept | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 5/6 | 3.6 | Mass changes when gases are in reactions | * Find out how mass can be gained or lost during a reaction.
* Find the mass of carbon dioxide released per gram of copper carbonate decomposed.
* Assess the accuracy of our measurements.
 | C3.1j | Worksheet;Practical sheet;Technician’s notes;Presentations 1 and 2;Graph plotter | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 5/6 | 3.7 | Using moles to balance equations | * Convert masses in grams to amounts in moles.
* Balance an equation given the masses of reactants and products.
* Change the subject of a mathematical equation.
 | C3.1k | Worksheet | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 7/8 | 3.8 | Key concept: Limiting reactants and molar masses | * Recognise when one reactant is in excess.
* Consider how this affects the amount of product made.
* Explore ways of increasing the amount of product.
 | Key Concept | Technician’s notes;Practical sheet;Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 9 | 3 | 7/8 | 3.9 | Amounts of substances in equations | * Calculate the masses of substances in a balanced symbol equation.
* Calculate the masses of reactants and products from balanced symbol equations.
* Calculate the mass of a given reactant or product.
 | C3.1l | Worksheet | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 7/8 | 3.10 | Endothermic and exothermic reactions | * Explore the temperature changes produced by chemical reactions.
* Consider how reactions are used to heat or cool their surroundings.
* Investigate how these temperature changes can be controlled.
 | C3.2a | Technician’s notes;Practical sheet;Worksheet;Graph plotters 1 and 2 | Quick starterHomework worksheetHomework quizSlideshow |
| 9 | 3 | 9/10 | 3.11 | Reaction profiles | * Use diagrams to show the energy changes during reactions.
* Show the difference between exothermic and endothermic reactions using energy profiles.
* Find out why many reactions start only when energy or a catalyst is added.
 | C3.2b, c | Technician’s notes;Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 9 | 3 | 9/10 | 3.12 | Energy change of reactions  | * Identify the bonds broken and formed during a chemical reaction.
* Consider why some reactions are exothermic and others are endothermic.
* Use bond energies to calculate overall energy changes.
 | C3.2d | Technician’s notes;Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 3 | 9/10 | 3.13 | Maths skill: Recognise and use expressions in decimal form | * Read scales in integers and using decimals.
* Calculate the energy change during a reaction.
* Calculate energy transferred for comparison.
 | CM3.2 | Practical sheet;Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 9 | 3 | 11/12 | 3.14 | Oxidation and reduction in terms of electrons | * Observe some reactions between metal atoms and metal ions.
* Learn to write ionic equations and half equations.
* Classify half equations as oxidation or reduction.
 | C3.3a, b | Technician’s notes;Practical sheet;Worksheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 9 | 3 | 11/12 | 3.15 | Key concept: Electron transfer, oxidation and reduction | * Review ion formation.
* Classify half equations as oxidation or reduction.
* Review patterns in reactivity.
 | Key ConceptC3.3c | Worksheet;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 9 | 3 | 11/12 | 3.16 | Neutralisation of acids and salt production | * React an acid and an alkali to make a salt.
* Predict the formulae of salts.
* Write balanced symbol equations.
 | C3.3d | Technician’s notes;Practical sheet;Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 10 | 1 | 1/2 | 3.17 | Soluble salts | * React an acid and a metal to make a salt.
* Predict the formulae of salts.
* Write balanced symbol equations and half equations.
 |  | Technician’s notes;Practical sheet;Worksheets 1 and 2;Presentation and 2 | Quick starterHomework worksheetHomework quizVideo |
| 10 | 1 | 1/2 | 3.18 | Reaction of metals with acids | * React an acid and a metal to make a salt.
* Predict the formulae of salts.
* Write balanced symbol equations and half equations.
 |  | Technician’s notes;Practical sheet;Worksheets 1 and 2;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 1/2 | 3.19 | Practical: Preparing a pure, dry sample of a soluble salt from an insoluble oxide or carbonate | * React a carbonate with an acid to make a salt.
* Describe each step in the procedure.
* Determine the purity of the product.
 | PAG | Technician’s notes;Practical sheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 3/4 | 3.20 | pH and neutralisation | * Estimate the pH of solutions.
* Identify weak and strong acids and alkalis.
* Investigate pH changes when a strong acid neutralises a strong alkali.
 | C3.3g–k | Technician’s notes 1, 2 and 3;Practical sheet;Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 3/4 | 3.21 | Strong and weak acids | * Explore the factors that affect the pH of an acid.
