Topic 1

	Qualitative analysis	
1.1	Demonstrate an understanding that analysis may be qualitative or quantitative	
1.2	Explain why the test for any ion must be unique	
1.3	Describe tests to show the presence of the following ions in solids or solutions as appropriate: a Al^{3+}, Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+} using sodium hydroxide solution b NH_4^+ using sodium hydroxide solution, warming and testing for the ammonia gas produced c Cl^-, Br^-, I^- using dilute nitric acid and silver nitrate solution	
1.4	*Identify the ions in unknown salts, using the tests above and in unit C2, specification point 2.15*	
1.5	Demonstrate an understanding that these tests form the basis for testing by chemists: a working in the water industry to check the purity of drinking water b for the presence of substances in the blood	

Topic 2

	Quantitative analysis	
2.1	Calculate the concentration of solutions in g dm^{-3}	
2.2	Demonstrate an understanding that some areas of the country have dissolved calcium or magnesium ions in their tap water and that the presence of these ions makes the water hard	
2.3	Describe problems caused by hard water, including: a it does not easily form a lather with soap b it reacts with soap to form a precipitate (“scum”), which causes soap to be wasted	
2.4	Describe hard water as either temporary or permanent, and describe how boiling removes temporary hardness but not permanent hardness	
2.5	Explain how hard water can be softened by removing the dissolved calcium and/or magnesium ions and that this can be done by: a boiling (for temporary hard water only) b using an ion exchange resin	
2.6	*Evaporate a solution to dryness to determine the mass of solute in a given mass of solution*	
2.7	**Demonstrate an understanding that the amount of a substance can be measured in grams, numbers of particles or number of moles of particles**	
2.8	**Convert masses of substances into moles of particles of the substance and vice versa**	
2.9	**Convert concentration in g dm^{-3} into mol dm^{-3} and vice versa**	
2.10	Demonstrate an understanding that if soluble salts are prepared from an acid and an insoluble reactant: a excess of the reactant can be added to ensure that all the acid is used up b the excess reactant can be removed by filtration c the solution remaining is only salt and water	
2.11	Demonstrate an understanding that if soluble salts are prepared from an acid and a soluble reactant: a titration must be used to determine the exact amount of the soluble reactant that reacts with an acid	

	b the acid and the soluble reactant can then be mixed in the correct proportions c the solution remaining after reaction is only salt and water	
2.12	Describe an acid-base titration as a neutralisation reaction where hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the base	
2.13	Describe how to carry out simple acid-base titrations using burette, pipette and suitable acid-base indicators	
2.14	*Carry out an acid-base titration to prepare a salt from a soluble base*	
2.15	**Carry out simple calculations using the results of titrations to calculate an unknown concentration of a solution or an unknown volume of solution required.**	

Topic 3

	Electrolytic processes	
3.1	Explain that electrolytes are ionic substances in the molten state or dissolved in water	
3.2	Describe the movement of ions during electrolysis, such that: a positively charged cations migrate to the negatively charged cathode b negatively charged anions migrate to the positively charged anode	
3.3	Demonstrate an understanding that oxidation can involve the loss of electrons and reduction can involve the gain of electrons	
3.4	Demonstrate an understanding that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions	
3.5	**Write half equations for reactions occurring at the anode and cathode in examples of electrolysis reactions in this unit**	
3.6	Describe the manufacture of sodium by the electrolysis of molten sodium chloride (details of the electrolytic cell are not required)	
3.7	Recall that sodium can be used in street lamps and as a coolant in some nuclear reactors	
3.8	*Electrolyse sodium chloride solution*	
3.9	Explain the formation of the products in the electrolysis of sodium chloride solution	
3.10	Describe how the electrolysis of aqueous solutions can give products from ions in water, rather than from ions of the dissolved solid	
3.11	Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including: a copper chloride solution b copper sulfate solution c sodium sulfate solution d molten lead bromide	
3.12	*Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes*	
3.13	Describe the purification of copper by electrolysis using a pure copper cathode and an impure copper anode	
3.14	Explain how electroplating can be used to improve the appearance and/or the resistance to corrosion of metal objects	

