

**AQA TRILOGY Chemistry (8464) from 2016 Topics T5.1 Atomic structure and the periodic table (Paper 1)**

Topic	Student Checklist	R	A	G
5.1.1 A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes	State that everything is made of atoms and recall what they are			
	Describe what elements and compounds are			
	State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds			
	Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols			
	<b>HT ONLY: Write balanced half equations and ionic equations</b>			
	Describe what a mixture is			
	Name and describe the physical processes used to separate mixtures and suggest suitable separation techniques			
	Describe how the atomic model has changed over time due to new experimental evidence, inc discovery of the atom and scattering experiments (inc the work of James Chadwick)			
	Describe the difference between the plum pudding model of the atom and the nuclear model of the atom			
	State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom			
	State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom			
	Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number			
	Describe isotopes as atoms of the same element with different numbers of neutrons			
	5.1.2 The periodic table	Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element		
Calculate the relative atomic mass of an element given the percentage abundance of its isotopes				
Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers				
Recall how the elements in the periodic table are arranged				
Describe how elements with similar properties are placed in the periodic table				
Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements				
Describe the early attempts to classify elements				
Explain the creation and attributes of Mendeleev's periodic table				

	Identify metals and non-metals on the periodic table, compare and contrast their properties				
	Explain how the atomic structure of metals and non-metals relates to their position in the periodic table				
	Describe noble gases (group 0) and explain their lack of reactivity				
	Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons				
	Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions				
	Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity				
	Describe the reactions of group 7 halogens with metals and non-metals				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.2 Bonding, structure, and the properties of matter (Paper 1)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.2.1 Chemical bonds, ionic, covalent and metallic</b>	Describe the three main types of bonds: ionic bonds, covalent bonds and metallic bonds in terms of electrostatic forces and the transfer or sharing of electrons				
	Describe how the ions produced by elements in some groups have the electronic structure of a noble gas and explain how the charge of an ion relates to its group number				
	Describe the structure of ionic compounds, including the electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams				
	Describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure				
	Work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure				
	Describe covalent bonds and identify different types of covalently bonded substances, such as small molecules, large molecules and substances with giant covalent structures				
	Represent covalent bonds between small molecules, repeating units of polymers and parts of giant covalent structures using diagrams				
	Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane				
	Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule				
	Describe the arrangement of atoms and electrons in metallic bonds and draw diagrams the bonding in metals				
<b>5.2.2 How bonding and structure are</b>	Name the three States of matter, identify them from a simple model and state which changes of state happen at melting and boiling points				
	Explain changes of state using particle theory and describe factors that affect the melting and boiling point of a substance				
	<b>HT ONLY: Discuss the limitations of particle theory</b>				
	Recall what (s), (l), (g) and (aq) mean when used in chemical equations and be able to use them appropriately				

	Explain how the structure of ionic compounds affects their properties, including melting and boiling points and conduction of electricity (sodium chloride structure only)				
	Explain how the structure of small molecules affects their properties				
	Explain how the structure of polymers affects their properties				
	Explain how the structure of giant covalent structures affects their properties				
	Explain how the structure of metals and alloys affects their properties, including explaining why they are good conductors				
	Explain why alloys are harder than pure metals in terms of the layers of atoms				
	Explain the properties of graphite, diamond and graphene in terms of their structure and bonding				
	Describe the structure of fullerenes, and their uses, including Buckminsterfullerene and carbon nanotubes				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.3 Quantitative chemistry (Paper 1)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.3.1 Chemical measurements, concentration of mass and the</b>	State that mass is conserved and explain why, including describing balanced equations in terms of conservation of mass				
	Explain the use of the multipliers in equations in normal script before a formula and in subscript within a formula				
	Describe what the relative formula mass (Mr) of a compound is and calculate the relative formula mass of a compound, given its formula				
	Calculate the relative formula masses of reactants and products to prove that mass is conserved in a balanced chemical equation				
	Explain observed changes of mass during chemical reactions in non-enclosed systems using the particle model when given the balanced symbol equation				
	Explain why whenever a measurement is made there is always some uncertainty about the result obtained				
	<b>5.3.2 Use of amount of substance in relation to mass of pure substance</b>	<b>HT ONLY: State that chemical amounts are measured in moles (mol) and explain what a mol is with reference to relative formula mass and Avogadro's constant</b>			
<b>HT ONLY: Use the relative formula mass of a substance to calculate the number of moles in a given mass of the substance</b>					
<b>HT ONLY: Calculate the masses of reactants and products when given a balanced symbol equation</b>					
<b>HT ONLY: Use moles to write a balanced equation when given the masses of reactants and products (inc changing the subject of the equation)</b>					
<b>HT ONLY: Explain the effect of limiting the quantity of a reactant on the amount of products in terms of moles or masses in grams</b>					
<b>HT ONLY: Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution</b>					
<b>HT ONLY: Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution</b>					
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.4 Chemical changes (Paper 1)</b>					