* Find out how the pH changes when an acid is diluted.
* Find out how the concentrations of solutions are measured.
 |  | Worksheet | Quick starterHomework worksheetHomework quizVideo |
| 10 | 1 | 3/4 | 3.22 | Maths skill: Make order of magnitude calculations | * Explore the factors that affect the acidity of rain.
* Find out how acid concentrations are compared.
* Explore the link between hydrogen ion concentration and pH.
 | CM3.3 | Technician’s notes;Practical sheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 5/6 | 3.23 | 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.
* Devise an investigation to test your hypothesis.
* Decide whether the evidence supports your hypothesis.
 | PAG | Technician’s notes;Practical sheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 5/6 | 3.24 | The process of electrolysis | * Explore what happens when a current passes through a solution of ions.
* Find out what an electrolyte is and what happens when it conducts electricity.
* Find out how electricity decomposes compounds.
 | C3.4a | Technician’s notes;Practical sheet;Worksheet;Presentation | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 10 | 1 | 5/6 | 3.25 | Electrolysis of molten ionic compounds | * Look in detail at the electrolysis of lead bromide.
* Communicate the science behind the extraction of elements from molten salts.
* Write balanced half equations for electrolysis reactions.
 | C3.4b | Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 7/8 | 3.26 | Electrolysis of aqueous solutions | * Investigate the products formed when copper sulfate is electrolysed.
* Predict what products other solutions will give.
* Write half equations for reactions at electrodes.
 | C3.4c–e | Technician’s notes;Worksheet;Practical sheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 7/8 | 3.27 | Practical: Investigating what happens when aqueous solutions are electrolysed using inert electrodes | * Devise a hypothesis.
* Devise an investigation to test your hypothesis.
* Decide whether the evidence supports your hypothesis.
 | PAG | Technician’s notes;Practical sheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 7/8 | **Assessment** |  | End of chapter test Student BookEnd of chapter test Collins ConnectEnd of teaching block test Collins ConnectEnd of year test Collins Connect |
| **Chapter 4:** **Predicting and identifying reactions and products (12 lessons)** |
| 10 | 1 | 9/10 | 4.1 | Exploring Group 0 | * Explore the properties of noble gases.
* Find out how the mass of their atoms affects their boiling points.
* Relate their chemical properties to their electronic structures.
 | C4.1a, b | Worksheet;Graph plotter 1;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 1 | 9/10 | 4.2 | Exploring Group 1 | * Explore the properties of Group 1 metals.
* Compare their reactivity.
* Relate their reactivity to their electronic structures.
 |  | Worksheets 1, 2 and 3;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 9/10 | 4.3 | Exploring Group 7 | * Explain why Group 7 non-metals are known as ‘halogens’.
* Compare their reactivity.
* Relate their reactivity to their electronic structures.
 |  | Worksheets 1, 2 and 3;Technician’s notes 1 and 2;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 1 | 11/12 | 4.4 | Transition metals | * Compare the properties of transition metals with those of Group 1 metals.
* Explore the uses of transition metals.
* Find out why they can form compounds with different colours.
 | C4.1c | Worksheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 1 | 11/12 | 4.5 | Reaction trends and predicting reactions | * Review the patterns in the periodic table.
* Compare the trends in Group 1 and Group 7.
* Relate these trends to the way atoms form ions.
 | C4.1d | Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 1 | 11/12 | 4.6 | Reactivity series | * Compare the reactivity of metals.
* Observe some reactions between metal atoms and metal ions.
* Consider why some metals are more reactive than others.
 | C4.1e, f | Practical sheet;Worksheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 2 | 1/2 | 4.7 | Tests for gases | * Recall the tests for four common gases.
* Identify the four common gases using these tests.
* Explain why limewater can be used to detect carbon dioxide.
 | C4.2a | Practical sheet;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 1/2 | 4.8 | Metal hydroxides | * Recognise the precipitate colour of metal hydroxides.
* Explain how to use sodium hydroxide to test for metal ions.
* Write balanced equations for producing insoluble metal hydroxides.
 | C4.2b–d | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 2 | 1/2 | 4.9 | Tests for anions | * Identify the tests for carbonates.
* Explain the tests for halides and sulfates.
* Identify anions and cations from the results of tests.
 |  | Practical sheets 1 and 2;Worksheet;Technician’s notes 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 3/4 | 4.10 | Flame tests | * Carry out flame-test procedures.
* Identify the colours of flames of ions.
