KESTEVEN AND SLEAFORD HIGH SCHOOL
Chemistry Scheme of Learning

Year 11 – Term 1 Topic 7

Intent – Rationale

The pupils begin the Organic Chemistry topic in which they learn about the properties and reactions of different homologous series, and the importance of functional groups in influencing the reactions of organic compounds. This topic links to many other topics in the GCSE course and feeds directly into the A level course, of which about one third is Organic Chemistry. There are many opportunities to develop practical skills and understand the hazards that are specific to organic compounds. The pupils will also recognise how widely used organic substances are in everyday life, from plastics to solvents to drinks

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
• **Year 7 Topic 3 Acids and Alkalis, Topic 4 Solutions, Topic 5 Simple Chemical Reactions, Topic 6 Compounds** • **Year 8 Topic 9 Reactions of Acids, Topic 10 Describing Chemical Reactions, Topic 11 Earth and Atmosphere** • **GCSE Topic 1 Atomic Structure and the Periodic Table, Topic 2 Bonding, Topic 4 Chemical Changes and Topic 5 Energy Changes**	• GCSE Topic 9 Chemistry of the Atmosphere and GCSE Topic 10 Using Resources • The entirety of A level Paper 2 – Physical and Organic Chemistry • A level Paper 3 – Synoptic and practical skills paper • A level Practical Endorsement
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
• Base the content here on what you already know but there will be time in future to liaise further as part of our collaborative work	• Synthesising organic compounds- synthetic and natural which ties into use of finite resources and production of greenhouse gases • Uses and importance of organic compounds such as alcohols, esters and carboxylic acids • Sustainability of making ethanol- different methods and their environmental impact

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	• Careers in biochemistry e.g. drug synthesis
What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	**What are the opportunities for developing mathematical skills?**
FROM THE LIBRARY *Principals of Organic Chemistry-547*	• General formulae • Balancing chemical equations • Ratios • Bond energy calculations

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Chemistry Scheme of Learning

Year 11 Term 1

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?

Know

- Do I know that crude oil is a finite resource found in rocks and that it is a mixture of a very large number of compounds. Most of the compounds in crude oil are hydrocarbons, which are molecules made up of hydrogen and carbon atoms only. Do I know that most of the hydrocarbons in crude oil are hydrocarbons called alkanes. The general formula for the homologous series of alkanes is C_nH_{2n+2}
- Do I know that the combustion of hydrocarbon fuels releases energy. During combustion, the carbon and hydrogen in the fuels are oxidised. The complete combustion of a hydrocarbon produces carbon dioxide and water.
- Do I know the conditions of catalytic cracking and steam cracking, and do I know what the products of cracking are?
- *Do I know that alkenes are hydrocarbons with a double carbon-carbon bond. The general formula for the homologous series of alkenes is C_nH_{2n} Do I know that alkene molecules are unsaturated because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms.*
- *Do I know that alcohols contain the functional group –OH and methanol, ethanol, propanol and butanol are the first four members of a homologous series*
- *Can I recall the uses of these alcohols*
- *Do I know that aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast and I know the conditions*
- *Do I know that carboxylic acids have the functional group –COOH.The first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid*
- *Do I know that alkenes can be used to make polymers such as poly(ethene) and poly(propene) by addition polymerisation, in which many small molecules (monomers) join together to form one large molecules (polymers).*
- *Do I know that condensation polymerisation involves monomers with two functional groups. When these monomers react they join together, usually losing small molecules such as water, and so the reactions are called condensation reactions*
- *Do I know that amino acids have two different functional groups in a molecule and that they react by condensation polymerisation to produce polypeptides?*
- Do I *know that DNA (deoxyribonucleic acid) is a large molecule essential for life. DNA encodes genetic instructions for the development and functioning of living organisms and viruses.*

Apply

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- Can I name and draw the displayed and molecular formulae of the first four members of the alkane homologous series? Can I explain how hydrocarbons are separated into fractions by fractional distillation and do I know some uses of these fractions?
- I know that alkenes are more reactive than alkanes and react with bromine water, which is used as a test for alkenes. Bromine water is decolourised by alkenes but not alkanes.
- *Do I know the first four members of the homologous series of alkenes are ethene, propene, butene and pentene and can I write the molecular formulae and draw the displayed formulae? I know that alkenes react with oxygen in combustion reactions in the same way as other hydrocarbons, but they tend to burn in air with smoky flames because of incomplete combustion*
- *Can I describe what happens when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent*
- *Can I explain why fermentation produces ethanol which is carbon neutral?*
- *Can I describe what happens when any of the first four carboxylic acids react with carbonates, dissolve in water, react with alcohols?*
- *Can I recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group C=C in the monomers?*
- *Do I know the simplest polymers are produced from two different monomers with two of the same functional groups on each monomer. For example: ethane diol and hexanedioic acid polymerise to produce a polyester*
- *Do I know that different amino acids can be combined to produce proteins?*
- *Do I know that most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. naturally occurring polymers important for life include proteins, starch and cellulose.*

