CHEMISTRY

Chapter 1: Atomic Structure (Paper 1)

	Aiming for Grade 4 (C)	Aiming Grade 6 (B)	Aiming for Grade 8 (A*)
Lesson 1.1	• Define the word element. • Classify familiar substances as elements or compounds. • Use the Periodic Table to find the symbols or names of given elements.	• Describe the basic structure of an atom. • Explain, including diagrams, the difference between a pure element, a mixture, and a compound. • Name and give the chemical symbol of the first 20 elements in the Periodic Table.	• Use chemical symbols of atoms to produce the chemical formulae of a range of elements and compounds. • Explain the significance of chemical symbols used in formulae and equations.
Lesson 1.2	• Describe familiar chemical reactions in word equations. • State that mass is conserved in a chemical reaction.	• Explain why mass is conserved in a chemical reaction. • Describe familiar chemical reactions with balanced symbol equations including state symbols. • Balance given symbol equations.	• Justify in detail how mass may appear to change in a chemical reaction. • Describe unfamiliar chemical reactions with more complex balanced symbol equations, including state symbols. • Write balanced symbol equations.
Lesson 1.2	• Define the word mixture. • Identify a mixture and a compound. • List different separation techniques.	• Explain the difference between a compound and a mixture. • Explain how the chemical properties of a mixture relate to the chemical it is made from. • Describe different separation techniques.	• Use experimental data to explain the classification of a substance as a compound or mixture. • Suggest an appropriate separation or purification technique for an unfamiliar mixture. • Explain in detail how multi-step separation techniques work.
Lesson 1.4	• State when fractional distillation would be used. • Safely make a paper chromatogram.	• Describe the process of fractional distillation. • Explain the main processes occurring in paper chromatography.	• Explain in detail how fractional distillation can separate miscible liquids with similar boiling points. • Evaluate separation or purification techniques for a given mixture.
Lesson 1.5	• List the significant models proposed for atoms. • Identify the key parts of the plum-pudding model and the nuclear model of the atom.	• Describe the differences between the plum-pudding model and the nuclear model of the atom. • Explain how evidence from scattering experiments changed the model of the atom.	• Justify why the model of the atom has changed over time. • Evaluate the current model of an atom.
Lesson 1.6	• State the relative charges and masses of sub-atomic particles. • State that atoms have no overall charge (are neutral). • Label the sub-atomic particles on a diagram of a helium atom.	• Describe atoms using the atomic model. • Explain why atoms have no overall charge. • Use atomic number and mass numbers of familiar atoms to determine the number of each sub-atomic particle.	• Use the Periodic table to find atomic number and mass number data and use it to determine the number of each sub-atomic particle in any given form. • Recognise and describe patterns in sub-atomic particles of elements listed in the Periodic Table. • Explain why we can be confident that there are no missing elements in the first 10 elements of the Periodic Table.

	Aiming for Grade 4 (C)	Aiming Grade 6 (B)	Aiming for Grade 8 (A*)
Lesson 1.7	• State what an ion is. • Define an isotope. • State the relative sizes of an atom and its nucleus.	• Describe isotopes using the atomic model. • Explain why ions have a charge. • Use atomic number and mass numbers of familiar ions to determine the number of each sub-atomic particle.	• Use the Periodic table to find atomic number and use it to determine the number of each sub-atomic particle in an ion. • Use SI units and prefixes to describe the size of an atom and its nucleus in standard form.
Lesson 1.8	• State that electrons are found in energy levels of an atom. • State the maximum number of electrons in the first three energy levels.	• Write the standard electronic configuration notation from a diagram for the first 20 elements. • Explain why elements in the same group react in a similar way.	• Use the Periodic Table to find atomic number and determine the electronic structure for the first 20 elements. • Make predictions for how an element will react when given information on another element in the same group.

Chapter 2: Periodic Table (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 2.1	• List the significant models for ordering the elements. • State how the elements are ordered in the periodic table.	• Describe how the elements are arranged in groups and periods in the periodic table. • Explain why the periodic table was a breakthrough in how to order elements.	• Explain how and why the ordering of the elements has changed over time.
Lesson 2.2	• Define a group and period in the periodic table. • Describe how electronic structure is linked to the periodic table. • State that noble gases are unreactive.	• Describe how the electronic structure of metals and non-metals are different. • Explain in terms of electronic structure how the elements are arranged in the periodic table. • Explain why the noble gases are unreactive and the trend in their boiling	• Explain how the electronic structure of metals and non-metals affects their reactivity. • Use the periodic table to make predictions about the electronic structure and reactions of elements. • Predict the electronic structure of stable ions for the first 20 elements.
Lesson 2.3	• Name the first three elements in Group 1. • Describe the Group 1 metals as having low densities. • Write word equations from descriptions of how Group 1 metals react with water.	• Recognise trends in supplied data. • Explain why the elements in Group 1 react similarly and why the first three elements float on water. • Describe how you can show that hydrogen and metal hydroxides are made when Group 1 metals react with water.	• Illustrate the reactions of Group 1 metals with balanced symbol equations. • Explain how Group 1 metals form ions with a +1 charge when they react with non-metals. • Justify how Group 1 metals are stored and the safety precautions used when dealing with them.
Lesson 2.4	• Name the first four elements in Group 7. • Recognise a halogen displacement reaction. • Describe the main properties of halogens.	• Recognise trends in supplied data. • Explain why the elements in Group 7 react similarly. • Explain how to complete a halogen displacement reaction and explain what happens in the reaction.	• Illustrate the reactions of Group 7 metals with balanced symbol equations. • Explain how Group 7 non-metals form ions with a −1 charge when they react with metals. • Explain in detail how to compare the reactivity of the Group 7 elements.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 2.5	• State the trend in reactivity in Group 1. • State the trend in reactivity in Group 7.	• Explain how electronic structure affects the trend in reactivity of Group 1 and Group 7 elements. • Use the nuclear model to explain how the outer electrons experience different levels of attraction to the nucleus.	• Use electronic structure to explain the trends in physical and chemical properties of Group 1 and Group 7 elements. • Apply knowledge of reactivity of Groups 1 and 7 to suggest and explain the trend in reactivity of Groups 2 and 6.
Lesson 2.6	• List the typical properties of transition metals and their compounds.	• Describe how the properties of Group 1 metals compare with transition metals. • Interpret the formula and names of familiar transition metal compounds.	• Justify the use of a transition metal or its compound in terms of its chemical properties. • Suggest why Group 1 metals have different properties compared to transition metals.

Chapter 3: Structure & Bonding (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 3.1	• Identify the three states of matter and their state symbols. • Describe the process of melting, freezing, boiling, and condensing. • Use the particle model to draw a representation of how particles are arranged in the three states of matter.	• Use data to determine the state of a substance at a given temperature. • Explain, in terms of particles, the energy and temperature of a substance when it is at the melting point or boiling point. • Describe the factors that affect rate of evaporation.	• Use the particle model to describe how energy, movement, and attraction between particles change as a substance is heated or cooled. • Suggest why substances have different melting and boiling points from each other. **• (H) Evaluate a model, explaining its limitations.**
Lesson 3.2	• State the particles involved in ionic and covalent bonding. • Describe, with an example, how a Group 1 metal atom becomes a positive ion. • Describe, with an example, how a Group 7 non-metal atom becomes a negative ion.	• Draw dot and cross diagrams of compounds formed between Group 1 and Group 7 elements. • Explain how electron transfer allows ionic bonding to occur in the compound formed when a Group 1 metal reacts with a Group 7 non-metal.	• Draw dot and cross diagrams of unfamiliar ionic compounds. • Suggest and explain the charge of a monatomic ion based on its position in the periodic table.
Lesson 3.3	• State that opposite charges attract. • Write the charges of ions of Group 1, Group 2, Group 6, and Group 7 elements. • Describe an ionic lattice.	• Explain how the position of an element in the periodic table relates to the charge on its most stable monatomic ion. • Explain, in terms of electronic structure, how unfamiliar elements become ions. • Interpret the formulae of familiar ionic compounds to determine the number and type of each ion present.	• Suggest the charge on unfamiliar ions using the position of the element in the periodic table. • Explain the ratio of metal and non-metal ions in compounds. • Generate the formulae of a wide range of ionic compounds when the charges of the ions are given.
Lesson 3.4	• State that ionic compounds have high melting points and can dissolve in water. • State that ionic compounds can conduct electricity when molten or dissolved in water. • Describe an ionic lattice	• Explain why ionic compounds have a high melting point. • Describe, in terms of ions, how an ionic compound can conduct electricity. • Explain the movement of ions in solution or when molten.	• Explain in detail why ionic compounds cannot conduct electricity when they are solid but can when molten or in solution. • Justify in terms of properties that a compound has ionic bonding. • Apply the ionic model to make predictions of the physical properties of ionic compounds.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 3.5	• Describe a covalent bond • Recognise a covalent compound from its formula, name, or diagram showing bonds. • Name familiar examples of small molecules which contain covalent bonds.	• Explain how a covalent bond forms in terms of electronic structure. • Draw dot and cross diagrams and ball and stick diagrams for H2, Cl2, O2, N2, HCl, H2O, NH3, and CH4. • Describe a double bond in a diatomic molecule.	• Draw dot and cross diagrams and ball and stick diagrams for unfamiliar small molecules. • Suggest how double and triple covalent bonds can be formed. • Suggest how the properties of a double covalent bond could be different to the properties of a single covalent bond.
Lesson 3.6	• State that small molecules have low melting and boiling points. • State that small molecules do not conduct electricity. • Describe an intermolecular force.	• Explain how the size of molecules affects melting and boiling points. • Explain why small molecules and polymers do not conduct electricity. • Identify substances that would have weak intermolecular forces.	• Predict the physical properties of unfamiliar covalently bonded substances. • Compare and contrast the properties of substances with different bonding. • Justify the use of a model to explain the physical properties of a small molecule and discuss the limitations of various molecular models.
Lesson 3,7	• List the main physical properties of diamond and graphite. • State that giant covalent structures have high melting points. • Describe the structure of graphite in terms of layers of carbon atoms.	• Recognise the structure of diamond and graphite from information provided in written or diagrammatic form. • Explain the properties of diamond in terms of its bonding. • Explain the properties of graphite in terms of its bonding.	• Use a molecular model of an unfamiliar giant covalent structure to predict and explain its physical properties. • Justify in detail a use for graphite based on its properties. • Justify in detail a use for diamond based on its properties.
Lesson 3.8	• Describe the relationship between graphite and graphene. • List the main physical properties of fullerenes. • State the molecular formula of buckminsterfullerene.	• Recognise the structure of a fullerene or nanotube in diagrams and prose. • Explain the structure of fullerenes. • List the properties and consequent uses of fullerenes and carbon nanotubes.	• Describe and explain the applications of fullerenes. • Use molecular models of graphene, nanotubes, and fullerenes to explain their properties. • Justify in detail a use for graphene, nanotubes, and fullerenes, based on their properties.
Lesson 3.9	• State that metals form a giant structure. • Recognise metallic bonding in diagrams.	• Describe metallic bonding. • Recognise and represent metallic bonding diagrammatically.	• Explain how metal atoms form giant structures. • Evaluate different models of metallic bonding.
Lesson 3.10	• List the physical properties of metals. • Describe the structure of a pure metal.	• Explain key physical properties of metals using the model of metallic bonding. • Describe why metals are alloyed.	• Explain in detail, including labelled diagrams, how alloying affects the structure and bonding in metals and its effect on properties. • Justify in detail why alloys are more often used than pure metals.
Lesson 3.11	• State a definition of nanoscience. • Describe how surface area to volume ratio increases as particle size decreases. • Recognise that the negative indices in standard form used in nanoscience represent very small numbers.	• Describe the size of nanoparticles. • Explain why surface area to volume ratio increases as particle size decreases. • Convert lengths into standard form.	• Classify a particle as coarse, fine, or nanoparticle based on its size. • Quantitatively explain the relationship between surface area to volume ratio and particle size and its effect on properties. • Convert standard form into a variety of length units.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 3.12	• State that nanoparticles can be used in sun cream. • List a variety of uses of nanoparticles.	• List the advantages and disadvantages of using nanoparticles. • Explain why nanoparticles can have new applications.	• Evaluate the use of nanoparticles in their applications, including sun cream. • Decide and justify in detail why nanotechnology research should continue.

