Science Chemistry Assessment Levels

I can do this		9=		8+	8=	8-	7+	7=	7-	6+	6=	6-	5+	5=	5-	4+	4=	4-	3+	3=	3-	2+	2=	2-	1+	1=	1-	F+	F=	F-
Particles				Explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres.			Explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings. Explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding. Represent three dimensional shapes in two dimensions and vice versa when looking at chemical structures e.g. allotropes of carbon (5b).			Describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two and three dimensional representations. Explain how the bulk properties of materials are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged, recognising that the atoms themselves do not have these properties. Recall that carbon can form four covalent bonds.			Use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur. Use data to predict states of substances under given conditions. Describe and compare the nature and arrangement of chemical bonds in ionic compounds, simple molecules, giant covalent structures, polymers and metals. Explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons. Construct dot and cross diagrams for simple ionic and covalent substances. Relate size and scale of atoms to objects in the physical world (1d). Translate information between diagrammatic and numerical forms (4a).			Use the particle model to explain observable phenomenon of each state of matter including diffusion, gas pressure, density and buoyancy and elasticity.			Explain different states of matter and changes of state in terms of energy and describe other features of matter including density, diffusion and gas pressure.			Use particle model diagrams to explain the properties of different states and to show the steps during changes of state and the process of diffusion.			Describe different states of matter and changes of state in terms of the particle model. Plot a graph to show how temperature changes with time, e.g. a 'cooling curve'.			Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water and rockCompare and group materials together, according to whether they are solids, liquids or gasses. Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)		

Atoms and elements			Describe how and why the atomic model has changed over time.	Explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number. Describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus.	Recall the typical size (order of magnitude) of atoms and small molecules. Calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes. Recall the general properties of transition metals (melting point, density, reactivity, formation of coloured ions with different charges and uses as catalysts) and exemplify these by reference to a small number of transition metals. Recall relative charges and approximate relative masses of protons, neutrons and electrons. Describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties.	Explain how atomic structure can be used to predict physical and chemical properties of elements, including those elements which are diatomic molecules.	Use the key terms atom, element, compound and molecule accurately with specific examples. Calculate density from mass and volume data.	Draw particle diagrams to represent the key terms atom, element, compound and molecule and use the periodic table to identify the chemical symbols of the elements. Recall the unit of density	Recognise metal and non-metal elements and describe ways to measure their physical properties	
Acids and alkalis	Describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only).	Recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one.	Use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids.		Recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions.	Explain the limitation of chemical indicators and the advantages of pH probes. Outline the enhanced precautions necessary when transporting and working with corrosive substances.	Describe a neutralisation reaction and list some uses of these reactions. Explain how indicators or pH probes could be used to track a neutralisation reaction.	Recognise the range of colours of Universal Indicator and quote the pH of some common examples. Link concentration to safety and describe how a dilution can be carried out.	Identify some basic safety symbols. Name examples of every day, and laboratory, acids and alkalis. Recognise the safety precautions needed and Describe the use of simple indicators.	

