| **Lesson** | **Lesson title** | **Lesson objectives** |
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| TOPIC 1 – ATOMIC STRUCTURE AND THE PERIODIC TABLE | | |
| 1.1 | Elements and compounds | Identify symbols of elements from the periodic table  Recognise the properties of elements and compounds.  Identify the elements in a compound |
| 1.2 | 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. |
| 1.3 | Mixtures | Recognise that all substances are chemicals  Understand that mixtures can be separated into their components  Suggest suitable separation and purification techniques for mixtures. |
| 1.4 | 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. |
| 1.5 | 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. |
| 1.6 | 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. |
| 1.7 | Sub-atomic particles | Find out what the periodic table tells us about each element’s atoms.  Learn what isotopes are.  Use symbols to represent isotopes. |
| 1.8 | Electronic structure | Find out how electrons are arranged in atoms.  Use diagrams and symbols to show which energy levels they occupy.  Use number notation to represent electronic structure. |
| 1.9 | 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. |
| 1.10 | 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. |
| 1.11 | 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. |
| 1.12 | 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. |
| 1.13 | Key concept: The outer electrons | Review the patterns in the periodic table.  Compare the trends in Group 1 and Group 7.  Relate these trends to the number of outer electrons and the sizes of atoms. |
| 1.14 | 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. |
| 1.15 | Exploring Group 1 | Explore the properties of Group 1 metals.  Compare their reactivity.  Relate their reactivity to their electronic structures. |
| 1.16 | Exploring Group 7 | Explain why Group 7 non-metals are known as ‘halogens’.  Compare their reactivity.  Relate their reactivity to their electronic structures. |
| 1.17 | 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. |
| 1.18 | 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. |
| 1.19 | 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. |
| TOPIC 2 – STRUCTURE AND BONDING | | |
| 2.1 | 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. |
| 2.2 | 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. |
| 2.3 | Ionic compounds | Identify ionic compounds from structures.  Explain the limitations of diagrams and models.  Work out the empirical formula of an ionic compound. |
| 2.4 | Covalent bonding | Identify single bonds in molecules and structures.  Draw dot- and-cross diagrams for small molecules.  Deduce molecular formulae from models and diagrams. |
| 2.5 | Metallic bonding | Describe why metals form giant structures.  Explain how metal ions are held together.  Explain the delocalisation of electrons. |
| 2.6 | Three states of matter | Use data to predict the states of substances.  Explain the changes of state.  Use state symbols in chemical equations. |
| 2.7 | 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. |
| 2.8 | 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. |
| 2.9 | Polymer structures | Recognise polymers from their unit formulae.  Explain why some polymers can stretch.  Explain why some plastics do not soften on heating. |
| 2.10 | Giant covalent structures | Recognise giant covalent structures from diagrams.  Explain the properties of giant covalent structures.  Recognise the differences in different forms of carbon. |
| 2.11 | 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. |
| 2.12 | Diamond | Identify why diamonds are so hard.  Explain how the properties relate to the bonding in diamond.  Explain why diamond differs from graphite. |
| 2.13 | Graphite | Describe the structure and bonding of graphite.  Explain the properties of graphite.  Explain the similarity to metals. |
| 2.14 | Graphene and fullerenes | Describe the structure of graphene.  Explain the structure and uses of the fullerenes.  Explain the structure of nanotubes. |
| 2.15 | 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 specific purposes. |
| 2.16 | 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. |
| 2.17 | Maths skills: Visualise and represent 2D and 3D shapes | Use two-dimensional (2D) diagrams and 3D models to:  ○ represent atoms, molecules and ionic structure  ○ represent giant covalent structures  ○ calculate empirical formulae of ionic structures. |
| TOPIC 3 – CHEMICAL QUANTITIES AND CALCULATIONS | | |
| 3.1 | 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. |
| 3.2 | 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. |
| 3.3 | 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. |
| 3.4 | Chemical measurements and uncertainty | Explore ideas about the accuracy of measurements.  Consider how closely measurements reflect true values.  Explore ways of estimating the uncertainty in a set of measurements. |
| 3.5 | 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. |
| 3.6 | 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. |
| 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. |
| 3.8 | Concentration of solutions | Relate mass, volume and concentration.  Calculate the mass of solute in solution.  Relate concentration in mol/dm3 to mass and volume. |
| 3.9 | 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. |
| 3.10 | 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. |
| 3.11 | 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 solute and 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).  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. |
| 3.13 | 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. |
| 3.14 | Maths skills: Change the subject of an equation | Use equations to demonstrate conservation.  Rearrange the subject of an equation.  Carry out multi-step calculations. |
| TOPIC 4 – CHEMICAL CHANGES | | |
| 4.1 | Metal oxides | Explore what happens when metals burn or corrode.  Classify chemical changes as oxidation or reduction.  Review the properties of metal oxides. |
| 4.2 | 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. |
| 4.3 | 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. |
| 4.4 | 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. |
| 4.5 | Reaction of metals with acids | React an acid and a metal to make a salt.  Predict the formulas of salts.  Write balanced symbol equations and half equations. |
| 4.6 | 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. |
| 4.7 | Soluble salts | React an acid and a metal to make a salt.  Predict the formulae of salts.  Write balanced symbol equations and half equations. |
| 4.8 | Required 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. |
| 4.9 | 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. |
| 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.  Use a burette to determine the volume of an acid needed.  Use the results to determine the concentration of an alkali. |
| 4.11 | 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. |
| 4.12 | 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. |
| 4.13 | 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. |
| 4.14 | 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. |
| 4.15 | 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 |
| 4.16 | Required 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. |
| 4.17 | Key concept: Electron transfer, oxidation and reduction | Review ion formation.  Classify half equations as oxidation or reduction.  Review patterns in reactivity. |
| 4.18 | Maths skills: 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. |
| TOPIC 5 – ENERGY CHANGES | | |
| 5.1 | Key concept: 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. |
| 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.  Devise an investigation to test your hypothesis.  Decide whether the evidence supports your hypothesis. |
| 5.3 | 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. |
| 5.4 | 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. |
| 5.5 | 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. |
| 5.6 | 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. |
| 5.7 | Maths skills: 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. |
| TOPIC 6 – RATE AND EXTENT OF CHEMICAL CHANGE | | |
| 6.1 | 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. |
| 6.2 | 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. |
| 6.3 | Calculating rates | Find out how to calculate rates of reaction.  Use graphs to compare reaction rates.  Use tangents to measure rates that change. |
| 6.4 | 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. |
| 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.  Devise an investigation to test a hypothesis.  Decide whether the evidence supports a hypothesis. |
| 6.6 | Factors increasing the rate | Interpret graphs.  Consider what determines the reaction rate.  Explore the effect of changing the amounts of reactants used. |
| 6.7 | Collision theory | Find out about the collision theory.  Use collision theory to make predictions about reaction rates.  Relate activation energies to collision theory. |
| 6.8 | Catalysts | Investigate catalysts.  Find out how catalysts work.  Learn how they affect activation energy. |
| 6.9 | Reversible reactions and energy changes | Investigate reversible reactions.  Explore the energy changes in a reversible reaction.  Find out how reaction conditions affect reversible reactions. |
| 6.10 | 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. |
| 6.11 | 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. |
| 6.12 | 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. |
| 6.13 | 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. |
| 6.14 | 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. |
| TOPIC 7 - HYDROCARBONS | | |
| 7.1 | 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. |
| 7.2 | 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. |
| 7.3 | 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. |
| 7.4 | Combustion | Describe the process of complete combustion.  Balance equations showing the combustion of hydrocarbons.  Explain the consequences of incomplete combustion. |
| 7.5 | 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. |
| 7.6 | 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. |
| 7.7 | Reactions 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. |
| 7.8 | 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. |
| 7.9 | Carboxylic acids | Describe the reactions of carboxylic acids.  Recognise carboxylic acids from their formulae.  Explain the reaction of ethanoic acid with an alcohol. |
| 7.10 | 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. |
| 7.11 | 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. |
| 7.12 | 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. |
| 7.13 | 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. |
| 7.14 | 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. |
| 7.15 | Maths skills: Visualise and represent 3D models | Use three-dimensional (3D) models to represent hydrocarbons, polymers and large biological molecules. |
| TOPIC 8 – CHEMICAL ANALYSIS | | |
| 8.1 | 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. |
| 8.2 | Formulations | Identify formulations given appropriate information.  Explain the particular purpose of each chemical in a mixture.  Explain how quantities are carefully measured for formulation. |
| 8.3 | Chromatography | Explain how to set up chromatography paper.  Distinguish pure from impure substances.  Interpret chromatograms and calculate *R*f values. |
| 8.4 | Required 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 *R*f values. |
| 8.5 | Test 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. |
| 8.6 | Flame tests | Carry out flame-test procedures.  Identify the colours of flames of ions.  Identify species from the results of the tests. |
| 8.7 | 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. |
| 8.8 | Tests for anions | Identify the tests for carbonates.  Explain the tests for halides and sulfates.  Identify anions and cations from the results of tests. |
| 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.  Make and record observations using flame tests and precipitation methods.  Identify unknown ions in chemical compounds. |
| 8.10 | Instrumental methods | Identify advantages of instrumental methods compared with the chemical tests.  Describe some instrumental techniques.  Explain the data provided by instrumental techniques. |
| 8.11 | Flame emission spectroscopy | Describe flame emission spectroscopy.  Identify the advantages of instrumental methods compared with the chemical tests.  Interpret an instrumental result using a reference set. |
| 8.12 | 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 |
| TOPIC 9 – THE ATMOSPHERE | | |
| 9.1 | 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. |
| 9.2 | 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. |
| 9.3 | 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. |
| 9.4 | How carbon dioxide decreased | Explore the processes that changed the amount of carbon dioxide in the atmosphere.  Find out what ice cores tell us about the atmosphere.  Explore how carbon dioxide levels have changed over time. |
| 9.5 | Key concept: Greenhouse gases | Review the greenhouse effect.  Explain how greenhouse gases trap heat.  Consider the consequences of adding greenhouse gases to the atmosphere. |
| 9.6 | Human activities | Consider the factors that affect the quality of scientific reports.  Consider the reliability of computer models.  Find out what peer review involves. |
| 9.7 | Global climate change | Explore the consequences of climate change.  Consider the risks to human health.  Judge the seriousness of these consequences. |
| 9.8 | 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. |
| 9.9 | Limitations on carbon footprint reduction | Review the uncertainties about carbon emissions.  Consider factors that limit our ability to reduce our carbon footprints.  Decide which factors are most important. |
| 9.10 | Atmospheric pollutants from fuels | Explore the products formed when fuels burn.  Distinguish between complete and incomplete combustion.  Write equations for complete and incomplete combustion. |
| 9.11 | 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. |
| 9.12 | 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. |
| TOPIC 10 – SUSTAINABLE DEVELOPMENT | | |
| 10.1 | Key concept: Using the Earth’s resources and sustainable development | Give examples of natural products replaced by synthetics.  Give examples of products replaced by agricultural products.  Distinguish between finite and renewable resources. |
| 10.2 | 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. |
| 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.  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. |
| 10.4 | Waste water treatment | Explain how waste water is treated.  Describe how sewage is treated.  Compare the ease of treating waste water, groundwater and salt water. |
| 10.5 | Alternative methods of metal extraction | Describe the process of phytomining.  Describe the process of bioleaching.  Evaluate alternative biological methods of metal extraction. |
| 10.6 | 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. |
| 10.7 | 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. |
| 10.8 | Corrosion and its prevention | Show that air and water are needed for rusting.  Describe experiments on rusting and interpret the results.  Explain methods for preventing corrosion. |
| 10.9 | Alloys as useful materials | Describe the composition of common alloys.  Interpret the composition of other alloys from data.  Evaluate the uses of other alloys. |
| 10.10 | Ceramics, polymers and composites | Compare the properties of materials quantitatively.  Compare glass, ceramics, polymers, composites and metals.  Select materials by relating their properties to uses. |
| 10.11 | Haber process | * Apply principles of dynamic equilibrium to the Haber process. * Use graphs to explain the trade-off between rate and equilibrium.   Explain how commercially used conditions relate to cost |
| 10.12 | 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 of fertilisers with laboratory preparation. |
| 10.13 | Maths skills: Translate information between graphical and numerical form | Represent information from pie charts numerically.  Represent information from graphs numerically.  Represent numeric information graphically. |