Chapter 4: Chemical Calculations (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 4.1	• Use the periodic table to identify the relative atomic mass for the first 20 elements. • Calculate the relative formula mass for familiar compounds when the formula is supplied and is without brackets.	• Use the periodic table to find the relative atomic mass of all elements. • Calculate the relative formula mass for unfamiliar compounds when the formula is given. **• (H) State the units for the amount of substance.**	• Explain why relative atomic masses may not be a whole number. • Explain why some elements have the same relative atomic mass as each other. **• (H) Calculate the number of moles or mass of a substance from data supplied.**
Lesson 4.2		• Explain why chemical equations must be balanced. • Calculate the relative formula mass for one substance when the relative formula masses are given for all the other substances in a balanced symbol equation.	• Interpret balanced symbol equations in terms of mole ratios. • Use balanced symbol equations to calculate reacting masses.
Lesson 4.3		• Explain why chemical equations must be balanced. • Identify the limiting reactant in a chemical reaction.	• Explain the effect of a limiting reactant on the amount of product made. • Explain the effect of a limiting reactant on the amount of product made.
Lesson 4.4	• State the definition of theoretical yield, actual yield, and percentage yield. • Calculate percentage yield when actual yield and theoretical yield are given.	• Calculate percentage yield when the actual yield is given and the mass of the limiting reactant is given. • List reasons why actual yield is often lower than theoretical yield.	• Calculate the percentage yield using a variety of units and conversions. • Justify why percentage yield can never be above 100%.
Lesson 4.5	• Calculate the formula mass of substances when the formula is given. • Balance simple equations • State a definition of atom economy	• Calculate the atom economy for a given chemical reaction. • Explain why using reactions with high atom economy is important.	• Evaluate different reactions to decide the best production method of a chemical. • Explain why the sum of the formula masses of the reactants is the same as the sum of the formula masses of the products.
Lesson 4.6	• Describe what the concentration of a solution is. • Calculate the concentration of a solution in g/dm3 when given the mass of solute in g and volume of solution in dm3.	**• (H) Explain how concentration of a solution can be changed.** • Calculate the mass of solute (in g) in a solution when given the concentration in g/dm3 and volume in dm3 or cm3.	• Calculate the mass of a chemical when any volume and concentration is given. • Explain the concentration of a solution in terms of particles.
Lesson 4.7	• Accurately read the volume on a burette to 1 decimal place. • Identify concordant results	• Calculate a titre. • Describe how an indicator can be used to determine the end point. • Explain how accuracy can be	• Justify the use of a pipette and burette for a titration, evaluating the errors involved in reading these instruments.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
		improved in a titration.	• Explain how precise results are obtained in a titration. • Justify the use of an indicator in an acid–base titration.
Lesson 4.8		• Calculate the concentration of a solution in mol/dm3 when given the amount of solute in moles and volume of solution in dm3. • Calculate the amount of acid or alkali needed in a neutralisation reaction. • Calculate the mole and mass of solute (in g) in a solution when given the concentration in mol/dm3 and volume in dm3 or cm3.	• Calculate the unknown concentration of a reactant in a neutralisation reaction when the volumes are known and the concentration of one reactant is also known. • Extract data from given information to perform multi-step calculations independently.
Lesson 4.9		• Calculate the amount in moles of gas in a given volume at room temperature and pressure. • Convert units	• Suggest how the volume of gas would change when temperature or pressure was changed. • Calculate the moles or volume of a gaseous substance involved in a chemical reaction.

Chapter 5: Chemical Changes (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 5.1	• List the order of common metals in the reactivity series. • Use general equations to write specific word equations for metals listed in the reactivity series reacting with oxygen, water, and acid. • Safely make and record observations.	• Describe oxidation and reduction in terms of gain or loss of oxygen. • Write word equations for the metals listed in the reactivity series reacting with oxygen, water, and acid, and balance given symbol equations. • Predict observations for the metals listed in the reactivity series reacting with oxygen, water, and acid.	• Justify uses of metals in the reactivity series based on their chemical reactivity. • Write balanced symbol equations, with state symbols, for the metals listed in the reactivity series reacting with oxygen, water, and acid. • Evaluate in detail the investigation of metals plus acid, assessing the control of variables and the validity of conclusions drawn from the data collected.

Lesson 5.2	• Recall a definition of a displacement reaction. • Use the reactivity series to determine whether a reaction between a metal and a different metal salt will occur. • Safely make and record observations.	• Explain why a displacement reaction occurs. • Write word equations and straightforward balanced symbol equations for displacement reactions. • Predict observations for the metals listed in the reactivity series reacting with a different metal salt.	**• (H) Describe displacement reactions using an ionic equation.** • Write balanced symbol equations, with state symbols, for displacement reactions. **• (H) Determine and explain which species is oxidised and which species (metal atom or ion) is reduced in a displacement reaction in terms of electron transfer.**
Lesson 5.3	• Define oxidation and reduction in terms of oxygen. • Describe how metals can be extracted.	• Identify species that are being oxidised and reduced in a chemical reaction. • Explain why some metals are found uncombined in the Earth's crust.	• Explain how carbon or hydrogen can be used to reduce an ore. • Evaluate the extraction process to obtain a metal from its ore.
Lesson 5.4	• Recall a definition of a salt. • Name a salt formed between a metal and sulfuric acid or hydrochloric acid. • Recall a general equation for a metal reacting with an acid and use it to write specific word equations.	• Describe how to make a salt by reacting a metal with an acid. • Write a balanced symbol equation to describe a reaction between a metal and sulfuric acid or hydrochloric acid. • Identify the chemical formula of the salt produced from the reaction between an acid and a metal.	**• (H) Explain the reaction between a metal and an acid.** **• (H) Write ionic and half equations, including state symbols, to describe a reaction between a metal and sulfuric acid or hydrochloric acid.** **• (H) Identify and explain in detail which species is oxidised and which is reduced.**
Lesson 5.5	• Safely prepare a pure, dry sample of a soluble salt from an insoluble base and a dilute acid. • Name a salt formed between a metal hydroxide or metal oxide and sulfuric acid or hydrochloric acid. • Recall a general equation for a base reacting with an acid and use it to write specific word equations.	• Describe a method to prepare a pure, dry sample of a soluble salt from an insoluble substance and a dilute acid. • Write a balanced symbol equation to describe a reaction between a metal hydroxide or oxide and sulfuric acid or hydrochloric acid. • Explain why the reaction between a base and a dilute acid is a neutralisation reaction.	**• (H) Explain the reaction between a metal oxide or metal hydroxide and an acid, including an ionic equation.** • Generate the formulae of salts given the names of the metal or base and the acid • Explain how alkalis are a subgroup of bases.
Lesson 5.6	• Safely make a salt by reacting a metal carbonate with a dilute acid. • Write a general word equation for metal carbonates and alkalis reacting with dilute acids and use this to make specific word equations.	• Describe how to make a dry sample of a salt from reacting a metal carbonate or an alkali with a dilute acid. • Write balanced symbol equations for neutralisation reactions.	• Explain the reaction between ammonia and dilute acids to produce salts and the agricultural importance of the salts. • Describe neutralisation using ionic equations, including the ionic equation for a carbonate plus an acid.
Lesson 5.7	• Safely use universal indicator to classify a solution as acidic or alkaline. • Describe the pH scale. • Recall an example of an alkaline, neutral, basic, and acidic chemical.	• Describe how universal indicator can be used to classify a chemical as acidic or alkaline. • Describe how solutions can be acidic or alkaline. • Describe the relationship between alkalis and bases.	• Evaluate how universal indicator or a data logger can be used to determine the approximate pH of a solution. • Use ionic equations to explain how solutions can be acidic or alkaline. • Explain how the pH of a solution changes as acid or alkali is added