Topic 4

	Gases, equilibria and ammonia	
4.1	**Demonstrate an understanding that one mole of any gas occupies 24**	

	dm3 at room temperature and atmospheric pressure and that this is known as the molar volume of the gas	
4.2	**Use molar volume and balanced equations in calculations involving the masses of solids and volumes of gases**	
4.3	**Use Avogadro's law to calculate volumes of gases involved in gaseous reactions, given the relevant equations**	
4.4	Recall that nitrogenous fertilisers are manufactured from ammonia and that they promote plant growth	
4.5	Demonstrate an understanding of the environmental consequences of the over-use of fertilisers, including excessive plant growth in rivers and lakes	
4.6	Recall that chemical reactions are reversible and that the Haber process uses a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) to form ammonia	
4.7	**Demonstrate an understanding of the concept of dynamic equilibrium**	
4.8	**Explain how the position of a dynamic equilibrium is affected by changes in:** a **temperature** b **pressure**	
4.9	**Demonstrate an understanding of the consequential effects of these changes on the rate of attainment of equilibrium and of the need to use a catalyst**	
4.10	**Describe how, in industrial reactions such as the Haber process, the temperature, pressure and catalyst used produce an acceptable yield in an acceptable time**	

Topic 5

	Organic chemistry	
5.1	Describe how ethanol is produced during the fermentation of carbohydrates, including: a that the fermentation mixture is kept warm and under anaerobic conditions b that yeast provides an enzyme for this reaction	
5.2	*Prepare a solution of ethanol by fermentation*	
5.3	Recall that different percentages of ethanol are present in various drinks	
5.4	Demonstrate an understanding of the social issues and possible harmful effects of ethanol in alcoholic drinks	
5.5	Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture	
5.6	**Recall how ethanol can also be manufactured by reacting ethene (from cracking of crude oil fractions) with steam**	
5.7	**Evaluate the factors which are relevant to the choice of method used in the manufacture of ethanol, including:** a **the relative availability of sugar cane or sugar beet and crude oil** b **the quality of the final product and whether it needs further processing**	
5.8	**Recall that the dehydration of ethanol results in the formation of ethene**	
5.9	Define homologous series as a series of compounds which: a have the same general formula b show a gradual variation in physical properties as exemplified by their boiling points c have similar chemical properties	
5.10	Recall the names, formulae and structures of members of the following homologous series:	

	a alkanes, up to 4 carbons atoms per molecule b alkenes, up to 3 carbons atoms per molecule c **alcohols, up to 3 carbons atoms per molecule** d **carboxylic acids, up to 3 carbon atoms per molecule** (no treatment of isomers is required in any of these series)	
5.11	Demonstrate an understanding that ethanol can be oxidised to form ethanoic acid and that this reaction occurs in open bottles of wine and in the production of ethanoic acid in vinegar	
5.12	Describe the use of vinegar as a flavouring and as a preservative	
5.13	Demonstrate an understanding that ethanoic acid is a typical acid, including: a its reaction with metals b its reaction with bases and carbonates to form salts (ethanoates) c its typical effect on indicators	
5.14	Describe the reaction of ethanol with ethanoic acid to produce an ester, ethyl ethanoate and water **including writing an equation for this reaction using molecular and structural formulae**	
5.15	Describe uses of: a esters as flavourings and perfumes, as they are pleasantsmelling b polyesters as fibres to make fabric and as plastics for making bottles (no consideration of the formation of polyester is required)	
5.16	Demonstrate an understanding that polyesters can be recycled to form fleece that is used to make clothing	
5.17	Recall that oils and fats are esters	
5.18	Describe the breaking down of oils and fats, by boiling with concentrated alkali solution, to produce soaps, which are sodium or potassium salts of long carbon chain carboxylic acids	
5.19	**Demonstrate an understanding of how a soap removes dirt or grease, including:** a **that part of the soap anion is hydrophobic and dissolves in dirt or grease** b **that the other part is hydrophilic and dissolves in water**	
5.20	**Demonstrate an understanding that liquid oils can be converted to solid fats by catalytic hydrogenation which removes the C==C unsaturation and that this process is used to manufacture margarine**	