Pure and impure substances		Explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced.	Use the names and symbols of common elements and compounds and the principle of conservation of mass to write half equations.	Interpret chromatograms, including measuring Rf values Predict the products of electrolysis of binary ionic compounds in the molten state. Describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present. Explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced.	Describe electrolysis in terms of the ions present and reactions at the electrodes. Recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes. Explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term 'pure'. Explain that many useful materials are formulations of mixtures Describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation. Recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases. Suggest suitable purification techniques given information about the substances involved. Use melting point data to distinguish pure from impure substances. Suggest chromatographic methods for distinguishing pure from impure substances. Describe and explain the separation of crude oil by fractional distillation. Describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series. Describe the production of materials that are more useful by	Use the key terms miscible and immiscible accurately and can relate their understanding of solutions to mixtures of liquids. Use values of concentration to compare different solutions.	Use the key terms dissolve, solute, solvent, solution, accurately to explain the conservation of mass during dissolving. Use the terms saturated and solubility to describe how different substances may dissolve in water. Recognise the unit of concentration.	Draw particle diagrams to show they understand the terms dissolve, solute, solvent, solution and saturated. Describe how to separate mixtures by the following methods; chromatography, freezing and melting, filtration and distillation	Describe the properties of pure and impure substances. State that mixtures can be made and this will affect the purity of a substance.	Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substances from a solution Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating Demonstrate that dissolving, mixing and changes of state are reversible change
Simple chemical reactions		Use the formulae of common ions to write balanced ionic equations.	Deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa.	Evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses. Arithmetic computation when calculating energy changes (1a) Use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations.	Distinguish between physical and chemical changes using particle models. Use chemical symbols to write the formulae of elements and simple covalent and ionic compounds. Use the formulae of common ions to deduce the formula of a compound. Recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry. Explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource. Recall that a chemical cell produces a potential difference until the reactants are used up. Interpretation of charts and graphs when dealing with reaction profiles (4a). Describe the physical states of products and reactants using state symbols (s, l, g and aq).	Select the most appropriate gas collection methods and tests. Balance symbol equations to represent a chemical reaction	Use particle diagrams to predict the products of chemical reactions. Use word equations to represent a chemical reaction.	Describe possible methods for collecting gases and results of common gas tests. Use particle diagrams to show the rearrangement of atoms in a chemical reaction.	Describe observations that show chemical change and suggest ways to measure the changes. Identify from particle diagrams the rearrangement of atoms in a chemical reaction.	Explain that some changes result in the formation of new materials and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda

Compounds	Use a balanced equation to calculate masses of reactants or products. Explain how the mass of a solute and the volume of the solution is related to the concentration of the solution. Describe the relationship between molar amounts of gases and their volumes and vice versa, and calculate the volumes of gases involved in reactions, using the molar gas volume at room temperature and pressure (assumed to be 24dm3). Explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution. Explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together. Convert units from mass to moles (1c).	Recall and use the definitions of the Avogadro constant (in standard form) and of the mole. Explain how the mass of a given substance is related to the amount of that substance in moles and vice versa. Deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant. Calculations with numbers written in standard form when using the Avogadro constant (1b).	Explain the basic principles of condensation polymerisation by reference to the functional groups of the monomers, the minimum number of functional groups within a monomer, the number of repeating units in the polymer, and simultaneous formation of a small molecule.	Predict the formulae and structures of products of reactions (combustion, addition across a double bond and oxidation of alcohols to carboxylic acids) of the first four and other given members of these homologous series. Deduce the structure of an addition polymer from a simple alkene monomer and vice versa. Calculate relative formula masses of species separately and in a balanced chemical equation. Interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set in the same form. Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry (1a, 1c and 1d). Change the subject of a mathematical equation (3b and 3c). Provide answers to an appropriate number of significant figures (2a). Convert units where appropriate. Interpret charts, particularly in spectroscopy (4a). Arithmetic computation and ratio when determining empirical formulae, balancing equations (1a and 1c).	Recognise functional groups and identify members of the same homologous series. Name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids. Recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds. Recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer. Recall that DNA is a polymer made from four different monomers called nucleotides and that other important naturally-occurring polymers are based on sugars and amino-acids. Recall and use the law of conservation of mass. Explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model. Describe tests to identify aqueous captions and aqueous anions identify species from test results. Interpret flame tests to identify metal ions, including the ions of lithium, sodium, potassium, calcium and copper. Describe the advantages of instrumental methods of analysis (sensitivity, accuracy and speed).	State the properties for some common compounds and elements. Match chemical formulae to chemical names.	Compare the properties of compounds with those of elements made of the same atoms. Use the terms mixture and compound accurately. Describe some methods for separating compounds. Recognise the atoms in a substance from a given name or chemical formula. State the law of the conservation of matter.	Recognise the numbers of each different type of atom in a compound from a given formula and can calculate relative formula mass. Describe the law of the conservation of matter and give examples.	State the properties for some common compounds and elements. Match chemical formulae to chemical names.	
Periodic Table				Explain in terms of isotopes how this changes the arrangement proposed by Mendeleev. Predict possible reactions and probable reactivity of elements from their positions in the Periodic Table.	Explain how the position of an element in the Periodic Table is related to the arrangement of electrons in its atoms and hence to its atomic number. Explain how the atomic structure of metals and non-metals relates to their position in the Periodic Table. Use the names and symbols of the first 20 elements, Groups 1, 7 and 0 and other common elements from a supplied Periodic Table to write formulae and balanced chemical equations where appropriate. Explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups.	Explain the trend in reactivity of Group 1 and Group 7 elements. Use balanced symbol equations to give examples of reaction used to show trends and patterns.	Describe why Mendeleev's approach was so important. Use given trends in reactivity to make predictions about other elements in the group.	Describe how repeating patterns in the elements led to the development of the Periodic Table. State that groups show trends in how quickly they react	Recognise key areas of the Periodic Table, namely metals and non-metals, the noble gases and groups 1, 2 and 7	

