Topic	Done
Structure of organic compounds	
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	
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	
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	
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	
Physical properties and trends	
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, dipole-dipole interactions and hydrogen bonds), which are influenced by the nature of the functional groups	
predict and explain the trends in melting and boiling point for members of a homologous series	
discuss the volatility and solubility in water of alcohols, aldehydes, ketones, carboxylic acids and halides	
Organic reactions and reaction pathways	
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	
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	
determine the primary, secondary and tertiary carbon atoms in halogenoalkanes and alcohols and apply IUPAC rules of nomenclature	
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)	
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	
recognise the acid-base properties of amines and explain, using equations, the reaction with carboxylic acids to form amides	
recognise reduction reactions and explain, using equations, the reaction of nitriles to form amines and alkenes to form alkanes	
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	
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)	
understand that the synthesis of organic compounds often involves constructing reaction pathways that may include more than one chemical reaction	
deduce reaction pathways, including reagents, condition and chemical equations, given the starting materials and the product	

Organic materials: structure and function	
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	
describe and explain the primary, secondary (α-helix and β-pleated sheets), tertiary and quaternary structure of proteins	
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	
recognise that monosaccharides contain either an aldehyde group (aldose) or a ketone group (ketose) and several -OH groups, and have the empirical formula CH2O	
distinguish between α-glucose and β-glucose, and compare and explain the structural properties of starch (amylose and amylopectin) and cellulose	
recognise that triglycerides (lipids) are esters and describe the difference in structure between saturated and unsaturated fatty acids	
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	
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	
Analytical techniques	
explain how proteins can be analysed by chromatography and electrophoresis	
select and use data from analytical techniques, including mass spectrometry, x-ray crystallography and infrared spectroscopy, to determine the structure of organic molecules	
analyse data from spectra, including mass spectrometry and infrared spectroscopy, to communicate conceptual understanding, solve problems and make predictions	
Chemical synthesis	
appreciate that chemical synthesis involves the selection of particular reagents to form a product with specific properties	
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)	
understand that fuels, including biodiesel, ethanol and hydrogen, can be synthesised from a range of chemical reactions including, addition, oxidation and esterification	
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	
describe, using equations, the production of ethanol from fermentation and the hydration of ethene	
describe, using equations, the transesterification of triglycerides to produce biodiesel	
discuss, using diagrams and relevant half-equations, the operation of a hydrogen fuel cell under acidic and alkaline conditions	
calculate the yield of chemical synthesis reactions by comparing stoichiometric quantities with actual quantities and by determining limiting reagents	

Green chemistry	
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	
outline the principles of green chemistry and recognise that the higher the atom economy, the ‘greener’ the process	
calculate atom economy and draw conclusions about the economic and environmental impact of chemical synthesis processes	
Macromolecules: polymers, proteins and carbohydrates	
describe, using equations, how addition polymers can be produced from their monomers including polyethene (LDPE and HDPE), polypropene and polytetrafluorethene	
describe, using equations, how condensation polymers, including polypeptides (proteins), polysaccharides (carbohydrates) and polyesters, can be produced from their monomers	
discuss the advantages and disadvantages of polymer use, including strength, density, lack of reactivity, use of natural resources and biodegradability	
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	
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	
Molecular manufacturing	
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	