* Identify species from the results of the tests.
 | C4.2e | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 3/4 | 4.11 | Instrumental methods | * Identify advantages of instrumental methods compared with the chemical tests.
* Describe some instrumental techniques.
* Explain the data provided by instrumental techniques.
 | C4.2f, g | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizSlideshowVideo |
| 10 | 2 | 3/4 | 4.12 | 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.
* Make and record observations using flame tests and precipitation methods.
* Identify unknown ions in chemical compounds.
 | PAG | Practical sheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 5/6 | **Assessment** |  | End of chapter test Student BookEnd of chapter test Collins Connect |
| **Chapter 5: Monitoring and controlling chemical reactions (20 lessons)** |
| 10 | 2 | 5/6 | 5.1 | Concentration of solutions | * Relate mass, volume and concentration.
* Calculate the mass of solute in solution.
* Relate concentration in mol/dm3 to mass and volume.
 | C5.1a–c | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 5/6 | 5.2 | Using concentrations of solutions | * Describe how to carry out titrations.
* Calculate concentrations in titrations in mol/dm3 and in g/dm3.
* Explain how the concentration of a solution in mol/dm3 is related to the mass of the mass of the solute and the volume of the solution.
 |  | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 2 | 7/8 | 5.3 | Practical: Finding the reacting volumes of solutions of acid and alkali by titration | * Use an acid to neutralise a known volume of alkali.
* Use a burette to determine the volume of an acid needed.
* Use the results to determine the concentration of an alkali.
 |  | Technician’s notes;Practical sheet;Presentation and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 7/8 | 5.4 | 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).
* Calculate the volume of a gas at rtp from its mass and relative formula mass.
* Calculate the volumes of gases from a balanced equation and a given volume of a reactant or product.
 | C5.1d–f | Practical sheet 3.12;Worksheet 3.12;Technician’s notes 3.12 | Quick starterHomework worksheetHomework quizVideo |
| 10 | 2 | 7/8 | 5.5 | Key Concept: Percentage yield | * Calculate the percentage yield from the actual yield.
* Identify the balanced equation needed for calculating yields.
* Calculate theoretical product amounts from reactant amounts.
 | Key ConceptC5.1g, h | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 10 | 2 | 9/10 | 5.6 | Atom economy | * Identify the balanced equation of a reaction.
* Calculate the atom economy of a reaction to form a product.
* Explain why a particular reaction pathway is chosen.
 | C5.1i–k | Worksheets 1 and 2. | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 9/10 | 5.7 | Maths skills: Change the subject of an equation | * Use equations to demonstrate conservation.
* Rearrange the subject of an equation.
* Carry out multi-step calculations.
 | CM5.1 | Worksheet | Quick starterHomework worksheetHomework quizVideo |
| 10 | 2 | 9/10 | 5.8 | Measuring rates | * Measure the volume of gas given off during a reaction.
* Use the results to measure the reaction rate.
* Explore how the rate changes during the reaction.
 | C5.2a | Technician’s notes;Practical sheet;Worksheet;Presentation 1 and 2;Graph plotter 1 | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 11/12 | 5.9 | Calculating rates | * Find out how to calculate rates of reaction.
* Use graphs to compare reaction rates.
* Use tangents to measure rates that change.
 | C5.2b | Technician’s notes;Practical sheet;Worksheet;Presentations 1 and 2  | Quick starterHomework worksheetHomework quiz |
| 10 | 2 | 11/12 | 5.10 | Factors affecting rates | * Measure the time taken to produce a specific amount of product.
* See how a reactant’s temperature or concentration can affect this time.
* Investigate the effect of breaking up a solid reactant into smaller pieces.
 | C5.2c | Technician’s notes;Practical sheet;Worksheets 1 and 2;Graph plotter 1;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 10 | 2 | 11/12 | 5.11 | Collision theory | * Find out about the collision theory.
* Use collision theory to make predictions about reaction rates.
* Relate activation energies to collision theory.
 | C5.2d | Worksheets 1 and 2;Presentations 1 and 2  | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 1/2 | 5.12 | Catalysts | * Investigate catalysts.
* Find out how catalysts work.
* Learn how they affect activation energy.
 | C5.2f–i | Technician’s notes;Practical sheet;Worksheet | Quick starterHomework worksheetHomework quizVideos |
| 10 | 3 | 1/2 | 5.13 | Factors increasing the rate | * Interpret graphs.
* Consider what determines the reaction rate.
* Explore the effect of changing the amounts of reactants used.
 | C5.2e | Technician’s notes;Practical sheet;Worksheet;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 3 | 1/2 | 5.14 | 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.