Extracting metals			Evaluate alternative biological methods of metal extraction (bacterial and phytoextraction).	Explain why and how electrolysis is used to extract some metals from their ores.	Explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including extraction of a non-ferrous metal. Describe the conditions which cause corrosion and the process of corrosion, and explain how mitigation is achieved by creating a physical barrier to oxygen and water and by sacrificial protection. Describe the composition of some important alloys in relation to their properties and uses.	Explain the properties of metals based on their atomic structure and bonding.	Relate the method of extraction metals to their position on the reactivity series. Use word equations to show the chemical reactions that occur during extraction of metals.	Describe methods of extraction, including reacting with carbon and electrolysis, and can relate the properties of metals to this wide range of uses.	Use the reactivity series to compare reactions of given examples. State some properties of metals.	
Reactions of acids				Explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion.	Recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water. Deduce an order of reactivity of metals based on experimental results. Recall that acids react with some metals and with carbonates and write equations predicting products from given reactants.	Write balanced symbol equations for all acid reactions and reaction with oxygen to form metal oxides. Use the concept of dissociation and using ions in equations, and explain the changes during neutralisation reactions.	Write word equations for acid reactions. Describe the trend in the acidity of metal oxides and use this to make predictions. Explain the steps involved in making a pure salt. State that neutralisation reactions involve the formation of ions.	Name the salt produced in an acid reaction. State that metal oxides may also be acidic or alkaline. Describe the steps needed to make a pure salt.	State that acids can react with metals, metal oxides, metal carbonates and alkalis. Describe observations from acid reactions.	