Lesson 5.8		• Recall examples of strong and weak acids. • Describe how an acid or alkali can be concentrated or dilute. • Describe how an acid or alkali can be weak or strong.	• Explain the difference between concentration and strong or weak in terms of acids and alkalis. • Use ionic equations to explain how acids can be strong or weak. • Quantatively explain how the concentration of hydrogen ions relates to the pH number.

Chapter 6: Electrolysis (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 6.1	• Define electrolysis. • Write a word equation to describe the electrolysis of a molten ionic compound.	• Describe electrolysis in terms of movement of ions. • Write a balanced symbol equation including state symbols for the overall electrolysis of a molten ionic compound. • Predict the products at each electrode for the electrolysis of a molten ionic compound.	• Explain why electrolysis can only occur when an ionic compound is molten or in aqueous solution. **• (H) Describe electrolysis with half equations at the electrodes.** • Explain the classification of the reactions at each electrode as oxidation or reduction.
Lesson 6.2	• State that oxygen can be produced at the anode when some solutions are electrolysed. • State that hydrogen can be produced at the cathode when some solutions are electrolysed. • Write a word equation to describe electrolysis of a solution.	• Describe electrolysis of solutions in terms of movement of ions. • Write a balanced symbol equation including state symbols for the overall electrolysis of a solution. • Predict the products at each electrode for the electrolysis of a molten ionic compound or its solution.	• Explain how hydrogen ions and hydroxide ions can be present in solutions, including a balanced symbol equation with state symbols, for the reversible reaction in which water ionises. **• (H) Describe electrolysis with half equations at the electrodes.** • Explain the classification of reactions at the electrodes as oxidation or reduction.
Lesson 6.3	• State that aluminium can be extracted from aluminium oxide using electrolysis. • Write a word equation to describe the electrolysis of aluminium oxide.	• Describe the electrolysis of aluminium oxide. • Explain why electrolysis is an expensive metal extraction method and illustrate this with the extraction of aluminium. • Explain why cryolite is added to aluminium oxide in the industrial extraction of aluminium.	• Explain why electrolysis is used to extract aluminium from compounds. **• (H) Describe electrolysis with half equations at the electrodes.** **• (H) Explain the classification of the reactions at each electrode as oxidation or reduction.**
Lesosn 6.4	• State the products of the electrolysis of brine and a use for each. • Safely electrolyse a solution, with guidance provided.	• Describe how to electrolyse brine in terms of ions moving. • Predict the products of electrolysis of a solution. • Plan and carry out an electrolysis investigation.	**• (H) Explain the electrolysis of brine using half equations, classifying reactions at the electrode as oxidation or reduction.** • Evaluate in detail an

			investigation they have planned and carried out, commenting on their methodology and quality of the data collected. • Compare and contrast the electrolysis of a compound in solution with its electrolysis as a molten compound.

Chapter 7: Energy Changes (Paper 1)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 7.1	• Define exothermic and endothermic reactions. • State that energy is conserved in a chemical reaction. • Safely complete a calorimetry experiment for a reaction that takes place in solution.	• Describe examples of exothermic and endothermic reactions. • Explain, using observations from calorimetry, how to classify a reaction as exothermic or endothermic. • Explain in detail how to carry out a calorimetry experiment.	• Explain a chemical reaction in terms of energy transfer. • Plan, carry out, and evaluate the errors in a calorimetry investigation.
Lesson 7.2	• State a use of an exothermic reaction and an endothermic reaction. • Write word equations for familiar reactions.	• Explain how an energy change from a chemical reaction can be used. • Write balanced symbol equations for familiar reactions.	• Suggest a chemical reaction for a specific purpose based on the energy change for the reaction. • Evaluate in detail the uses of exothermic and endothermic reactions.
Lesson 7.3	• Define activation energy. • Sketch a generic reaction profile diagram for an exothermic or endothermic reaction.	• Label activation energy on a reaction profile diagram. • Generate a specific reaction profile diagram for a given chemical reaction when its energy change is also supplied. **• (H) Identify bonds broken in reactants and new bonds made in products of a reaction.**	• Explain why chemical reactions need activation energy to start them. • Use the particle model to explain how a chemical reaction occurs. **• (H) Explain energy change in terms of the balance between bond making and bond breaking.**
Lesson 7.4	• State when fractional distillation would be used. • Safely make a paper chromatogram.	• Explain, using the particle model, how reactants become products in a chemical reaction. • Explain why bond breaking is endothermic and bond making is exothermic. • Define bond energy and identify all the bonds that break and are made in a chemical reaction.	• Calculate the energy needed to break the reactant bonds and the energy released when the product bonds are made. • Calculate the energy change for a reaction, including the correct unit. • Explain in terms of bond energies how a reaction is either exothermic or endothermic.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 7.5	• Describe a simple cell. • Describe a battery • Give an example of a non-rechargeable battery	• Explain how a hydrogen fuel cell produces electricity. • List the advantages and disadvantages of hydrogen fuel cells. • Explain why hydrogen fuel cells are an alternative to rechargeable cells and batteries.	• Describe an electrochemical cell with half equations and ionic equations. • Explain why the reactions in an electrochemical cell are redox reactions and determine which species is oxidised or reduced in an electrochemical cell. • Evaluate the use of non-rechargeable cells.
Lesson 7.6	• Describe a hydrogen fuel cell. • State some uses for hydrogen fuel cells. • State that hydrogen fuel cells could be an alternative to rechargeable cells and batteries.	• Explain how a hydrogen fuel cell produces electricity. • List the advantages and disadvantages of hydrogen fuel cells. • Explain why hydrogen fuel cells are an alternative to rechargeable cells and batteries.	**• (H) Describe the reactions in fuel cells using balanced symbol and half equations.** • Evaluate the use of hydrogen fuel cells instead of rechargeable cells and batteries. • Determine and explain which species is oxidised and which is reduced in a hydrogen fuel cell.

