**CHEMISTRY Unit 4 LG and SC**

| **TOPIC NAME**  **and TIMING** | **QCAA Reference**  **&**  **Objectives** | **LEARNING GOALS and SUCCESS CRITERIA** |
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| **Structure of organic compounds**  **Year 12 Week 13 - 15 (7 lessons)** | **Unit 4 - Topic 1**  Objectives | **SC 51** recognise that organic molecules have a hydrocarbon skeleton and can contain functional groups, including alkenes, alcohols, aldehydes, ketones, carboxylic acids, haloalkanes, esters, nitriles, amines, amides and that structural formulas (condensed and extended) can be used to show the arrangement of atoms and bonding in organic molecules  **SC 52** deduce the structural formulas and apply IUPAC rules in the nomenclature of organic compounds (parent chain up to 10 carbon atoms) with simple branching for alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids, haloalkanes, esters, nitriles, amines and amides  **SC** **53** identify structural isomers as compounds with the same molecular formula but different arrangement of atoms; deduce the structural formulas and apply IUPAC rules in the nomenclature for isomers of the non-cyclic alkanes up to C6  **SC** **54** identify stereoisomers as compounds with the same structural formula but with different arrangement of atoms in space; describe and explain geometrical (*cis* and *trans*) isomerism in non-cyclic alkenes |
| **LG 13 I understand and can apply the IUPAC rules for hydrocarbons and simple functional groups**  **LG 14 I can identify, draw and name structural, geometric and stereo isomers for non-cyclic hydrocarbons.** |
|  |  | **STUDENT RESEARCH INVESTIGATION WILL COMMENCE IN WEEK 15 (REFER TO OVERVIEW)** |
| **Organic materials: structure and function**  **Macromolecules: polymers, proteins and carbohydrates**  **Year 12 Week 16 -19 (4 lessons + 5 lessons)** | Unit 4 Tpoic 1 and Topic 2  Objectives 1, 2, 3, 4, 5, 6, 7 | **SC** **55** appreciate that organic materials including proteins, carbohydrates, lipids and synthetic polymers display properties including strength, density and biodegradability that can be explained by considering the primary, secondary and tertiary structures of the materials  **SC** **56** discuss the advantages and disadvantages of polymer use, including strength, density, lack of reactivity, use of natural resources and biodegradability  **SC** **57** describe, using equations, how condensation polymers, including polypeptides (proteins), polysaccharides (carbohydrates) and polyesters, can be produced from their monomers  **SC** **58** describe and explain the primary, secondary (α--helix and β-pleated sheets), tertiary and quaternary structure of proteins  **SC** **59** recognise that enzymes are proteins and describe the characteristics of biological catalysts (enzymes) including that activity depends on the structure and the specificity of the enzyme action  **SC** **60** describe the condensation reaction of 2-amino acids to form polypeptides (involving up to three amino acids), and understand that polypeptides (proteins) are formed when amino acid monomers are joined by peptide bonds  **SC** **61** recognise that monosaccharides contain either an aldehyde group (aldose) or a ketone group (ketose) and several -OH groups, and have the empirical formula CH2O  **SC** **62** distinguish between α-glucose and β-glucose, and compare and explain the structural properties of starch (amylose and amylopectin) and cellulose  **SC** **63** describe the condensation reaction of monosaccharides to form disaccharides (lactose, maltose and sucrose) and polysaccharides (starch, glycogen and cellulose), and understand that polysaccharides are formed when monosaccharides monomers are joined by glycosidic bonds  **SC** **64** recognise that triglycerides (lipids) are esters and describe the difference in structure between saturated and unsaturated fatty acids  **SC** **65** describe, using equations, the base hydrolysis (saponification) of fats (triglycerides) to produce glycerol and its long chain fatty acid salt (soap), and explain how their cleaning action and solubility in hard water is related to their chemical structure  **SC** **66** explain how the properties of polymers depends on their structural features including; the degree of branching in polyethene (LDPE and HDPE), the position of the methyl group in polypropene (syntactic, isotactic and atactic) and polytetrafluorethene  **SC 67** describe, using equations, how addition polymers can be produced from their monomers including polyethene (LDPE and HDPE), polypropene and polytetrafluorethene. |
| **LG 15 I understand the structure and function of the functional groups in proteins, carbohydrates, and fats.**  **LG 16 I can explain and predict the featues of polymers and polymerization reactions.** |
| **Organic reactions and reaction pathways**  **Year 12 Week 20, 21, 22 (6 lesson)** | Unit 4 Topic 1  Objectives 1, 2, 3, 4 | **SC** **68** appreciate that each class of organic compound displays characteristic chemical properties and undergoes specific reactions based on the functional group present; these reactions, including acid-base and oxidation reactions, can be used to identify the class of the organic compound  **SC** **69** understand that saturated compounds contain single bonds only and undergo substitution reactions, and that unsaturated compounds contain double or triple bonds and undergo addition reactions  **SC** **70** determine the primary, secondary and tertiary carbon atoms in halogenoalkanes and alcohols and apply IUPAC rules of nomenclature  **SC** **71** describe, using equations:  ­ oxidation reactions of alcohols and the complete combustion of alkanes and alcohols  ­ substitution reactions of alkanes with halogens  ­ substitution reactions of haloalkanes with halogens, sodium hydroxide, ammonia