Extend

- Can I explain fractional distillation in terms of evaporation and condensation? Can I explain how boiling point, viscosity and flammability are affected by molecular size?
- Can I write balanced equations for the complete combustion of hydrocarbons with a given formula.
- Can I balance chemical equations as examples of cracking
- Can I give examples to illustrate the usefulness of cracking and explain how modern life depends on the uses of these hydrocarbon products
- *I know that alkenes react with hydrogen, water and the halogens, by the addition of atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond*
- *Can I write balanced symbol equations for the reactions when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent*
- *Can I evaluate the sustainability of the different methods of producing ethanol?*
- *Can I write balanced symbol equations for the reactions when any of the first four carboxylic acids react with carbonates, dissolve in water, react with alcohols?*
- *Can I explain why carboxylic acids are weak acids in terms of ionisation and pH*
- *Can I draw diagrams to represent the formation of a polymer from a given alkene monomer relate the repeating unit to the monomer?*
- *Can I explain the basic principles of condensation polymerisation by reference to the functional groups in the monomers and the repeating units in the polymer?*
- *Can I draw a dipeptide given the structure of the individual amino acids?*

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- *Can I name the types of monomers from which these naturally occurring polymers are made and can I explain the difference in the bonding between the neucleoides in the DNA polymer strand and the intermolecular forces holding the two polymers together?*

What subject specific language will be used and developed in this topic?	What opportunities are available for assessing the progress of students?
	• 6 mark questions after lessons 1 and 7 • End of Topic Test (after lesson 3 for Combined and lesson 13 for Triple)

Addition polymer	Made by adding monomers that contain C=C. No other product is made
Alcohol	All contain the functional group -OH $C_nH_{2n+1}OH$
Alkane	Saturated hydrocarbon with formula C_nH_{2n+2}
Alkene	Unsaturated hydrocarbon containing C=C. C_nH_{2n}
Amino acid	The monomers that make up a proteins. E.g. H_2NCH_2COOH
Carboxylic Acid	All contain COOH $C_nH_{2n+1}COOH$

Combustion	Reaction of a fuel with oxygen
Condensation polymer	Made from 2 different monomers and releases a small molecule (usually water)
Cracking	Heating a long chain hydrocarbon into smaller, more useful products
DNA	Large organic molecule that contains the genetic information for the development and functioning of living organisms and viruses
Ester	Made from the reaction of an acid and an alcohol
Fermentation	Making alcohol and carbon dioxide from sugar in the presence of yeast at warm temperatures (37^{o}C)
Flammable	Easily ignited and can burn rapidly
Fraction	Hydrocarbons with similar boiling points

Fractional Distillation	Separating mixtures of hydrocarbons by their different boiling points
Functional Group	Group of atoms that give compound its characteristic reactions
Homologous Series	Group of related organic compounds with the same functional group and general formula
Hydrocarbon	Contains only hydrogen and carbon
Saturated	Only contains C-C bonds (no double C=C bonds)
Unsaturated	Contains C=C bond
Weak acid	Acids that do not ionise completely

Proteins	Natural polymers made from amino acids that join together in a condensation reaction	
Incomplete combustion	Fuels burning in limited oxygen so makes carbon monoxide or particulates	
Complete combustion	Combustion takes place when there is enough oxygen to make carbon dioxide	
Double bond	Two Covalent bonds sharing 2 pairs of electrons.	

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Intent – Concepts

Lesson title	Learning challenge	Higher level challenge	Suggested activities and resources
Lesson 1 Alkanes and Fractional Distillation	• Do I know that crude oil is a finite resource found in rocks and that it is a mixture of a very large number of compounds. Most of the compounds in crude oil are hydrocarbons, which are molecules made up of hydrogen and carbon atoms only. • Do I know that most of the hydrocarbons in crude oil are hydrocarbons called alkanes. The general formula for the homologous series of alkanes is C_nH_{2n+2} • Can I name and draw the displayed and molecular formulae of the first four members of the alkane homologous series? • Can I explain how hydrocarbons are separated into fractions by fractional distillation and do I know some uses of these fractions?	• Can I explain fractional distillation in terms of evaporation and condensation? • Can I explain how boiling point, viscosity and flammability are affected by molecular size?	