Describing reactions	Predict the effect of changing reaction conditions (concentration, temperature and pressure) on equilibrium position and suggest appropriate conditions to produce a particular product. Explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products. Explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes. Explain how the commercially used conditions for an industrial process are related to the availability and cost of raw materials	Calculate energy changes in a chemical reaction by considering bond making and bond breaking energies	Interpret graphs of reaction conditions versus rate.	Draw and label a reaction profile for an exothermic and an endothermic reaction, identifying activation energy. Explain activation energy as the energy needed for a reaction to occur. Explain catalytic action in terms of activation energy. Recall that some reactions may be reversed by altering the reaction conditions. Recall that dynamic equilibrium occurs when the rates of forward and reverse reactions are equal. Determining gradients of graphs as a measure of rate of change to determine rate (4d and 4e). Explain the importance of the Haber process in agricultural production.	Interpret rate of reaction graphs. Describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction. Explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles. Explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio. Describe the characteristics of catalysts and their effect on rates of reaction. Identify catalysts in reactions. Recall that enzymes act as catalysts in biological systems. Arithmetic computation, ratio when measuring rates of reaction (1a and 1c). Drawing and interpreting appropriate graphs from data to determine rate of reaction (4b and 4c). Proportionality when comparing factors affecting rate of reaction (1c). Recall the importance of nitrogen, phospharus and potassium compounds in agricultural production. Describe the industrial production of fertilisers as several integrated processes using a variety of raw materials and compare with laboratory syntheses. Compare the industrial production of fertilisers with laboratory syntheses of the same products. Calculate the percentage yield of a reaction product from the actual yield of a reaction. Calculate the theoretical amount of a product from a given amount of reactant. Define the atom economy of a reaction. Calculate the atom economy of a reaction to form a desired product from the balanced equation. Arithmetic computation when calculating yields and atom economy (1a and 1c).	Explain why some reactions are endothermic and others are exothermic. Explain why temperature has a greater effect on rate than surface area and concentration. Use balanced symbol equations throughout.	Write word equations for different types of chemical reaction. Relate energy changes to the bond being broken and made. Use particle diagrams to explain the effect of temperature, catalysts, surface area and concentration on the rate of a chemical reaction.	Recognise chemical reactions as combustion, thermal decomposition, oxidation and reduction and displacement. Describe that reaction involves energy changes and use the terms endothermic and exothermic accurately. Describe methods to monitor the rate of a chemical reaction	Identify different types of chemical reaction. Describe observations that could be made during a chemical reaction. State that temperature, catalysts surface area and concentration may affect the rate of a chemical reaction.	
Earth and atmosphere				Evaluate the evidence for additional anthropogenic causes of climate change, including the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels, and describe the uncertainties in the evidence base. Use orders of magnitude to evaluate the significance of data (2h).	Interpret evidence for how it is thought the atmosphere was originally formed. Describe how it is thought an oxygen-rich atmosphere developed over time. Describe the greenhouse effect in terms of the interaction of radiation with matter. Describe the potential effects of increased levels of carbon dioxide and methane on the Earth's climate and how these effects may be mitigated, including consideration of scale, risk and environmental implications. Describe the major sources of carbon monoxide, sulphur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances. Describe the principal methods for increasing the availability of potable water in terms of the separation techniques used, including ease of treatment of waste, ground and salt water. Extract and interpr	Explain changes in the Earth using the idea of convection currents, reactive molecules in the Earth's upper atmosphere and the effect of carbon dioxide levels on global temperatures. Evaluate evidence of human impact and give balanced views on factors affecting a product's carbon footprint	Describe the composition of the atmosphere and the importance of ozone. Relate carbon dioxide levels to global warming and how	Describe changes in the rock cycle. Summarise the carbon cycle and how humans may affect this. Relate recycling to reducing a product's carbon footprint.	Describe the layers of the Earth. Describe rocks as igneous, sedimentary or metamorphic. State that humans can have impact on the Earth and the importance of recycling.	Describe in simple terms how fossils are formed when things that have lived are trapped within rock Recognise that soils are made from rocks and organic matter

Innovative materials				Evaluate factors that affect decisions on recycling. Compare quantitatively the physical properties of glass and clay ceramics, polymers, and composites. Explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required.	Compare 'nano' dimensions to typical dimensions of atoms and molecules. Describe the surface area to volume relationship for different-sized particles and describe how this affects properties. Describe how the properties of nanoparticulate materials are related to their uses. Explain the possible risks associated with some nanoparticulate materials. Estimate size and scale of atoms and nanoparticles (1d). Interpret, order and calculate with numbers written in standard form when dealing with nanoparticles (1b). Use ratios when considering relative sizes and surface area to volume comparisons (1c). Calculate surface areas and volumes of cubes (5c). Describe the basic principles in carrying out a life-cycle assessment of a material or product. Interpret data from a life-cycle assessment of a material or product. Describe a process where a material or product is recycled for a different use, and explain why this is viable.	Explain the benefits of innovative materials. Evaluate the impact of innovative materials on financial cost, health, environmental cost and ethical considerations.	Describe reasons for designing new materials and the influence that new materials have had on key products.	Compare suitability of materials and give examples of products made from ceramics, polymers, composites, smart and Nano materials.	Give examples of innovative materials and link properties of products to the choice of material.	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching