UNIT 5 Amount of substance

Recommended Prior Knowledge Unit 1. This unit is best taught towards the middle of the course when students have become familiar with using formulae and equations.
Context The skills taught in this unit are necessary for all other units. It is strongly suggested that ideas about symbols, equations and calculations are taught using an integrated approach through all other units. This unit should link together and revise ideas that have been introduced in earlier units. Unit 5 should be taught before Unit 6 and Unit 7.
Outline The unit contains skills of using calculations to calculate amounts of substances, including volumes of gases, in chemical reactions. These calculations are useful in handling data throughout the course. Volumetric analysis is routinely assessed in the practical component of the examination.

A list of mathematical requirements for candidates is available under Appendix 1 of the syllabus.

	Summary of learning Outcomes (see syllabus for full detail)	**Suggested Teaching Activities**	**Further teacher guidance**	**Online resources**
3 a b c d	**Formulae, Stoichiometry and the mole concept** Know the symbols and formulae of elements and compounds named in the syllabus. Deduce formulae of compounds Interpret and construct chemical equations (including ionic equations and state symbols)	It is strongly suggested that these ideas are taught using an integrated approach across the syllabus. It is expected that examination candidates will be able to write, interpret and use formulae and equations fluently across all units. It is suggested that the use of symbols is introduced in Unit 1, with the teaching of atomic structure. The use of equations and formulae can be introduced in Unit 2 in the context of the Periodic Table and reactions of Groups I and VII. There are opportunities to teach and practise ionic equations in displacement reactions (Group VII [introductory work in Unit 2] and metals[Unit 6]) and in electrolysis [Unit 9].	Students can be given a copy of the Periodic Table (use Appendix 2 of the syllabus) and a list of guidance notes for writing symbols and formulae, and for writing and balancing equations. These notes can be stuck in the front cover of their books – or in a prominent section of their files - so that they can refer to them during the course.	www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Elements, Compounds, Mixtures' www.s-cool.co.uk/contents.asp click on 'GCSE revision' then 'Chemistry' then choose topic: 'Writing formulae and balancing equations'. Use the 'Quick learn' section.
e f	Define relative atomic mass, A_r define and calculate relative molecular mass, M_r.	It is suggested that this is covered in Units 1 and 3. Students should be able to work out relative molecular masses using formulae of compounds and by referring to the Periodic Table.		www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 5 www.wpbschoolhouse.btinter

g		Students should be able to calculate the % by mass of an element in a compound.	Fertilisers are useful examples for this type of calculation.	net.co.uk/page10/page10.htm Click on 'Chemical Calculations'
h	calculate empirical and molecular formulae	Suggested experiment: Heating magnesium to form magnesium oxide and working out its formula. Students should understand, with reference to structures met in Units 2 and 4, such as polyethene, sodium chloride and silicon dioxide, that some formulae represent simple ratios. Suitable molecules for illustrating empirical formulae include hydrocarbons (alkanes and alkenes), phosphorus oxides and polymers.	See Appendix 1 of the current syllabus for advice about mathematical requirements. This experiment is useful in terms of processing a class set of results using a spreadsheet such as Excel and plotting the graph.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 61, 67, 90
i	calculate reacting masses and volumes of gases using the mole concept	Students should practise working out reacting masses on both an experimental scale, using grams, and an industrial scale, using tonnes. Less able students can work out reacting masses from ratios of masses in the equation without learning about molar amounts. Students can be given a set of rules for guidance to carry out these calculations. These can be stuck in the back cover of their books for reference – or in a prominent section of their files - during later Units.	These skills should be practised in the context of the later units of the course. It is common for examination questions to test calculation skills in the context of other syllabus areas. Suitable contexts for practising calculations include reaction rates, acids, bases and salts, metal reactions and extraction and organic chemistry.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 68 www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Chemical Calculations' http://www.boc.com/education/formulae_/formula.html
j	process results of volumetric experiments using the concept of solution concentration	Suggested experiments: • Acid-base titrations e.g. dilute hydrochloric or sulphuric acid with aqueous sodium hydroxide. • Potassium manganate(VII) titrations.	Use past practical (or alternative to practical) papers for examples of common volumetric calculations.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 8, 45, 48, 5

		Students should practise calculating concentrations from titres and equations.	It is important that the techniques of rough and accurate titres are practised to prepare for the practical paper.	
k	calculate percentage yield and purity.	Students need to be able to identify the limiting factor that determines the maximum yield. Suggested experiments: Determination of percentage yield: Preparation of copper sulphate from an excess of copper carbonate and a known volume of sulphuric acid. Purity: Determination of the copper carbonate content of a weighed sample of malachite by reaction with sulphuric acid. The calculation can either be based on the dried residue waste, or on a back-calculation from the mass of copper sulphate produced (this will need heating and drying to the anhydrous form).	Again, use past practical papers for examples of this type of calculation. Alternatively, this can be taught as an integral part of the preparation of salts in Unit 8 or the amount of metals in ores in Unit 6.	