Chapter 8: Rates & Equilibrium (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 8.1	• Recall a definition for rate of reaction. • Safely describe and follow a method to monitor rate of reaction. • State the units for rate of reaction	• Explain how there can be different units for measuring rate of reaction. • Calculate the mean rate of reaction. • Calculate the rate of reaction at a specific time.	• Plot and use a graph to calculate the gradient to measure the initial rate of reaction. • Justify a chosen method for a given reaction to monitor the rate of reaction. • Explain why there is more than one unit for rate of reaction.
Lesson 8,2	• Describe how surface area of a solid can be increased. • State that chemical reactions can only occur when a collision occurs with enough energy. • List the factors that can affect the rate of a chemical reaction.	• Use collision theory to explain how changing temperature alters the rate of reaction. • Calculate mean rates of reaction.	• Use collision theory to explain in detail how increasing surface area increases the rate of reaction. • Use a graph to calculate the rate of reaction at specific times in a chemical reaction. • Explain why many collisions do not lead to a chemical reaction.
Lesson 8.3	• Describe how temperature affects the rate of reaction. • Safely complete an experiment on how temperature affects the rate of a reaction.	• Use collision theory to explain how changing temperature alters the rate of reaction. • Calculate mean rates of reaction.	• Use a graph to calculate the rate of reaction at specific times in a chemical reaction. • Calculate 1 / t and plot a graph with a more meaningful line of best fit.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 8.4	• Describe how changing concentration affects the rate of reaction. • Describe how changing pressure affects the rate of gas phase reactions.	• Use collision theory to explain how changing concentration or pressure alters the rate of reaction. • Calculate mean rates of reaction. • Explain how to change gas pressure.	• Interpret a rate of reaction graph, including calculating the rate of reaction at specific times in a chemical reaction. • Explain why changing pressure has no effect on the rate of reaction for some reactions. • Justify quantitative predictions and evaluate in detail their investigation into the effect of concentration on rate of reaction.
Lesson 8.5	• Define a catalyst • Describe how adding a catalyst affects the rate of reaction. • Describe and carry out a method to safely investigate which catalyst is best for a reaction.	• Use collision theory to explain how adding a catalyst alters the rate of reaction. • Explain, with an example, the industrial use of a catalyst. • Calculate the mean rate of reaction.	• Use a reaction profile diagram to explain in detail the effect of adding a catalyst. • Justify the use of catalysts in industry and in household products. • Explain what an enzyme is and how it works.
Lesson 8,6	• Define a reversible reaction. • Write a word equation for a familiar reversible reaction. • State an example of a reversible reaction.	• Explain, using a familiar example, how a reaction can be reversible. • Describe a familiar reversible reaction using a balanced symbol equation. • Predict the observations of a familiar reversible reaction when the conditions are changed.	• Describe an unfamiliar reversible reaction, using a balanced symbol equation with state symbols. • Justify the use of reversible reactions in the lab and items available in the home. • Justify the classification of a reaction as reversible.
Lesson 8,7	• State whether a reversible reaction is exothermic or endothermic in the reverse direction if the forward direction is stated. • Write a word equation for the reversible reaction of dehydration/hydration of copper • sulfate.	• Explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction. • Generate balanced symbol equations for reversible reactions from information provided. • Make predictive observations of familiar reversible reactions when information is supplied.	• Explain in detail the energy changes in an equilibrium system. • Suggest and explain a simple laboratory test which could be completed using a reversible reaction. • Make predictive observations of unfamiliar reversible reactions when information is supplied.
Lesson 8,8	• Define a dynamic equilibrium • Describe a closed system	• Describe how to achieve dynamic equilibrium. • Describe how rate of the forward reaction compares to rate of the backward reaction in a dynamic equilibrium. **• (H) Describe Le Chatelier's Principle.**	• Explain dynamic equilibrium. **• (H)Explain why the concentration of chemicals in a dynamic equilibrium remains constant.** **• (H)Predict the effect on the rate of forward and reverse reactions by applying the Le Chatelier's Principle when the conditions of a dynamic equilibrium are changed.**
Lesson 8.9		• Explain how changing conditions for a system at dynamic equilibrium affects the rate of the forward and reverse reactions. • Predict the effect on yield of changing temperature, concentration, or pressure in a given equilibrium system.	• Explain why changing pressure has no effect on some systems. • Justify, in detail, the compromise conditions chosen in given industrial processes.