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Lesson 2 Combustion of Alkanes	• Do I know that the combustion of hydrocarbon fuels releases energy? • Do I know the products of combustion and how to test for them?	• Can I write balanced equations for the complete combustion of hydrocarbons with a given formula?	
Lesson 3 Cracking	• Do I know the conditions of catalytic cracking and steam cracking, and do I know what the products of cracking are?	• Can I balance chemical equations as examples of cracking • Can I give examples to illustrate the usefulness of cracking and explain how modern life depends on the uses of these hydrocarbon products	
Lesson 4 and 5 Alkenes	• *Do I know that alkenes are hydrocarbons with a double carbon-carbon bond. The general formula for the homologous series of alkenes is C_nH_{2n}* • *Do I know that alkene molecules are unsaturated because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms?* • *Do I know the first four members of the homologous series of alkenes are ethene, propene, butene and pentene and can I write the*	• *Do I know that alkenes react with oxygen in combustion reactions in the same way as other hydrocarbons, but they tend to burn in air with smoky flames because of incomplete combustion?* • *I know that alkenes react with hydrogen, water and the halogens, by the addition of atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond*	

	molecular formulae and draw the displayed formulae?		
Lesson 6 Alcohols	• *Do I know that alcohols contain the functional group –OH and methanol, ethanol, propanol and butanol are the first four members of a homologous series* • *Can I recall the uses of these alcohols* • *Can I describe what happens when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent?*	• *Can I write balanced symbol equations for the reactions when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent?*	
Lesson 7 Fermentation	• *Do I know that aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast and I know the conditions*	• *Can I explain why fermentation produces ethanol which is carbon neutral?* • *Can I evaluate the sustainability of the different methods of producing ethanol?*	
Lesson 8 Carboxylic Acids	• *Do I know that carboxylic acids have the functional group –COOH.The first four members of a homologous series of carboxylic acids are methanoic acid,*	• *Can I write balanced symbol equations for the reactions when any of the first four carboxylic acids react with carbonates, dissolve in water,*	

	ethanoic acid, propanoic acid and butanoic acid • *Can I describe what happens when any of the first four carboxylic acids react with carbonates, dissolve in water*	• *Can I explain why carboxylic acids are weak acids in terms of ionisation and pH*	
Lesson 9 Esters	• *Do I know the uses of esters?* • *Do I recognise the structure of an ester?* • *Can I describe what happens when any of the first four carboxylic acids react with alcohols and do I know the reaction conditions?*	• *Can I write balanced symbol equations for the reactions when any of the first four carboxylic acids react alcohols*	
Lesson 10 Addition Polymers	• *Do I know that alkenes can be used to make polymers such as poly(ethene) and poly(propene) by addition polymerisation, in which many small molecules (monomers) join together to form one large molecules (polymers)* • *Can I recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional*	• *Can I draw diagrams to represent the formation of a polymer from a given alkene monomer relate the repeating unit to the monomer?*	

	group C=C in the monomers?		
Lesson 11 Condensation Polymers	• *Do I know that condensation polymerisation involves monomers with two functional groups. When these monomers react they join together, usually losing small molecules such as water, and so the reactions are called condensation reactions* • *Do I know the simplest polymers are produced from two different monomers with two of the same functional groups on each monomer. For example: ethane diol and hexanedioic acid polymerise to produce a polyester*	• *Can I explain the basic principles of condensation polymerisation by reference to the functional groups in the monomers and the repeating units in the polymer?*	
Lesson 12 Amino Acids	• *Do I know that amino acids have two different functional groups in a molecule and that they react by condensation polymerisation to produce polypeptides?* • *Do I know that different amino acids can be*	• *Can I draw a dipeptide given the structure of the individual amino acids?*	

	combined to produce proteins?		
Lesson 13 DNA	• Do I *know that DNA (deoxyribonucleic acid) is a large molecule essential for life. DNA encodes genetic instructions for the development and functioning of living organisms and viruses.* • *Do I know that most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. naturally occurring polymers important for life include proteins, starch and cellulose.*	• *Can I name the types of monomers from which these naturally occurring polymers are made and can I explain the difference in the bonding between the neucleoides in the DNA polymer strand and the intermolecular forces holding the two polymers together?*	
Test and 6 mark question			