* Devise an investigation to test a hypothesis.
* Decide whether the evidence supports a hypothesis.
 | PAG | Technician’s notes;Practical sheets 1 and 2;Presentations 1 and 2;Graph plotter 1 | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 3/4 | 5.15 | Reversible reactions and energy changes | * Investigate reversible reactions.
* Explore the energy changes in a reversible reaction.
* Find out how reaction conditions affect reversible reactions.
 | C5.3a | Technician’s notes;Practical sheet;Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 3/4 | 5.16 | Equilibrium | * Recognise reactions that can reach equilibrium.
* Find out what happens to the reactants and products at equilibrium.
* Use Le Chatelier’s principle to make predictions.
 | C5.3b | Technician’s notes;Worksheet;Presentation  | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 3/4 | 5.17 | Changing concentration and equilibrium | * Distinguish between reactants and products.
* Explore how changing their concentrations affects reversible reactions.
* Use Le Chatelier’s principle to make predictions about changing concentrations.
 | C5.3c | Technician’s notes;Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 5/6 | 5.18 | Changing temperature and equilibrium | * Distinguish between exothermic and endothermic forward reactions.
* Explore how changing the temperature affects reversible reactions.
* Use Le Chatelier’s principle to make predictions about changing temperatures.
 |  | Technician’s notes;Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 5/6 | 5.19 | Changing pressure and equilibrium | * Recognise the number of product and reactant molecules in a reaction.
* Explore how changing the pressure affects reversible reactions.
* Use Le Chatelier’s principle to make predictions about changing pressures.
 |  | Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 5/6 | 5.20 | Maths skills: Use the slope of a tangent as a measure of rate of change | * Practice drawing graphs.
* Use graphs to compare reaction rates.
* Use tangents to measure rates that change.
 | CM5.3 | Worksheets 1 and 2;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 10 | 3 | 7/8 | **Assessment** |  | End of chapter test Student BookEnd of chapter test Collins ConnectEnd of teaching block test Collins Connect |
| **Chapter 6: Global Challenges (42 lessons)** |
| 10 | 3 | 7/8 | 6.1 | Extraction of metals | * Find out where metals come from.
* Extract iron from its oxide using carbon.
* Consider how other metals are extracted from their ores.
 | C6.1a, b | Technician’s notes;Practical sheet;Worksheet;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 3 | 7/8 | 6.2 | Using electrolysis to extract metals | * Review the connection between the reactivity series and the ways metals are extracted.
* Consider how aluminium is extracted from aluminium oxide.
* Learn the oxidation and reduction reactions involved.
 |  | Worksheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizSlideshow |
| 10 | 3 | 9/10 | 6.3 | Alternative methods of metal extraction | * Describe the process of phytomining.
* Describe the process of bioleaching.
* Evaluate alternative biological methods of metal extraction.
 | C6.1c | Practical sheet;Worksheets 1 and 2;Technician’s notes. | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 9/10 | 6.4 | The Haber process | * Apply principles of dynamic equilibrium to the Haber process.
* Use graphs to explain the trade off with rate and equilibrium.
* Explain how commercially used conditions relate to cost.
 | C6.1d–g | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 9/10 | 6.5 | Production and use of NPK fertilisers | * Describe how to make a fertiliser in the laboratory.
* Explain how fertilisers are produced industrially.
* Compare the industrial production with laboratory preparation.
 | C6.1h | Practical sheet;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 11/12 | 6.6 | Life cycle assessment and recycling | * Describe the components of a life cycle assessment (LCA).
* Interpret LCAs of materials or products from information.
* Carry out a simple comparative LCA for shopping bags.
 | C6.1i–l | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 10 | 3 | 11/12 | 6.7 | Ways of reducing the use of resources | * Describe ways of recycling and reusing materials.
* Explain why recycling, reusing and reducing are needed.
* Evaluate ways of reducing the use of limited resources.
 |  | Worksheets 1 and 2. | Quick starterHomework worksheetHomework quizVideo |
| 10 | 3 | 11/12 | 6.8 | Alloys as useful materials | * Describe the composition of common alloys.
* Interpret the composition of other alloys from data.
* Evaluate the uses of other alloys.
 | C6.1m | Worksheets 1, 2 and 3 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 1/2 | 6.9 | Corrosion and its prevention | * Show that air and water are needed for rusting.
* Describe experiments and interpret results on rusting.