Chapter 9: Crude oil and fuels (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 9.1	• Describe the composition of crude oil. • State a definition of a hydrocarbon. • State a definition of an alkane.	• Describe the process of cracking, including conditions. • Generate a balanced symbol equation to describe cracking. • Describe a chemical test to show an alkene is present.	• Explain why fractional distillation is used to separate crude oil into fractions. • Apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane. • Classify and justify the classification of a chemical as an alkane.
Lesson 9.2	• Name the different fractions from crude oil. • State a use for each fraction from crude oil.	• Explain the differences between complete and incomplete combustion. • Write balanced symbol equations for the complete and incomplete combustion of hydrocarbons. • Explain how to test for the products of complete combustion.	• Explain in detail how fractional distillation is used to separate crude oil into fractions. • Explain how chain length affects the properties of crude oil fractions. • Make predictions about the properties of crude oil fractions from the fraction's hydrocarbon chain length.
Lesson 9.3	• Define complete and incomplete combustion. • Write a word equation to describe the complete combustion of a hydrocarbon. • Write a word equation to describe the incomplete combustion of a hydrocarbon.	• Describe how the trend in colour, viscosity, flammability, and boiling point changes as the length of the hydrocarbon chain changes. • Describe how the properties of a fraction of crude oil make it appropriate for its use.	**• (H) Justify the use of a given fuel over another.** • Explain in detail how the production of carbon monoxide in incomplete combustion can be lethal. **• (H) Use balanced symbol equations to calculate amounts of reactants or products in a combustion reaction.**
Lesson 9.4	• Define the process of cracking. • Generate a word equation to describe cracking. • Recognise and give examples of alkenes.	• Describe how the trend in colour, viscosity, flammability, and boiling point changes as the length of the hydrocarbon chain changes. • Describe how the properties of a fraction of crude oil make it appropriate for its use.	• Use examples to explain the process of cracking and why it is so important to the petrochemical industry. • Explain the similarities and differences between alkanes and alkenes. • Explain, using balanced symbol equations, the reaction between bromine water and an alkene.

Chapter 10: Chemical Reactions (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 10.1	• State a definition of an alkene. • Name the first four alkenes. • State the product of a combustion and an addition reaction of an alkene.	• Draw the displayed structural formulae for the first four alkenes. • Draw the displayed structural formulae for the products of the addition reactions between alkenes and hydrogen, water (steam), or a halogen. • Predict the word and balanced symbol equations for the complete combustion of an alkene when the number of carbon atoms is given.	• Predict the word and balanced symbol equations to describe reactions between alkenes and hydrogen, water (steam), or a halogen. • Compare and contrast the reactivity of alkanes and alkenes. • Predict the general formula of an alkene.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 10.2	• Recognise the functional group in an alcohol and a carboxylic acid. • Name for the first four primary alcohols and the first four carboxylic acids. • Name ethyl ethanoate from its formula.	• Classify an organic compound as an alcohol, a carboxylic acid, or an ester. • Draw the structural and displayed formulae for the first four primary alcohols and the first four carboxylic acids. • Draw the structural and displayed formulae for ethyl ethanoate.	• Predict the word and balanced symbol equations to describe reactions between alkenes and hydrogen, water (steam), or a halogen. • Compare and contrast the reactivity of alkanes and alkenes. • Predict the general formula of an alkene.
Lesson 10.3	• State that fermentation can be used to make ethanol. • List some chemical properties of the first four alcohols. • Recognise the formula and structure of ethanol and state some of its uses.	• Describe fermentation to make aqueous solutions of ethanol, including a word equation. • Describe the reactions of alcohols, including using word equations. • Explain the relationship between ethanol and ethanoic acid.	• Explain why solutions of ethanol have a pH of 7. • Describe complete combustion reactions of a range of alcohols using balanced symbol equations. • Plan an investigation to determine the relative energy transferred to the surroundings by the combustion of different alcohols.
Lesson 10.4	• Recognise a carboxylic acid from its name or formula. • List some chemical properties of carboxylic acids. • Describe an ester and state some uses of this class of compounds.	• Describe why carboxylic acids are acidic. • Use word equations to describe the reactions of carboxylic acids with metal carbonates and with alcohols. • Describe how to make an ester.	• Explain, using ionic equations, why carboxylic acids are weak acids. • Predict he products of the reactions of a range of carboxylic acids with metal carbonates and with alcohols. • Explain the term volatile in terms of molecular forces.

Chapter 11: Polymers (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 11.1	• Define a monomer and a polymer. • State some uses of poly(ethene) and poly(propene). • Write a word equation for the formation of poly(ethene) and poly(propene).	• Describe how monomers become polymers. • Draw the monomer for an addition polymer when the structure of the polymer is given. • Draw an addition polymer structure when the structure of the monomer is given.	• Explain why monomers for addition polymers must be unsaturated. • Explain the process of addition polymerisation in detail, including using balanced symbol equations and the concept of atom economy. • Explain how the repeating unit of a polymer relates to the monomer.
Lesson 11.2		• Describe condensation polymerisation. • Draw a simplified structure of the monomers for a condensation polymer when the structure of the polymer is given. • Draw a simplified structure of a condensation polymer when the structure of the monomers are given.	• Predict the products of condensation polymerisation. • Explain the process of condensation polymerisation in detail, including using equations. • Compare and contrast in detail, giving appropriate examples, the two methods of polymerisation.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 11.3	• State an example of a natural polymer. • Describe the relationship between sugar as a monomer and starch or cellulose as a polymer. • Describe the relationship between amino acids as a monomer and protein as a polymer.	• Identify the monomer from the structural formula of a polymer. **• (H) Describe the structure of an amino acid.**	**• (H) Predict the products of condensation polymerisation using natural monomers.** • Explain in detail the process of condensation polymerisation with natural monomers, including using equations. **• (H) Explain how amino acids react together in an acid–base reaction.**
Lesson 11.4	• State that DNA is an example of a natural polymer. • State what DNA stands for. • Name the type of monomers used to make DNA.	• Describe the main structure of DNA. • Describe the importance of DNA for living systems. • Sketch the shape of a DNA strand.	• Explain the shape of the DNA polymer. • Explain how nucleotides form DNA. • Explain the purpose of DNA.