To pic	Student Checklist	R	A	G
5.4.1 Reactivity of metals	Describe how metals react with oxygen and state the compound they form, define oxidation and reduction			
	Describe the arrangement of metals in the reactivity series, including carbon and hydrogen, and use the reactivity series to predict the outcome of displacement reactions			
	Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids			
	Relate the reactivity of metals to its tendency to form positive ions and be able to deduce an order of reactivity of metals based on experimental results			
	Recall what native metals are and explain how metals can be extracted from the compounds in which they are found in nature by reduction with carbon			
	Evaluate specific metal extraction processes when given appropriate information and identify which species are oxidised or reduced			
5.4.2 Reactions of acids	<b>HT ONLY: Describe oxidation and reduction in terms of loss and gain of electrons</b>			
	<b>HT ONLY: Write ionic equations for displacement reactions, and identify which species are oxidised and reduced from a symbol or half equation</b>			
	<b>HT ONLY: Explain in terms of gain or loss of electrons that the reactions between acids and some metals are redox reactions, and identify which species are oxidised and which are reduced (Mg,Zn, Fe + HCl &amp; H<sub>2</sub>SO<sub>4</sub>)</b>			
	Explain that acids can be neutralised by alkalis, bases and metal carbonates and list the products of each of these reactions			
	Predict the salt produced in a neutralisation reaction based on the acid used and the positive ions in the base, alkali or carbonate and use the formulae of common ions to deduce the formulae of the salt			
	Describe how soluble salts can be made from acids and how pure, dry samples of salts can be obtained			
	<i>Required practical 8: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution</i>			
	Recall what the pH scale measures and describe the scale used to identify acidic, neutral or alkaline solutions			
	Define the terms acid and alkali in terms of production of hydrogen ions or hydroxide ions (in solution), define the term base			
	Describe the use of universal indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions			
	<b>HT ONLY: Use and explain the terms dilute and concentrated (in terms of amount of substance) and weak and strong (in terms of the degree of ionisation) in relation to acids</b>			
	<b>HT ONLY: Explain how the concentration of an aqueous solution and the strength of an acid affects the pH of the solution and how pH is related to the hydrogen ion concentration of a solution</b>			
5.4.3 Electrolysis	Describe how ionic compounds can conduct electricity when dissolved in water and describe these solutions as electrolytes			
	Describe the process of electrolysis			
	Describe the electrolysis of molten ionic compounds and predict the products at each electrode of the electrolysis of binary ionic compounds			

	Explain how metals are extracted from molten compounds using electrolysis and use the reactivity series to explain why some metals are extracted with electrolysis instead of carbon				
	Describe the electrolysis of aqueous solutions and predict the products of the electrolysis of aqueous solutions containing single ionic compounds				
	<i>Required practical 9: investigate what happens when aqueous solutions are electrolysed using inert electrodes</i>				
	<b>HT ONLY: Describe the reactions at the electrodes during electrolysis as oxidation and reduction reactions and write balanced half equations for these reactions</b>				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.5 Energy changes (Paper 1)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.5.1 Exothermic and endothermic reactions</b>	Describe how energy is transferred to or from the surroundings during a chemical reaction				
	Explain exothermic and endothermic reactions on the basis of the temperature change of the surroundings and give examples of everyday uses				
	<i>Required practical 10: investigate the variables that affect temperature changes in reacting solutions</i>				
	Describe what the collision theory is and define the term activation energy				
	Interpret and draw reaction profiles of exothermic and endothermic reactions, including identifying the relative energies of reactants and products, activation energy and overall energy change				
	<b>HT ONLY: Explain the energy changes in breaking and making bonds and calculate the overall energy change using bond energies</b>				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.6 The rate and extent of chemical change (Paper 2)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.6.1 Rate of reaction</b>	Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm <sup>3</sup> /s or mol/s				
	Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction				
	<b>HT ONLY: Calculate the gradient of a tangent to the curve on the graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction</b>				
	Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts				
	<i>Required practical 11: investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity</i>				
	Use collision theory to explain changes in the rate of reaction, including discussing activation energy				
	Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems				

