Topic 1 Atomic structure and the periodic table

1.1	Explain how Mendeleev: a arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds	$(\dot{\mathbf{O}})$		
	b used his table to predict the existence and properties of some elements not then discovered			
1.2	Classify elements as metals or non-metals according to their position in the periodic table	\odot		\odot
1.3	Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells (energy levels	\odot		
1.4	Demonstrate an understanding that the nucleus of an atom is very small compared to the overall size of the atom	$\overline{\mathbf{O}}$		\odot
1.5	Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element			\odot
1.6	Recall the relative charge and relative mass of: a a proton b a neutron c an electron	\odot		
1.7	Demonstrate an understanding that atoms contain equal numbers of protons and electrons	\odot	•••	(:)
1.8	Explain the meaning of the terms: a atomic number b mass number c relative atomic mass			
1.9	Describe the arrangement of elements in the periodic table such that: a elements are arranged in order of increasing atomic number, in rows called periods b elements with similar properties are placed in the same vertical column, called groups			
1.10	Demonstrate an understanding that the existence of isotopes results in some relative atomic masses not being whole numbers	\odot		
1.11	Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes	\bigcirc		\odot
1.12	Apply rules about the filling of electron shells (energy levels) to predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form 2.8.1			
1.13	Describe the connection between the number of outer electrons and the position of an element in the periodic table	\odot		\odot

Topic 2 Ionic compounds and analysis

2.1	Demonstrate an understanding that atoms of different elements can combine to form compounds by the formation of new chemical bonds			
2.2	Describe how ionic bonds are formed by the transfer of electrons to produce cations and anions	\odot	•••	\odot
2.3	Describe an ion as an atom or group of atoms with a positive or negative charge	\odot		
2.4	Describe the formation of sodium ions, Na ⁺ , and chloride ions, Cl2, and hence the formation of ions in other ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7			
2.5	Demonstrate an understanding of the use of the endings –ide and –ate in the names of compounds	\odot	•••	\odot
2.6	Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions			\odot
2.7	Describe the structure of ionic compounds as a lattice structure:	\odot	<u>••</u>	\odot
	a consisting of a regular arrangement of ions b held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions			
2.8	Describe and explain the properties of ionic substances including sodium chloride and magnesium oxide, limited to: a melting points and boiling points b whether they conduct electricity as solids, when molten and in aqueous solution			
2.9	Recall the general rules which describe the solubility of common types of substances in water: a all common sodium, potassium and ammonium salts are soluble b all nitrates are soluble c common chlorides are soluble except those of silver and lead d common sulfates are soluble except those of lead, barium and calcium e common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium			
2.10	Demonstrate an understanding that insoluble salts can be formed as precipitates by the reaction of suitable reagents in solution	\odot		\odot
2.11	Demonstrate an understanding of the method needed to prepare a pure, dry sample of an insoluble salt	\odot	\bigcirc	\odot
2.12	Prepare an insoluble salt by precipitation	\odot	\bigcirc	\odot
2.13	Use solubility rules to predict whether a precipitate is formed when named solutions are mixed together and to name the precipitate	$\overline{\mathbf{O}}$		
2.14	Recall that the insoluble salt, barium sulfate, is given as a 'barium meal' to X-ray patients because: a it is opaque to X-rays b it is safe to use as, although barium salts are toxic, its insolubility prevents it entering the blood	\odot		

2.15	Describe tests to show the following ions are present in solids	(\mathbf{x})	(\bullet)	\odot
	or solutions:	\bigcirc	\bigcirc	
	a Na ⁺ , K ⁺ , Ca ^{2+,} Cu ²⁺ using flame tests			
	b CO ₃ ²⁻			
	using dilute acid and identifying the carbon dioxide evolved			
	c SO ₄ ²⁻ using dilute hydrochloric acid and barium chloride			
	solution			
	d Cl ₂ using dilute nitric acid and silver nitrate solution			
2.16	Recall that chemists use spectroscopy (a type of flame test) to	()	\bigcirc	\bigcirc
	detect the presence of very small amounts of elements and	U	$\overline{\bigcirc}$	
	that this led to the discovery of new elements, including			
	rubidium and caesium			

Topic 3 Covalent compounds and separation techniques

3.1	Describe a covalent bond as a pair of electrons shared between two atoms	\odot	<u>••</u>	\odot
3.2	Recall that covalent bonding results in the formation of molecules	\odot	<u>.</u>	(
3.3	Explain the formation of simple molecular, covalent substances using dot and cross diagrams, including: a hydrogen b hydrogen chloride c water d methane e oxygen f carbon dioxide	\odot		٢
3.4	Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulphate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)			
3.5	Describe the properties of typical simple molecular, covalent compounds, limited to: a low melting points and boiling points, in terms of weak forces between molecules b poor conduction of electricity			
3.6	Demonstrate an understanding of the differences between the properties of simple molecular, covalent substances and those of giant molecular, covalent substances, including diamond and graphite			
3.7	Explain why, although they are both forms of carbon and giant molecular substances, graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools	÷	\bigcirc	
3.8	Describe the separation of two immiscible liquids using a separating funnel	\odot	•••	\odot
3.9	Describe the separation of mixtures of miscible liquids by fractional distillation, by referring to the fractional distillation of liquid air to produce nitrogen and oxygen			
3.10	Describe how paper chromatography can be used to separate and identify components of mixtures, including colouring agents in foodstuffs	\odot		
3.11	Evaluate the information provided by paper chromatograms, including the calculation of Rf values, in a variety of contexts, such as the food industry and forensic science			

