Medium Term Planning - Topic: Chemical calculations

Curriculum Intent	In addition to working further on objectives from Year __, pupils will be taught, following National Curriculum guidelines, the following this topic:
Skills/National Curriculum Links	**Aiming for Grade 4 LOs:** • Use the periodic table to identify the relative atomic mass for the first 20 elements. Calculate the relative formula mass for familiar compounds when the formula is supplied and is without brackets. **Aiming for Grade 6 LOs:** • Use the periodic table to find the relative atomic mass of all elements. • Calculate the relative formula mass for unfamiliar compounds when the formula is given. **State the units for the amount of substance.** • Explain why relative atomic masses may not be a whole number. • Explain why some elements have the same relative atomic mass as each other. **Calculate the number of moles or mass of a substance from data supplied.** **Aiming for Grade 6 LOs:** • Explain why chemical equations must be balanced. Calculate the relative formula mass for one substance when the relative formula masses are given for all the other substances in a balanced symbol equation. **Aiming for Grade 8 LOs:** • Interpret balanced symbol equations in terms of mole ratios. Use balanced symbol equations to calculate reacting masses. **Aiming for Grade 6 LOs:** • Explain why chemical equations must be balanced. Identify the limiting reactant in a chemical reaction. **Aiming for Grade 8 LOs:** • Explain the effect of a limiting reactant on the amount of product made. Explain the effect of a limiting reactant on the amount of product made. **Aiming for Grade 4 LOs:** • State the definition of theoretical yield, actual yield, and percentage yield. Calculate percentage yield when actual yield and theoretical yield are given. **Aiming for Grade 6 LOs:** • Calculate percentage yield when the actual yield is given and the mass of the limiting reactant is given. List reasons why actual yield is often lower than theoretical yield. **Aiming for Grade 8 LOs:** • Calculate the percentage yield using a variety of units and conversions. Justify why percentage yield can never be above 100%. **Aiming for Grade 4 LOs:** • Calculate the formula mass of substances when the formula is given. • Balance simple equations State a definition of atom economy **Aiming for Grade 6 LOs:** • Calculate the atom economy for a given chemical reaction. Explain why using reactions with high atom economy is important. **Aiming for Grade 8 LOs:** • Evaluate different reactions to decide the best production method of a chemical. Explain why the sum of the formula masses of the reactants is the same as the sum of the formula masses of the products. **Aiming for Grade 4 LOs:** • Describe what the concentration of a solution is. Calculate the concentration of a solution in g/dm^3 when given the mass of solute in g and volume of solution in dm^3. **Aiming for Grade 6 LOs:** • **Explain how concentration of a solution can be changed.** Calculate the mass of solute (in g) in a solution when given the concentration in g/dm^3 and volume in dm^3 or cm^3. **Aiming for Grade 8 LOs:** • Calculate the mass of a chemical when any volume and concentration is given. Explain the concentration of a solution in terms of particles. **Aiming for Grade 4 LOs:** • Accurately read the volume on a burette to 1 decimal place. Identify concordant results

	Aiming for Grade 6 LOs: • Calculate a titre. • Describe how an indicator can be used to determine the end point. Explain how accuracy can be improved in a titration. **Aiming for Grade 8 LOs:** • Justify the use of a pipette and burette for a titration, evaluating the errors involved in reading these instruments. • Explain how precise results are obtained in a titration. Justify the use of an indicator in an acid–base titration. **Aiming for Grade 6 LOs:** • Calculate the concentration of a solution in mol/dm^3 when given the amount of solute in moles and volume of solution in dm^3. • Calculate the amount of acid or alkali needed in a neutralisation reaction. Calculate the mole and mass of solute (in g) in a solution when given the concentration in mol/dm^3 and volume in dm^3 or cm^3. **Aiming for Grade 8 LOs:** • Calculate the unknown concentration of a reactant in a neutralisation reaction when the volumes are known and the concentration of one reactant is also known. Extract data from given information to perform multi-step calculations independently. **Aiming for Grade 6 LOs:** • Calculate the amount in moles of gas in a given volume at room temperature and pressure. Convert units **Aiming for Grade 8 LOs:** Suggest how the volume of gas would change when temperature or pressure was changed. Calculate the moles or volume of a gaseous substance involved in a chemical reaction.
Spiritual, moral, social, and cultural development	**SMSC:** group work from practical activities in this section. Also pupils can work in groups to produce a timeline for the development of the periodic table. **PSHE/British Values:** The history of the is important development of the atom when learning about british values and world values. Students will complete teamwork, leadership and put science into everyday situations. They will show mutual respect during classwork. **Skills Builder:**Listening (Receiving, retaining and processing info), Speaking (The oral transmission of info and ideas), Problem solving (Find a solution to a situation or challenge), Creativity (imagination and generation of new ideas), Staying positive (The ability to use tactics and strategies to overcome setbacks), aiming high (Set clear and tangible goals), Leadership and teamwork
Numeracy	
Literacy	**Vocabulary Tier 2:** compounds, molecular, symbol, reaction, reactants, excess, limiting, apparatus, neutralization, solvent, solute, acid, alkali, **Vocabulary Tier 3:** avagadro constant, burette, concentration, concordant, end point, limiting reactant, mole, percentage yield, pipette, relative atomic mass, Ar, relative formula mass, Mr, titration, yield. **Reading:** Following a written method and read risk assessments. Students may be directed to the textbook; this could be in lesson or at home on Kerboodle. **Writing:** Describing and explaining scientific phenomenon, free response writing for describing precautions taken, use of word mat to promote sentence formation. **Oracy:** inclusion of BEST resources which are research evidence on common misunderstandings in science, effective diagnostic questioning and formative assessment, constructivist approaches to building understanding, and effective sequencing of key concepts that promote metacognitive talk and dialogue.
Becoming future ready	**Careers/Employability:** Scientist Chemist Drug development Teacher Post-doctoral researcher
Adaptation	Throughout this topic, quality first teaching will provide differentiation:

QFT/SEND Provision	**By product:** Linear assessments and differentiated practical work. **By resource:** Lessons are differentiated per class and students, worksheets are available if support and assessments are linear. **By Intervention**: by providing different levels of supervision and support **By Progressive Questioning:** exploring pupils' understanding through interactive dialogue. **By Grouping:** according to prior attainment, gender, social preference, preferred learning style. **By Offering Optional Activities:** In class or as homework, to extend learning. This QFT/SEND provision will be explicit within the lesson-by-lesson schemes of work.
Implementation Curriculum Delivery Learning Outcomes **(Core Knowledge)**	To be able to: 3.1.2 The relative formula mass *M*r of a compound is the **sum of the relative atomic masses of the atoms** in the numbers shown in the formula. **3.2.1 Chemical amounts are measured in moles. The symbol for the unit mole is mol.** **The mass of one mole of a substance in grams is numerically equal to its relative formula mass.** **One mole of a substance contains the same number of the stated particles, atoms, molecules, or ions as one mole of any other substance.** **The number of atoms, molecules, or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} per mole.** Students should understand that the measurement of amounts in **moles** can apply to atoms, molecules, ions, electrons, formulae, and equations, for example that in **one mole of carbon, C, the number of atoms is the same as the number of molecules in one mole of carbon dioxide, CO_2.** **Students should be able to use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa.** 3.2.2 The masses of reactants and products can be calculated from balanced symbol equations. Chemical equations can be interpreted in terms of moles. For example: $Mg + 2HCl \rightarrow MgCl_2 + H_2$ shows that one mole of magnesium reacts with two moles of hydrochloric acid to produce one mole of magnesium chloride and one mole of hydrogen gas. Students should be able to: • calculate the **masses of substances shown in a balanced symbol equation** • calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant or product. 3.2.3 The balancing numbers in a symbol equation can be calculated from the masses of reactants and products by converting the masses in grams to amounts in moles and converting the numbers of moles to simple whole number ratios. Students should be able to balance an equation given the masses of reactants and products. Students should be able to change the subject of a mathematical equation. 3.2.4 In a chemical reaction involving two reactants, it is common to use an excess of one of the reactants to ensure that all of the other reactant is used. The reactant that is completely used up is called the limiting reactant because it limits the amount of products. Students should be able to explain the effect of a **limiting quantity of a reactant** on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams. 3.3.1 Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because: • the reaction may not go to competition because it is reversible • some of the product may be lost when it is separated from the reaction mixture • some of the reactants may react in ways different to the expected reaction. The amount of a product obtained is known as the **yield**. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield. **% yield = mass of product actually made maximum theoretical mass of product × 100** Students should be able to: • calculate the theoretical amount of a product from a given amount of reactant and the balanced equation for the reaction • calculate the percentage yield of a product from the actual yield of a reaction. 3.3.2 The atom economy (atom utilisation) is a measure of the amount of starting materials that end up as useful products. It is important for sustainable development and for economic reasons to use reactions with high atom economy. The percentage atom economy of a reaction is calculated using the balanced symbol equation for the reaction as follows:

	relative formula mass of desired product from equation sum of relative formula masses of all reactants from equation × 100 Students should be able to: • calculate the atom economy of a reaction to form a desired product from the balanced equation • **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**. 3.2.5 Many chemical reactions take place in solutions. The concentration of a solution can be measured in mass per given volume of solution, for example, grams per dm^3 (g/dm^3). Students should be able to: • calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution • **explain how the mass of a solute and the volume of a solution is related to the concentration of the solution.** 3.2.5 The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator. Students should be able to: • **describe how to carry out titrations** using strong acids and strong alkalis only (sulfuric, hydrochloric, and nitric acids only) to find the **reacting volumes accurately**. **Required practical:** Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. 3.4 The concentration of a solution can be **measured in mol/dm^3. The amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in mol/dm^3.** If the volumes of two solutions that react completely are known and the concentration of one solution is known, the concentration of the other solution can be calculated. Students should be able to explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution. 4.2.5 Students should be able to: • calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3. **Required practical: Determination of the concentration of one of the solutions in mol/dm^3 and g/dm^3 from the reacting volumes and the known concentration of the other solution.** **3.5 Equal amounts in moles of gases occupy** **the same volume under the same conditions of temperature and pressure.** **The volume of one mole of any gas at room temperature and pressure (20 °C and 1 atmosphere pressure) is 24 dm^3.** **The volume of gaseous reactants and products can be** **calculated from the balanced equation for the reaction.** Students should be able to: • calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass • calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product.
Current learning to be developed in the future within:	A level chemistry students will again cover all the topic again, with a lot more detailed focus on all the calculations.
Assessment	Refer to assessment maps for formative and summative assessment opportunities.
Impact	Attainment and Progress – Refer to assessment results / data review documentation.