* Explain methods for preventing corrosion.
 | C6.1n, o | Practical sheets 1 and 2;Worksheets 1 and 2;Technician’s notes 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 1/2 | 6.10 | Ceramics, polymers and composites | * Compare quantitatively properties of materials.
* Compare glass, ceramics, polymers, composites and metals.
* Select materials by relating their properties to uses.
 | C6.1p | Worksheets 1, 2 and 3 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 1/2 | 6.11 | Maths skill: Translate information between graphical and numerical form | * Represent information from pie charts numerically.
* Represent information from graphs numerically.
* Represent numeric information graphically.
 | CM6.1 | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 3/4 | 6.12 | Function groups and homologous series | * Identify the first four hydrocarbons in the alkane series.
* Name the first four compounds in homologous series.
* Identify the functional group of a series.
 | C6.2a, C6.2b | Worksheet | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 3/4 | 6.13 | Structure and formulae of alkenes | * Describe the difference between an alkane and an alkene.
* Draw the displayed structural formulae for the first four members of the alkenes.
* Explain why alkenes are called unsaturated molecules.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 3/4 | 6.14 | Reaction of alkenes | * Describe the addition reactions of alkenes.
* Draw the full displayed structural formulae of the products alkenes make.
* Explain how alkenes react with hydrogen, water and the halogens.
 |  | Practical sheet; Worksheets 1 and 2; Technician's notes  | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 5/6 | 6.15 | Alcohols | * Recognise alcohols from their name or from given formulae.
* Describe the conditions used for the fermentation of sugar using yeast.
* Write balanced chemical equations for the combustion of alcohols.
 |  | Practical sheets 1 and 2; Worksheets 1 and 2; Technician's notes  | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 5/6 | 6.16 | Carboxylic acids | * Describe the reactions of carboxylic acids.
* Recognise carboxylic acids from their formulae.
* Explain the reaction of ethanoic acid with an alcohol.
 |  | Practical sheet; Worksheets 1 and 2; Technician's notes | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 5/6 | 6.17 | Addition polymerisation | * Recognise addition polymers and monomers from diagrams.
* Draw diagrams of the formation of a polymer from an alkene.
* Relate the repeating unit of the polymer to the monomer.
 | C6.2a–g | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 7/8 | 6.18 | Condensation polymerisation | * Explain the basic principles of condensation polymerisation.
* Explain the role of functional groups in producing a condensation polymer.
* Explain the structure of the repeating units in a condensation polymer.
 |  | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 7/8 | 6.19 | Amino acids | * Describe the functional group of an amine.
* Identify the two functional groups of an amino acid.
* Explain how different amino acids build proteins.
 |  | Worksheet | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 7/8 | 6.20 | DNA and other naturally occurring polymers | * Describe the components of natural polymers.
* Explain the structure of proteins and carbohydrates.
* Explain how a molecule of DNA is constructed.
 | C6.2h, i | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 9/10 | 6.21 | Crude oil, hydrocarbons and alkanes | * Describe why crude oil is a finite resource.
* Identify the hydrocarbons in the series of alkanes.
* Explain the structure and formulae of the alkanes.
 | C6.2l–o | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 9/10 | 6.22 | Fractional distillation and petrochemicals | * Describe how crude oil is used to provide modern materials.
* Explain how crude oil is separated by fractional distillation.
* Explain why the boiling points of the fractions are different.
 | C6.2j, k | Practical sheet;Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 9/10 | 6.23 | Properties of hydrocarbons | * Describe how different hydrocarbon fuels have different properties.
* Identify the properties that influence the use of fuels.
* Explain how the properties are related to the size of the molecules.
 |  | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 1 | 11/12 | 6.24 | Cracking and alkenes | * Describe the usefulness of cracking.
* Balance chemical equations as examples of cracking.
* Explain why modern life depends on the uses of hydrocarbons.
 |  | Practical sheet; WorksheetTechnician’s notes | Quick starterHomework worksheetHomework quizSlideshow 1Slideshow 2 |
| 11 | 1 | 11/12 | 6.25 | Cells and batteries | * Make simple cells and measure their voltages.
* Consider the importance of cells and batteries.
* Find out how larger voltages can be produced.
 | C6.2p | Technician’s notes;Practical sheet;Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 1 | 11/12 | 6.26 | Fuel cells | * Find out how fuel cells work.
* Compare and contrast the uses of hydrogen fuel cells, batteries and rechargeable cells.
* Learn what reactions take place inside hydrogen fuel cells.
 | C6.2q | Technician’s notes;Worksheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 1/2 | 6.27 | Key concept: Intermolecular forces | * Identify the bonds within a molecule and the forces between molecules.
