Triple Science - Chemistry Paper 1 Higher Tier Personal Learning Checklist (PLC)

C1 Atomic Structure and the Periodic Table

Learning Objectives:	Confidence		
	R	A	G
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			
HT ONLY: Write balanced half equations and ionic equations			
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			
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			
Chem ONLY: Describe the properties of transition metals and compare them with group 1 elements, including melting points and densities, strength and hardness, and reactivity (for CR, Mn Fe, Co, Ni & Cu)			

C2 Bonding

Learning Objectives:	Confidence		
	R	A	G
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			
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			
HT ONLY: Discuss the limitations of particle theory			
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			
Chem ONLY: Compare the dimensions of nanoparticles to other particles and explain the effect of their surface area to volume ratio on their properties			
Chem ONLY: Discuss the applications of nanoparticles and their advantages and disadvantages, including uses in medicine, cosmetics, fabrics and the development of catalysts			

C3 Quantitative Chemistry

Learning Objectives:	Confidence		
	R	A	G
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			
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			
HT ONLY: Use the relative formula mass of a substance to calculate the number of moles in a given mass of the substance			
HT ONLY: Calculate the masses of reactants and products when given a balanced symbol equation			
HT ONLY: Use moles to write a balanced equation when given the masses of reactants and products (inc changing the subject of the equation)			
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			
Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution			
HT ONLY: Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution			
Chem ONLY: Explain why it is not always possible to obtain the calculated or expected amount of a product			
Chem ONLY: Calculate the theoretical amount of a product and percentage yield of a product using the formula ***% yield = mass of product made/max theoretical mass of product x 100***			
Chem & HT ONLY: Calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction			
Chem ONLY: Describe atom economy as a measure of the amount of reactants that end up as useful products			
Chem ONLY: Calculate the percentage atom economy of a reaction to form a desired product using the equation ***% atom economy =RfM of desired product/sum of RfM of all reactants x 100***			
Chem & HT ONLY: Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data			
Chem & HT ONLY: Calculate the amount of solute (in moles or grams) in a solution from its concentration in mol/dm^3			
Chem & HT ONLY: Calculate the concentration of a solution when it reacts completely with another solution of a known concentration			
Chem & HT ONLY: Describe how to carry out titrations of strong acids and strong alkalis and calculate quantities in titrations involving concentrations in mol/dm^3 and g/dm^3			
Chem & HT ONLY: Explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution			
Chem & HT ONLY: Explain what the volume of one mole of any gas at room temperature is			
Chem & HT ONLY: Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass			

C4 Chemical Changes

Learning Objectives:	Confidence

	R	A	G
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			
HT ONLY: Describe oxidation and reduction in terms of loss and gain of electrons			
HT ONLY: Write ionic equations for displacement reactions, and identify which species are oxidised and reduced from a symbol or half equation			
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 & H_2SO_4)			
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			
Required practical 1: *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*			
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			
Chem ONLY: Describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids to find the reacting volumes accurately			
Chem & HT ONLY: Calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3			
Chem ONLY: ***Required practical 2:*** *determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration*			
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			
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			
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			
Required practical 3: *investigate what happens when aqueous solutions are electrolysed using inert electrodes*			
HT ONLY: Describe the reactions at the electrodes during electrolysis as oxidation and reduction reactions and write balanced half equations for these reactions			

C5 Energy Changes

Learning Objectives:	Confidence		
	R	A	G
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			
***Required practical 4**: investigate the variables that affect temperature changes in reacting solutions*			
Describe what the collision theory is and define the term activation energy			
Interpret and draw reaction profiles of exothermic and endothermic reactions, inc identifying the relative energies of reactants and products, activation energy and overall energy change			
HT ONLY: Explain the energy changes in breaking and making bonds and calculate the overall energy change using bond energies			
Chem ONLY: Describe what a simple cell and a battery is and how they produce electricity			
Chem ONLY: Describe why alkaline batteries are non-rechargeable, state why some cells are rechargeable and evaluate the use of cells			
Chem ONLY: Describe fuel cells and compare fuel cells to rechargeable cells and batteries			
Chem ONLY: Describe the overall reaction in a hydrogen fuel cell			
Chem & HT ONLY: Write half equations for the electrode reactions in a hydrogen fuel cell			