Topic 4 Groups in the periodic table

4.1	Classify elements as alkali metals (group 1), halogens (group 7), noble gases (group 0) and transition metals based on their position in the periodic table			
4.2	Describe the structure of metals as a regular arrangement of positive ions surrounded by a sea of delocalised electrons	\odot		\odot
4.3	Describe and explain the properties of metals, limited to malleability and the ability to conduct electricity	6		\odot
4.4	Recall that most metals are transition metals and that their typical properties include: a high melting point b the formation of coloured compounds	$\overline{\mathbf{O}}$		
4.5	Demonstrate an understanding that elements and compounds can be classified as: a ionic b simple molecular covalent			
	d metallic and that each type of substance has different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)			
4.6	Describe alkali metals as: a soft metals b metals with comparatively low melting points			
4.7	Describe the reactions of lithium, sodium and potassium with water to form hydroxides which are alkaline, and hydrogen gas	\odot		\bigcirc
4.8	Describe the pattern in reactivity of the alkali metals lithium, sodium and potassium with water, use this pattern to predict the reactivity of other alkali metals and explain the pattern			
4.9	Recall the colours and physical states of the halogens at room temperature	\odot		
4.10	Describe the reaction of halogens with metals to form metal halides	\odot		\odot
4.11	Recall that halogens react with hydrogen to produce hydrogen halides which dissolve in water to form acidic solutions	8	•••	\odot
4.12	Investigate displacement reactions of halogens reacting with halide ions in solution	8	•••	\odot
4.13	Describe the relative reactivity of the halogens as shown by their displacement reactions with halide ions in aqueous solution	\odot		
4.14	Describe the noble gases as chemically inert, compared with the other elements, and demonstrate an understanding that this lack of reactivity can be explained by the electronic arrangements in their atoms	\odot		
4.15	Demonstrate an understanding that the discovery of the noble gases was due to chemists: a noticing that the density of nitrogen made in a reaction differed from that of nitrogen obtained from air b developing a hypothesis about the composition of the air c performing experiments to test this hypothesis and show the presence of the noble gases			

4.16	Relate the uses of the noble gases to their properties,	\odot		\odot
	including:		\bigcirc	e
	a inertness (including providing an inert atmosphere for			
	welding and in filament lamps)			
	b low density (including filling balloons)			
	c non-flammability			
4.17	Use the pattern in a physical property of the noble gases, such	()	\bigcirc	\bigcirc
	as boiling point or density, to estimate an unknown value for	U		9
	another member of the group			

Topic 5 Chemical reactions

5.1	Measure temperature changes accompanying some of the following types of change: a salts dissolving in water b neutralisation reactions c displacement reactions d precipitation reactions			
5.2	Define an exothermic change or reaction as one in which heat energy is given out, including combustion reactions or explosions	\odot		
5.3	Define an endothermic change or reaction as one in which heat energy is taken in, including photosynthesis or dissolving ammonium nitrate in water	\odot		
5.4	Describe the breaking of bonds as endothermic and the making of bonds as exothermic	(•••	(:)
5.5	Demonstrate an understanding that the overall heat energy change for a reaction is:	\odot		\odot
	a exothermic if more heat energy is released making bonds in the products than is required to break bonds in the reactants b endothermic if less heat energy is released making bonds in the products than is required to break bonds in the reactants			
5.6	Draw and interpret simple graphical representations of energy changes occurring in chemical reactions (no knowledge of activation energy is required)	8		
5.7	Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips	\odot		
5.8	Recall that the rates of chemical reactions vary from very fast, explosive reactions to very slow reactions	\odot	•••	(:)
5.9	Describe the effect of changes in temperature, concentration and surface area of a solid on the rate of reaction	\odot		
5.10	Describe how reactions can occur when particles collide and explain how rates of reaction are increased by increasing the frequency and/or energy of collisions			
5.11	Demonstrate an understanding that not all collisions lead to a reaction, especially if particles collide with low energy	\odot	•••	(:)
5.12	Recall the effect of a catalyst on the rate of reaction	\odot		\odot
5.13	Demonstrate an understanding that catalytic converters in cars: a have a high surface area to increase the rate of reaction of carbon monoxide and unburnt fuel from exhaust gases with oxygen from the air to produce carbon dioxide and water b work best at high temperatures	\odot		

Topic 6 Quantitative chemistry

6.1	Calculate relative formula mass given relative atomic masses	\odot	•••	\odot
6.2	Calculate the formulae of simple compounds from reacting masses and understand that these are empirical formulae	\odot		\odot
6.3	Determine the empirical formula of a simple compound, such as magnesium oxide	\odot	•••	\odot
6.4	Calculate the percentage composition by mass of a compound from its formula and the relative atomic masses of its constituent elements			
6.5	Use balanced equations to calculate masses of reactants and products	\odot	•••	\odot
6.6	Recall that the yield of a reaction is the mass of product obtained in the reaction	\odot		\odot
6.7	Demonstrate an understanding that the actual yield of a reaction is usually less than the yield calculated using the chemical equation (theoretical yield)			
6.8	Calculate the percentage yield of a reaction from the actual yield and the theoretical yield	\odot		\odot
6.9	Demonstrate an understanding of the reasons why reactions do not give the theoretical yield due to factors, including: a incomplete reactions b practical losses during the preparation c competing, unwanted reactions	\odot		
6.10	Demonstrate an understanding that many reactions produce waste products which: a are not commercially useful b can present economic, environmental and social problems for disposal	\odot		
6.11	Demonstrate an understanding that chemists in industry work to find the economically most favourable reactions where: a the percentage yield is high b all the products of the reaction are commercially useful c the reaction occurs at a suitable speed	\odot		