	Draw and interpret reaction profiles for catalysed reactions				
5.6.2 Reversible reactions and dynamic equilibrium	Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: $A + B \rightleftharpoons C + D$				
	Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction				
	Describe the State of dynamic equilibrium of a reaction as the point when the forward and reverse reactions occur at exactly the same rate				
	<b>HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions</b>				
	<b>HT ONLY: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction</b>				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.7 Organic chemistry (Paper 2)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
5.7.1 Carbon compounds as fuels and feedstock	Describe what crude oil is and where it comes from, including the basic composition of crude oil and the general chemical formula for the alkanes				
	State the names of the first four members of the alkanes and recognise substances as alkanes from their formulae				
	Describe the process of fractional distillation, state the names and uses of fuels that are produced from crude oil by fractional distillation				
	Describe trends in the properties of hydrocarbons, including boiling point, viscosity and flammability and explain how their properties influence how they are used as fuels				
	Describe and write balanced chemical equations for the complete combustion of hydrocarbon fuels				
	Describe the process of cracking and state that the products of cracking include alkanes and alkenes and describe the test for alkenes				
	Balance chemical equations as examples of cracking when given the formulae of the reactants and products				
	Explain why cracking is useful and why modern life depends on the uses of hydrocarbons				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.8 Chemical analysis (Paper 2)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
5.8.1 Purity, formulations and chromatography	Define a pure substance and identify pure substances and mixtures from data about melting and boiling points				
	Describe a formulation and identify formulations given appropriate information				
	Describe chromatography, including the terms stationary phase and mobile phase and identify pure substances using paper chromatography				
	Explain what the $R_f$ value of a compound represents, how the $R_f$ value differs in different solvents and interpret and determine $R_f$ values from chromatograms				
	<b>Required practical 12: investigate how paper chromatography can be used to separate and tell the difference between coloured substances (inc calculation of <math>R_f</math> values)</b>				

	Explain how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine				
<b>AQA TRILOGY Chemistry (8465) from 2016 Topics T5.9 Chemistry of the atmosphere (Paper 2)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.9.1 The composition and evolution of the Earth's atmosphere</b>	Describe the composition of gases in the Earth's atmosphere using percentages, fractions or ratios				
	Describe how early intense volcanic activity may have helped form the early atmosphere and how the oceans formed				
	Explain why the levels of carbon dioxide in the atmosphere changes as the oceans were formed				
	State the approximate time in Earth's history when algae started producing oxygen and describe the effects of a gradually increasing oxygen level				
	Explain the ways that atmospheric carbon dioxide levels decreased				
<b>5.9.2 Carbon dioxide and greenhouse gases</b>	Name some greenhouse gases and describe how they cause an increase in Earth's temperature				
	List some human activities that produce greenhouse gases				
	Evaluate arguments for and against the idea that human activities cause a rise in temperature that results in global climate change				
	State some potential side effects of global climate change, including discussing scale, risk and environmental implications				
	Define the term carbon footprint and list some actions that could reduce the carbon footprint				
<b>5.9.3 Common atmospheric pollutants</b>	Describe the combustion of fuels as a major source of atmospheric pollutants and name the different gases that are released when a fuel is burned				
	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				
	Describe the properties and effects of carbon monoxide, sulfur dioxide and particulates in the atmosphere				
	Describe and explain the problems caused by increased amounts of these pollutants in the air				
<b>AQA TRILOGY Chemistry (8464) from 2016 Topics T5.10 Using resources (Paper 2)</b>					
<b>To pic</b>	<b>Student Checklist</b>	<b>R</b>	<b>A</b>	<b>G</b>	
<b>5.10.1 Using the Earth's resources and obtaining potable water</b>	State what humans use Earth's resources for, give some examples of natural resources that they use				
	Define the term finite and distinguish between finite and renewable resources				
	Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes				
	State examples of natural products that are supplemented or replaced by agricultural and synthetic products				
	Discuss the importance of water quality for human life, including defining potable water				
	Describe methods to produce potable water, including desalination of salty water or sea water and the potential problems of desalination				

	<b>Required practical 13: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</b>				
	Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals				
	Describe the process of sewage treatment and compare the ease of obtaining potable water from waste water as opposed to ground or salt water				
	<b>HT ONLY: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching</b>				
	<b>HT ONLY: Evaluate alternative methods for extracting metals</b>				
5.10.2 Life cycle assessment and	Describe, carry out and interpret a simple comparative life cycle assessment (LCA) of materials or products				
	Discuss the advantages and disadvantages of LCAs				
	Carry out simple comparative LCAs for shopping bags made from plastic and paper				
	Discuss how to reduce the consumption of raw resources and explain how reusing and recycling reduces energy use (inc environmental impacts)				