	Lesson title	Learning objectives
	C1 Atomic Structure and Periodic Table	
1.1	Elements and compounds	• Identify symbols of elements from the periodic table. • Recognise compounds from their formula. • Identify the elements in a compound.
1.2	Atoms, formulae and equations	• Explain that an element consists of the same type of atoms. • Explain that atoms join together to make molecules. • Explain how formulae represent elements and compounds
1.3	Mixtures	• Recognise that all substances are chemicals. • Understand that all substances are either mixtures, compounds or elements. • Explain that mixtures can be separated.
1.4	Changing ideas about atoms	• Describe how the atomic model has changed over time. • Explain why the atomic model has changed over time • Understand that a theory is provisional until the next piece of evidence is available.
1.5	Modelling the atom	• Describe the atom as a positively charged nucleus surrounded by negatively charged electrons. • Explain that most of the mass of an atom is in the nucleus. • Explain that the nuclear radius is much smaller than that of the atom and most of the mass is in the nucleus.
1.6	Relating charges and masses	• Describe the structure of atoms. • Recall the relative masses and charges of protons, neutrons and electrons. • Explain why atoms are neutral.
1.7	Sub-atomic particles	• Use the definition of atomic number and mass number. • Calculate the numbers of protons, neutrons and electrons in *atoms*. • Calculate the numbers of sub-atomic particles in isotopes and ions.
1.8	Electronic structure	• Explain how electrons occupy ‘shells’ in order. • Describe the pattern of the electrons in shells for the first 20 elements.
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 outer shell corresponds to the element’s group number. • Explain that the electronic structure of transition metals position the elements into the transition metal block.
1.10	Developing the periodic table	• Describe the steps in the development of the periodic table. • Explain how Mendeleev left spaces for undiscovered elements. • Explain why the element order in the modern periodic table was changed. • Explain how testing a prediction can support or refute a new scientific idea.
1.11	Comparing metals and non-metals	• Recall a number of physical properties of metals and non-metals. • Describe some chemical properties of metals and non-metals. • Explain the differences between metals and non-metals on the basis of their characteristic physical and chemical properties.
1.12	Metals and non-metals	• Describe that metals are found on the left of the periodic table and non-metals on the right. • Explain the differences between metals and non-metals based on their physical and chemical properties. • Explain that metals form positive ions and non-metals do not.
1.13	Key concept: The outer electrons	• Recognise when electrons transfer • Recognise when atoms share electrons. • Predict when electrons are transferred most easily.
1.14	Exploring Group 0	• Describe the unreactivity of noble gases. • Predict and explain the trend in boiling point of the noble gases (going down the group). • Explain how properties of the elements in Group 0 depend on the outer shell of electrons of their atoms •
1.15	Exploring Group 1	• Explain why Group 1 metals are known as the alkali metals. • Predict the properties of other Group 1 metals from trends down the group. • Relate the properties of the alkali metals to the number of electrons in their outer shell.

	Lesson title	Learning objectives
	C1 Atomic Structure and Periodic Table	
1.16	Exploring Group 7	• Recall that fluorine, chlorine, bromine and iodine are non-metal elements called halogens. • Describe that they react vigorously with alkali metals. • Construct balanced symbol equations for the reactions of metals with halogens.
1.17	Reaction trends and predicting reactions	• Explain why the trends down the group in Group 1 and in Group 7 are different. • Explain the changes across a period. • Predict the reactions of elements with water, dilute acid or oxygen from their position in the periodic table.
1.18	Maths skills: Standard form and making estimates	• Recognise the format of standard form. • Convert decimals to standard form and vice versa. • Make estimates without calculators so the answer in standard form seems reasonable.
	Chapter 2: Structure and bonding	
2.1	Chemical bonds	• Describe the three main types of bonding. • Explain how electrons are used in the three 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 and non-metals from the group number of the element (1, 2, 6 and 7).
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	• Recognise substances made of small molecules from their formula. • Draw dot and cross diagrams for small molecules. • Deduce molecular formulae from models and diagrams.
2.5	Metallic bonding	• Describe that 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	• Identify polymers from diagrams showing their bonding and structure. • 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 bonding and structure 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 metal alloys. • Describe the purpose of a lead-tin alloy. • Explain why alloys are harder than pure metals - distortion of the layers of atoms.
2.12	Diamond	• Identify why diamonds are so hard. • Explain how the properties relate to the bonding structure of 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	• Explain the properties of graphene in terms of its structure and bonding. • Recognise graphene and fullerenes from their bonding and structure. • Describe the uses of fullerenes, including carbon nanotubes.

	Lesson title	Learning objectives
		Chapter 3: Chemical quantities and calculations
3.1	Key concept: Conservation of mass and balanced equations	• Explain the law of conservation of mass. • Explain why a multiplier appears as a subscript in a formula. • Explain why a multiplier appears in equations before a formula.
3.2	Relative formula mass	• Identify the relative atomic mass of an element from the periodic table. • Calculate the relative formula masses from atomic masses. • Verify the law of conservation of mass in a balanced equation.
3.3	Mass changes when gases are in reactions	• Explain any observed changes in mass in a chemical reaction. • Identify the mass changes using a balanced symbol equation. • Explain these changes in terms of the particle model.
3.4	Chemical measurements and uncertainty	• Understand that all measurements have a degree of uncertainty. • Estimate the uncertainty from the distribution of results. • Measure uncertainty from the range of a set of measurements and their mean.
3.5	Moles	• Describe the measurement of amounts of substances in moles. • Calculate the number of moles in a given mass. • Calculate the mass of a given number of moles.
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/dm^3 to mass and volume.
3.9	Key concept: Amounts in chemistry	• Use atomic masses to calculate formula mass. • Explain how formula mass relates to number of moles. • Explain how number of moles relate to other quantities.
3.10	Maths skills: Change the subject of an equation	• To use an equation to demonstrate conservation. • To change the subject of an equation. • To carry out a multi-step calculation.
		Chapter 4: Chemical changes
4.1	Metal oxides	• Identify that metals react with oxygen to form metal oxides. • Explain oxidation by gain of oxygen. • Identify metal oxides as bases.
4.2	Reactivity series	• Describe the reactions, if any, of metals with water or dilute acids. • Deduce an order of reactivity of metals based on experimental results. • Explain how the reactivity relates to the tendency of the metal to form positive ion.
4.3	Extraction of metals	• Identify substances reduced by loss of oxygen. • Explain how extraction methods depend on metal reactivity. • Interpret or evaluate information on specific metal extraction processes.
4.4	Oxidation and reduction in terms of electrons	• Use experimental results of displacement reactions to confirm the reactivity series. • Write ionic equations for displacement reactions. • Identify in a half equation which species are oxidised and which are reduced.
4.5	Reaction of metals with acids	• Describe how to make salts from metals and acids. • Write full balanced symbol equations for making salts. • Use half equations to describe oxidation and reduction.
4.6	Neutralisation of acids and salt production	• Describe ways that salts can be made. • Predict products from given reactants. • Deduce the formulae of salts from the formulae of common ions. •

	Lesson title	Learning objectives
		Chapter 4: Chemical changes
4.7	Soluble salts	• Describe how to make pure, dry samples of soluble salts. • Explain how to name a salt. • Derive a formula for a salt from its ions.
4.8	Required practical: Preparing pure, dry sample of soluble salt	• Describe a practical procedure for producing a salt from a solid and an acid. • Explain the apparatus, materials and techniques used for making the salt. • Describe how to safely manipulate apparatus to accurately measure melting points.
4.9	pH and neutralisation	• Describe the use of universal indicator to measure pH. • Use the pH scale to identify acidic or alkaline solutions. • Investigate pH changes when a strong acid neutralises a strong alkali.
4.10	Strong and weak acids	• Explain weak and strong acids by the degree of ionisation. • Describe neutralisation by the effect on hydrogen ions and pH. • Explain dilute and concentrated as amounts of substance.
4.11	The process of electrolysis	• Identify reactions at electrodes during electrolysis. • Explain why a mixture is used and the anode needs constant replacement. • Write and balance half equations for the electrode reactions.
4.12	Electrolysis of molten ionic compounds	• Identify which ions migrate to the cathode and anode. • Explain how the ions of a molten electrolyte are discharged. • Predict the products of electrolysis of molten binary compounds.
4.13	Using electrolysis to extract metals	• Explain the process of the electrolysis of aluminium oxide. • Explain why a mixture is used and the anode needs constant replacement. • Write half equations for the reactions at the electrodes.
4.14	Electrolysis of aqueous solutions	• Explain the electrolysis of copper sulfate using inert electrodes. • Predict the products of the electrolysis of aqueous solutions. • Represent reactions at electrodes by half equations.
4.15	Required practical: Investigating what happens when aqueous solutions are electrolysed	• Use scientific theories and explanations to develop hypotheses. • Plan experiments to make observations and test hypotheses. • Apply a knowledge of the apparatus needed for electrolysis including use of inert electrodes and varying electrolytes. • Make and record observations.
4.16	Key concept: Electron transfer, oxidation and reduction	• Explain why atoms lose or gain electrons. • Explain oxidation and reduction by electron transfer. • Relate ease of losing electrons to reactivity.
		Chapter 5: Energy changes
5.1	Key concept: Endothermic and exothermic reactions	• Identify exothermic and endothermic reactions from temperature changes. • Evaluate the energy transfer of a fuel. • Investigate the variables that affect temperature changes in reacting solutions.
5.2	Required Practical: Investigate the variables that affect temperature changes	• Use scientific theories and explanations to develop hypotheses. • Plan experiments to make observations and test hypotheses. • Evaluate methods to suggest possible improvements and further investigations.
5.3	Reaction profiles	• Draw simple reaction profiles (energy level diagrams). • Use reaction profiles to identify reactions as exothermic or endothermic. • Explain the energy needed for a reaction to occur and calculate energy changes.
5.4	Energy change of reactions	• Describe the energy changes in bond breaking and bond making. • Explain how a reaction is endothermic or exothermic overall. • Calculate the energy transferred in chemical reactions using bond energies.
5.5	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.