Chapter 12: Chemical Analysis (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 12.1	• State what a pure substance is. • Describe how melting point and boiling point data can be used to identify pure substances. • State what a formulation is.	• Describe the difference between pure substances, impure substances, and formulations. • Explain how melting point and boiling point data can be used to determine the purity of a substance. • State uses of formulations.	• Justify the classification of pure substances, impure substances, and formulations when data is supplied. • Explain in detail the use of formulations. • Calculate percentage composition of components in a range of formulations.
Lesson 12.2	• Describe and safely carry out a method to make a paper chromatogram. • Describe how to calculate Rf values. • Describe a use of chromatography.	• Explain how chromatography separates solutes. • Calculate Rf values from given data. • Use a chromatogram to determine if a sample is pure or impure.	• Explain why different substances and different conditions will have different Rf values. • Calculate Rf values from a chromatogram, using an appropriate number of significant figures. • Interpret a chromatogram to identify unknown substances.
Lesson 12.3	• Safely carry out the laboratory test for hydrogen, oxygen, carbon dioxide, and chlorine. • Describe how to safely carry out the laboratory test for chlorine gas. • Identify hydrogen, carbon dioxide, and oxygen from a laboratory test.	• Explain why limewater turns milky when it reacts with carbon dioxide. • Interpret results to identify a gas that is present. • Explain why hydrogen 'pops' near a naked flame.	• Write balanced symbol equations, including state symbols, for the reactions of limewater with carbon dioxide and hydrogen with oxygen. • Explain why a glowing splint re-ignites in oxygen. • Explain why chlorine gas turns damp indicator paper colourless.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 12.4	• Safely carry out a flame test. • Safely carry out testing for metal ions using sodium hydroxide. • Write a word equation for the reaction between sodium hydroxide and a specified metal salt solution.	• Identify a metal ion from the colour of a flame or the colour of the hydroxide precipitate. • Write balanced symbol equations, including state symbols, for the production of an insoluble metal hydroxide. • Explain why a flame test cannot be used to identify a mixture of metal solutions.	• Evaluate flame tests as a method for identifying of positive metal ions. • **(H) Write balanced ionic equations, including state symbols for the production of an insoluble metal hydroxide.** • Explain why iron(II) hydroxide solution often changes colour when it stands in air.
Lesson 12.5	• Safely carry out testing for carbonates, halides, and sulfate ions. • Write a word equation for the reaction when a specific carbonate, halide, or • sulfate is being tested with support.	• Identify the presence of carbonate, a specific halide, or sulfate ions from simple laboratory tests. • Write balanced symbol equations, including state symbols for the reactions in the simple laboratory tests for carbonate, halide, or sulfate ions. • Explain why it can be difficult to identify halides using this method.	• Evaluate the halide ion test. • Write balanced ionic equations, including state symbols, for simple laboratory tests for carbonate, halide, or sulfate ions. • Explain in detail how to identify a compound from the results of simple laboratory tests.
Lesson 12.6	• List some of the advantages and disadvantages of instrumental techniques. • State an example of an instrumental technique. • State a use for flame emission spectroscopy.	• Compare and contrast instrumental techniques with simple laboratory tests. • Describe the main processes of flame emission spectroscopy. • Explain how flame emission spectroscopy is an improvement on flame tests.	• Evaluate the use of instrumental techniques. • Explain how metal ions emit light when in a flame. • Interpret results from flame emission spectroscopy when data is given.

Chapter 13: The Earth's Atmosphere (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 13.1	• Describe the Earth's early atmosphere. • Describe how oxygen was formed in the development of the atmosphere.	• State the composition, including formulae, of the Earth's early atmosphere. • Describe a theory for the development of the Earth's atmosphere. • Explain, using word equations, how gases were formed in the atmosphere and how oceans were formed.	• Use a theory to explain in detail how the atmosphere developed. • Explain the limits of the theory for the development of the Earth's atmosphere and why it has changed. • Use balanced symbol equations to explain how gases were formed in the atmosphere and explain how oceans were formed.
Lesson 13.2	• State that the levels of carbon dioxide have decreased in the atmosphere. • List the names and symbols of the gases in dry air. • State where methane and ammonia in the atmosphere may have come from.	• Describe how the proportion of carbon dioxide in the early atmosphere was reduced. • State the composition of dry air. • Use word equations to show how carbon dioxide can form sedimentary rocks.	• Use a theory to explain in detail how the early atmosphere developed to form the atmosphere today. • Explain why the composition of the Earth's atmosphere has not changed much for 200 million years. • Use balanced symbol equations to explain how carbon dioxide forms sedimentary rock and how methane and ammonia were removed from the atmosphere.

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 13.3	• Describe the greenhouse effect. • Name three greenhouse gases • State some human activities that affect the proportion of greenhouse gases in the atmosphere.	• Explain the greenhouse effect • Explain how greenhouse gases increase the temperature of the atmosphere. • Explain how human activity can change the proportion of greenhouse gases in the atmosphere.	• Justify why scientists, as well as the public, disagree about the cause of climate change. • Explain the difference between global warming and the greenhouse effect. • Evaluate evidence to suggest if global warming is man-made or natural.
Lesson 13.4	• List some of the possible outcomes of climate change. • State a definition for carbon footprint. • List some ways to reduce a carbon footprint.	• Explain the possible effects of global climate change and why they are difficult to predict. • Explain possible methods to reduce greenhouse gas emissions. • Explain some of the problems in trying to reduce greenhouse gas emissions.	• Evaluate the scale, risk, and environmental impact of global climate change. • Justify why reducing greenhouse gas emissions can be difficult to achieve. • Evaluate the use of products, services, or events in terms of their carbon footprint.
Lesson 13.5	• List some atmospheric pollutants. • Describe how carbon monoxide and soot (carbon) can be made from the incomplete combustion of fossil fuels. • Complete word equations to describe how atmospheric pollutants can be made.	• Explain how sulfur dioxide and nitrogen oxides are made when fossil fuels are combusted. • Describe the health impacts of atmospheric pollutants. • Use balanced symbol equations to show how atmospheric pollutants are formed.	• Predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used. • Evaluate the negative social, economic, and environmental consequences of atmospheric pollution. • Suggest and explain methods to reduce atmospheric pollution.

Chapter 14: Earth's Resources (Paper 2)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 14.1	• List some human uses of the Earth's resources. • Give examples of a finite and a renewable resource. • State an example of a natural product that is supplemented or replaced by agricultural or synthetic products.	• Describe and classify a resource as finite or renewable when information is given. • Explain the use of natural, sustainable, and finite resources. • Interpret information from different formats including graphs, charts, tables, and prose.	• Understand data and interpret information using orders of magnitude to compare. • Explain the role of chemistry in improving agricultural and industrial processes. • Draw conclusions consistent with information provided from graphs, charts, tables, and prose and evaluate the validity of the data.
Lesson 14.2	• Describe why potable water is important. • List the key processes to make drinking water. • Safely distill salty water	• Explain why the method of obtaining potable water depends on the local conditions. • Explain reasons for filtration and sterilisation in water treatment. • Describe and explain in detail how to safely distil salty water.	• Explain the difference between pure water and potable water. • Justify the choice of potable water supply in a given scenario. • Explain in detail why desalination is not often used to generate safe clean drinking water and justify when it is used.