and potassium cyanide  ­ addition reactions of alkenes with water, halogens and hydrogen halides  ­ addition reactions of alkenes to form poly(alkenes)  **SC** **72** recall the acid-base properties of carboxylic acids and explain, using equations, that esterification is a reversible reaction between an alcohol and a carboxylic acid  **SC** **73** recognise the acid-base properties of amines and explain, using equations, the reaction with carboxylic acids to form amides  **SC** **74** recognise reduction reactions and explain, using equations, the reaction of nitriles to form amines and alkenes to form alkanes  **SC** **75** recognise and explain, using equations, that:  ­ esters and amides are formed by condensation reactions  ­ elimination reactions can produce unsaturated molecule and explain, using equations, the reaction of haloalkanes to form alkenes  **SC** **76** understand that organic reactions can be identified using characteristic observations and recall tests to distinguish between:  ­ alkanes and alkenes using bromine water  ­ primary, secondary and tertiary alcohols using acidified potassium dichromate (VI) and potassium manganate (VII)  **SC** **77** understand that the synthesis of organic compounds often involves constructing reaction pathways that may include more than one chemical reaction |
| **LG 17 deduce reaction pathways, including reagents, condition and chemical equations, given the starting materials and the product.** |
| **Physical properties and trends**  **Year 12 Week 23 (3 lessons)** | Unit 4 Topic 1  Objectives 1, 2, 3, 4 | **SC** **78** recognise that organic compounds display characteristic physical properties, including melting point, boiling point and solubility in water and organic solvents that can be explained in terms of intermolecular forces (dispersion forces, dipoledipole interactions and hydrogen bonds), which are influenced by the nature of the functional groups  **SC** **79** predict and explain the trends in melting and boiling point for members of a homologous series  **SC** **80** discuss the volatility and solubility in water of alcohols, aldehydes, ketones, carboxylic acids and halides. |
| **LG 18 predict and explain the physical properties of boiling point and solubility for simple organic molecules** |
| **Chemical synthesis**  **Year 12 Week 25, 26 (6 lessons)** | **Unit 4 Topic 2**  **Objectives 1, 2, 3, 4, 5, 6, 7** | **SC 81** appreciate that chemical synthesis involves the selection of particular reagents to form a product with specific properties  **SC 82** understand that reagents and reaction conditions are chosen to optimise the yield and rate for chemical synthesis processes, including the production of ammonia (Haber process), sulfuric acid (contact process) and biodiesel (base-catalysed and lipase-catalysed methods)  **SC 83** understand that fuels, including biodiesel, ethanol and hydrogen, can be synthesised from a range of chemical reactions including, addition, oxidation and esterification  **SC** **84** understand that enzymes can be used on an industrial scale for chemical synthesis to achieve an economically viable rate, including fermentation to produce ethanol and lipase-catalysed transesterification to produce biodiesel  **SC** **85** describe, using equations, the production of ethanol from fermentation and the hydration of ethene describe, using equations, the transesterification of triglycerides to produce biodiesel  **SC** **86** discuss, using diagrams and relevant half-equations, the operation of a hydrogen fuel cell under acidic and alkaline conditions  **SC 87** calculate the yield of chemical synthesis reactions by comparing stoichiometric quantities with actual quantities and by determining limiting reagents. |
| **LG 19 I can explain and justify reaction conditions in terms of yield and rate of reaction.**  **LG 20 I can explain and describe the chemistry involved in the production of fuels** |
| **Molecular manufacturing and Green chemistry**  **Year 12 Week 27 (2 lessons and 1 lesson)** | Unit 4 Topic 2  Objectives 1, 6 | **SC 88** appreciate that molecular manufacturing processes involve the positioning of molecules to facilitate a specific chemical reaction; such methods have the potential to synthesise specialised products, including proteins, carbon nanotubes, nanorobots and chemical sensors used in medicine.  Green Chemistry  **SC** **89** appreciate that green chemistry principles include the design of chemical synthesis processes that use renewable raw materials, limit the use of potentially harmful solvents and minimise the amount of unwanted products  **SC** **90** outline the principles of green chemistry and recognise that the higher the atom economy, the ‘greener’ the process  **SC** **91** calculate atom economy and draw conclusions about the economic and environmental impact of chemical synthesis processes. |
| **LG 21 describe the advantages of nanoscale chemical techniques in the manufacturing products.**  **LG 22 explain and calculate the degree to which a chemical process matches the criteria for green chemistry** |
| **Analytical techniques**  **Year 12 Week 28, 29 (5 lessons)** | Unit 4 Topic 1  Objectives 1, 2, 3, 4, 5, 6, 7 | **SC** **92** explain how proteins can be analysed by chromatography and electrophoresis  **SC** **93** select and use data from analytical techniques, including mass spectrometry, x-ray crystallography and infrared spectroscopy, to determine the structure of organic molecules  **SC** **94** analyse data from spectra, including mass spectrometry and infrared spectroscopy, to communicate conceptual understanding, solve problems and make predictions. |
| **LG 23 interpret and explain the results from analytical techniques in order to provide justified identification of simple organic molecules including proteins** |