4.3.4 (HT only)	**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.**	**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.** **WS 4.2, 4.3, 4.6** **MS 1a, 1c, 3b, 3c**	**1**	**Explain the meaning of concentration and the unit mol per dm^3.** **Be able to convert cm^3 into dm^3.** **Use the equation** $C = n / v$ **to calculate the concentration of a solution.** **Rearrange the equation** $C = m / v$ **to make number of moles the subject.** **Extended writing: write instructions to another student on how to calculate the concentration, or how to rearrange the equation to calculate number of moles** **Extended writing: write instructions to another student on how to carry out a titration. Include reasons for using a burette instead of other measuring equipment.** **Grade 9: explain why indicators eg methyl orange and phenolphthalein are used instead of Universal indicator.**	**Titrate HCl with NaOH using an indicator of methyl orange.** **Use the titre results and know volumes of NaOH and concentration, to calculate the concentration of the HCl.**	**Video clip** **YouTube:** **Concentration formula and calculations**	

4.4.2.5	The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator.	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. (HT Only) Calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3. WS 2.4, 2.6 MS 1a, 1c, 2a	2		**Required practical 2:** Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) 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. AT skills covered by this practical activity: 1 and 8		Past paper question 8 specimen paper 1 set 1 Past paper question 9 specimen paper 1 set 2.
4.3.5 (HT only)	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 volumes of gaseous reactants and products can be calculated from	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	0.5	Recall the equation: $\frac{number\ of\ moles\ =\ mass}{relative\ formula\ mass}$ Use the equation: volume of gas at rtp = number of moles x molar gas volume (24 dm^3) for simple examples. Extended writing: write instructions to another		YouTube: Molar volumes of gases YouTube: Calculating gas volume	Past paper question 7 specimen paper 1 set 1 TEST

	the balanced equation for the reaction.	equation and a given volume of a gaseous reactant or product. Change the subject of a mathematical equation. WS 1.2, 4.1, 4.2, 4.3, 4.6 MS 1a, 1c, 3c, 3d		student on how to calculate the volume of a gas. Use balanced equations and known volume of reactant/product to calculate the volumes of gaseous reactants/ products.			

Spec ref.	**Summary of the specification content**	**Learning outcomes** *What most candidates should be able to do*	**Suggested timing (hours)**	**Opportunities to develop Scientific Communication skills**	**Opportunities to develop and apply practical and enquiry skills**	**Self/peer assessment opportunities and resources** *Reference to past questions that indicate success*	Key pieces of assessed work	
4.8.3.1	Flame tests can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests:	Identify species from the results of the tests in 8.3a to 8.3e. *Flame colours of other metal*	1	Describe the flame tests for identifying cations to another student. Research how firework manufacturers	Carry out flame tests on the following cations: • lithium • sodium • potassium • calcium • copper.	Video clip YouTube: Testing for positive ions – Part 1		

	• lithium compounds result in a crimson flame • sodium compounds result in a yellow flame • potassium compounds result in a lilac flame • calcium compounds result in an orange-red flame • copper compounds result in a green flame. If a sample containing a mixture of ions is used, some flame colours can be masked.	*ions are **not** required knowledge.* WS 2.2		produce the different colours in fireworks.	AT 8		
4.8.3.2	Sodium hydroxide solution can be used to identify some metal ions (cations). Solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate dissolves in excess sodium hydroxide solution. Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added. Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate.	Be able to write balanced equations for the reactions to produce the insoluble hydroxides. *Students are **not** expected to write equations for the production of sodium aluminate.* WS 2.2	2	Describe how sodium hydroxide can be used to identify some cations to another student.	Use sodium hydroxide to test for the following cations: • aluminium • calcium • magnesium • copper(ll) • iron(ll) • iron(lll). AT8		

4.8.3.3	Carbonates react with dilute acids to form carbon dioxide gas. Carbon dioxide can be identified with limewater.		1	Describe how dilute acids can be used to identify carbonates to another student.	Use dilute acid to test for the following carbonates: • sodium carbonate • potassium carbonate. Analyse the composition of an egg shell, testing for the presence of various ions using acids and other test tube reactions and flame tests.	Video clip: YouTube: Sulfate and Carbonate Tests	
4.8.3.4	Halide ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid. Silver chloride is white, silver bromide is cream and silver iodide is yellow.		1	Describe how silver nitrate can be used to identify halides to another student.	Use silver nitrate to test the following halides: • chloride • bromide • iodide.	Video clip: YouTube: Halide ion tests	
4.8.3.4	Halide ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid. Silver chloride is white, silver bromide is cream and silver iodide is yellow.		1	Describe how silver nitrate can be used to identify halides to another student.	Use silver nitrate to test the following halides: • chloride • bromide • iodide.	Video clip: YouTube: Halide ion tests	
4.8.3.6	Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid.	State advantages of instrumental methods compared with the chemical tests in this specification.	0.5		Research instrumental methods for detecting elements and compounds. Compare these to chemical tests carried out in this specification.		

		WS 1.4			Suggest advantages of the instrumental methods compared with the chemical tests.		
4.8.3.7	Flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions. The sample is put into a flame and the light given out is passed through a spectroscope. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.	Interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set in the same form, limited to flame emission spectroscopy. WS 3.6 MS 4a	1	Describe the process of flame emission spectroscopy. Explain what happens to a sample throughout the process of flame emission spectroscopy. Interpret instrumental results for flame emission spectroscopy. Research how chemical analysis has been used to detect and solve crimes especially in forgery and murder by poisoning. Research how robotic spacecraft sent to investigate other planets analyse their atmospheres and surface materials using instrumentation. Discuss the advantages and disadvantages of instrumental analysis versus test tube analysis.	Research how flame emission spectroscopy takes place. An opportunity to observe flame spectra using a hand-held spectroscope. AT 8	Video clip YouTube: Atomic Emission Spectroscopy	Past paper question 1 specimen paper 2 set 2 Past paper question 7 specimen paper 2 set 1 EXAM