* Explain changes of state.
* Explain how polymer structure determines its ability to stretch.
 | Key Concept | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 1/2 | 6.28 | Maths skills: Visualise and represent 3D models | * Use 3D models to represent hydrocarbons.
* Use 3D models to represent polymers.
* Use 3D models to represent large biological molecules.
 | CM6.2 | Worksheets 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 1/2 | 6.29 | Proportions of gases in the atmosphere | * Review the composition of the atmosphere.
* Measure the percentage of oxygen in the atmosphere.
* Consider why it stays the same.
 | C6.3a | Worksheets 1 and 2;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 3/4 | 6.30 | The Earth’s early atmosphere | * Explore the origins of the Earth’s atmosphere.
* Consider the evidence that ideas about the early atmosphere are based on.
* Consider the strength of the evidence these ideas are based on.
 |  | Worksheet | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 3/4 | 6.31 | How oxygen increased | * Explore the processes that changed the oxygen concentration in the atmosphere.
* Consider the role of algae.
* Consider why oxygen levels in the atmosphere didn’t rise when oxygen was first produced.
 | C6.3b | Worksheet;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 11 | 2 | 3/4 | 6.32 | Greenhouse gases | * Review the greenhouse effect.
* Explain how greenhouse gases trap heat.
* Consider the consequences of adding greenhouse gases to the atmosphere.
 | Key conceptC6.3c–f | Worksheet;Presentation | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 5/6 | 6.33 | Human activities | * Consider the factors that affect the quality of scientific reports.
* Consider the reliability of computer models.
* Find out what peer review involves.
 |  | Worksheet;Presentations 1 and 2 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 5/6 | 6.34 | Global climate change | * Explore the consequences of climate change.
* Consider the risks to human health.
* Judge the seriousness of these consequences.
 |  | Worksheet;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 11 | 2 | 5/6 | 6.35 | Carbon footprint and its reduction | * Find out what a carbon footprint is.
* Consider factors that contribute to our carbon footprints.
* Explore ways of reducing our carbon footprints.
 |  | Worksheet;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 7/8 | 6.36 | Limitations on carbon footprint reduction | * Review the uncertainties about carbon emissions.
* Consider factors which limit our ability to reduce our carbon footprints.
* Decide which factors are most important.
 |  | Worksheets 1 and 2;Presentation | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 7/8 | 6.37 | Atmospheric pollutants from fuels | * Explore the products formed when fuels burn.
* Distinguish between complete and incomplete combustion.
* Write equations for complete and incomplete combustion.
 |  | Worksheets 1, 2, 3 and 4;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizSlideshow |
| 11 | 2 | 7/8 | 6.38 | Properties and effects of atmospheric pollutants | * Review the hazards associated with air pollutants.
* Investigate correlations between pollutant emissions and deaths from asthma.
* Consider whether these support the hypothesis that air pollution makes asthma worse.
 |  | Worksheets 1 and 2;Presentations 1 and 2 | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 9/10 | 6.39 | Potable water | * Distinguish between potable water and pure water.
* Describe the differences in treatment of ground water and salty water.
* Explain what is needed to provide potable water for all.
 | C6.3g–j | Worksheets 1, 2 and 3;Technician’s notes | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 9/10 | 6.40 | Waste water treatment | * Explain how waste water is treated.
* Describe how sewage is treated.
* Compare the ease of treating waste, ground and salt water.
 |  | Worksheets 1, 2 and 3 | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 9/10 | 6.41 | 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.
* Recognise when sampling techniques need to be used and made representative.
* Carry out a procedure to produce potable water from salt solution.
* Evaluate methods and suggest possible improvements and further investigations.
 | PAG | Practical sheets 1 and 2;Worksheet;Technician’s notes | Quick starterHomework worksheetHomework quiz |
| 11 | 2 | 11/12 | 6.42 | Maths skills: Use ratios, fractions and percentages | * Consider ways of comparing the amounts of gases in the atmosphere.
* Review what balanced symbol equations show.
* Compare the yields in chemical reactions.
 | CM6.3 | Worksheets 1 and 2;Technician’s notes;Presentation | Quick starterHomework worksheetHomework quizVideo |
| 11 | 2 | 11/12 | **Assessment** | End of chapter test Student BookEnd of chapter test Collins ConnectEnd of teaching block test Collins ConnectEnd of year test Collins ConnectEnd of course test Collins Connect |