Lesson 14.3	• List what is removed from waste water before it can be released. • State the main processes in sewage treatment. • State uses of sewage slurry.	• Explain why waste water should be treated before it is released into the environment. • Describe the main processes in sewage treatment. • Explain uses of sewage slurry.	• Evaluate the ease of obtaining potable water from waste, ground, or salt water. • Explain in detail how and why waste water is processed before it is released into the environment. • Evaluate the uses of sewage slurry.
Lesson 14.4		• Describe the processes of phytomining and bioleaching. • Write balanced symbol equations to explain metal extraction techniques. • Explain the need for new ways of extracting metals (in particular copper).	• Explain in detail how phytomining and bioleaching extract metals. • Write ionic equations to explain metal extraction techniques and identify the species being oxidised or reduced. • Evaluate biological methods of metal extraction.
Lesson 14.5	• State the different stages of an LCA in the correct order. • Carry out an LCA for shopping bags made from plastic or paper with support.	• Explain the importance of LCA and how it can be misused. • Carry out LCAs for different products when data is supplied.	• Explain the limits of LCAs. • Evaluate products in detail using LCAs.
Lesson 14.6	• List some products that can be reused or recycled. • Describe how metal can be reused and recycled. • Describe how glass can be reused and recycled.	• Explain the importance of reusing and recycling products. • Explain why some recycling can be difficult. • Evaluate ways of reducing the use of limited resources when information is given.	• Evaluate the environmental, economic, and social impacts of reusing and recycling products. • Evaluate ways of reducing the use of limited resources. • Suggest ways of minimising the environmental impact of exploiting raw materials.

Chapter 15: Using our Resources (Paper 2 – Triple only)

	Aiming for Grade 4	Aiming for Grade 6	Aiming for Grade 8
Lesson 15.1	• Define the term corrosion • State what is required for iron to rust. • List some ways to prevent rusting.	• Describe an experiment to investigate the conditions required for rusting to occur. • With the help of equations, describe the process of rusting. • Explain how different corrosion prevention techniques work.	• Explain in detail why corrosion is a problem. • Write balanced equations to describe rusting and identify species that are oxidised and reduced. • Evaluate rust prevention techniques and suggest which is best for a specific purpose.
Lesson 15.2	• State the difference between a metal before and after being alloyed. • State the elements in steel and bronze. • List some common examples of alloys and their uses.	• Explain in detail why pure metals are often alloyed before they are used. • Describe how different amounts of carbon affect the properties of iron. • Identify an appropriate purpose for an alloy when given data on its properties.	• Explain the term carat. • Use data on the properties of unfamiliar alloys to explain a suitable alloy for a given purpose. • Evaluate an alloy in terms of its properties and uses.

Lesson 15.3	• Describe the properties of a thermosetting plastic. • Describe the properties of a thermosoftening plastic. • Describe the difference between LD and HD poly(ethene).	• Explain how thermosetting plastics and thermosoftening plastics are different in terms of structure and bonding. • Describe the different conditions used to make poly(ethene). • Explain how the structure of poly(ethene) affects its properties and therefore its uses.	• Explain in detail, giving examples, how the properties of plastics can be changed. • When data about the properties of plastics is give, suggest a suitable plastic for a given purpose. • Evaluate a plastic in terms of its properties and uses.
Lesson 15.4	• Describe how to make soda-lime glass and borosilicate glass. • Describe how to make clay ceramics. • State examples of clay ceramics and composites.	• Describe what a composite is. • Explain the difference between a composite and an advanced composite. • Compare quantitatively the physical properties of glass and clay ceramics, polymers, composites, and metals.	• Explain the properties of ceramics and composites in terms of structure and bonding. • When data about the properties of a material is provided, classify it and suggest a suitable material for a given purpose. • Evaluate materials in terms of their properties and uses.
Lesson 15.5	• State the purpose of the Haber process. • State the conditions for the Haber process. • Write a word equation to describe the Haber process.	• Describe how the raw materials are turned into the reactants for the Haber process. • Describe how the Haber process is a reversible reaction. • Describe the Haber process with the help of a balance symbol equation including state symbols.	• Evaluate the Haber process using atom economy and LCA to determine its environmental impact. • Explain how costs are kept to a minimum in the Haber process. • Explain, with the use of balanced symbol equations, where the reactants come from for the Haber process.
Lesson 15.6		• Explain the effect of changing temperature on the yield of the Haber process. • Explain the effect of changing pressure on the yield of the Haber process. •Explain why the conditions used in the Haber process are a compromise.	• Justify why the conditions used in the Haber process are a compromise. • Explain the effect of an iron catalyst on the rate and position of equilibrium in the Haber process. • Use data to predict and explain the effect on the equilibrium and rate of reaction of changing conditions in the Haber process.
Lesson 15.7	• State what a fertiliser is. • Identify the fertiliser produced from a reaction. • Write a word equation for the formation of the chemicals in NPK fertiliser.	• Explain the importance of fertilisers for agriculture. • Describe in detail how fertilisers are produced in the laboratory. • Write balanced symbol equations for the reactions to make components of NPK fertilisers.	• Evaluate the importance of fertilisers for agriculture. • Write ionic equations for reactions to make fertilisers. • Calculate the concentration of an ammonia solution from the results of a titration.
Lesson 15.8	• Name the elements in NPK fertilisers. •Describe where the raw materials for NPK fertilisers come from. • Name and give formulae of the chemicals in NPK fertilisers.	• Describe production of fertilisers in industry. • Compare and contrast the industrial and laboratory production of fertilisers. • Write balanced symbol equations for the reactions to make components of NPK fertilisers.	• Evaluate the composition of fertilisers. • Evaluate different processes to make NPK fertilisers. • Write ionic equations to illustrate the reactions to make NPK fertilisers.