

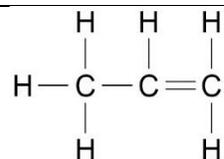
Spec ref.	Summary of the specification content	Learning outcomes <i>What most candidates should be able to do</i>	Suggested timing (hours)	Opportunities to develop Scientific Communication skills	Opportunities to develop and apply practical and enquiry skills	Self/peer assessment opportunities and resources <i>Reference to past questions that indicate success</i>	Key pieces of assessed work	
4.7.1.1	<p>Crude oil is a finite resource found in rocks. Crude oil is the remains of an ancient biomass consisting mainly of plankton that was buried in mud.</p> <p>Crude oil 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.</p> <p>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}. The first four members of the alkanes are methane, ethane, propane and butane.</p>	<p>Be able to recognise substances as alkanes given their formulae in these forms.</p> <p>Students do not need to know the names of specific alkanes other than methane, ethane, propane and butane.</p> <p>WS 1.2</p>	1	<p>Describe the formation of crude oil.</p> <p>Describe the composition of crude oil.</p> <p>Define a hydrocarbon.</p> <p>Explain what is meant by the formula C_nH_{2n+2}</p> <p>Make molecular models and work out general formula for the alkanes.</p> <p>Draw the covalent bonding in:</p> <ul style="list-style-type: none"> • methane • ethane • propane • butane. <p>Define the term saturated.</p>	<p>Plot boiling points of alkanes against number of carbons. Make predictions of the boiling points of other alkanes.</p> <p>Make models of alkane molecules using molecular modelling kits.</p>	<p>Exampro user guide</p> <p>PowerPoint</p>		

	<p>Alkane molecules can be represented in the following forms: C_2H_6 or</p> <pre> H H H — C — C — H H H </pre>						
4.7.1.2	<p>The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by fractional distillation.</p> <p>The fractions can be processed to produce fuels and feedstock for the petrochemical industry.</p> <p>Many of the fuels on which we depend for our modern lifestyle such as petrol, diesel oil, kerosene, heavy fuel oil and liquefied petroleum gases, are produced from crude oil.</p> <p>Many useful materials on which modern life</p>	<p>Explain how fractional distillation works in terms of evaporation and condensation.</p> <p>Knowledge of the names of other specific fractions or fuels is not required.</p> <p>WS 1.2</p>	2	<p>Describe the process of fractional distillation.</p> <p>Grade 9: explain the process of fractional distillation in terms of intermolecular forces of attraction.</p> <p>Suggest the impact on fuels, feedstocks and petrochemicals of the depleting stocks of crude oil.</p> <p>Describe a life without oil or oil derived products. Look at the cultural and environmental impact of the oil industry around the world.</p>	<p>Research uses of the fractions of crude oil.</p>	<p>Video clips YouTube: Fractional distillation</p> <p>YouTube: Crude Oil Fractions and their uses</p>	

	<p>depends are produced by the petrochemical industry, such as solvents, lubricants, polymers, detergents.</p> <p>The vast array of natural and synthetic carbon compounds occur due to the ability of carbon atoms to form families of similar compounds.</p>						
4.7.1.3	<p>Some properties of hydrocarbons depend on the size of their molecules, including boiling point, viscosity and flammability. These properties influence how hydrocarbons are used as fuels.</p> <p>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.</p>	<p>Recall how boiling point, viscosity and flammability change with increasing molecular size.</p> <p>Write balanced equations for the complete combustion of hydrocarbons with a given formula. Knowledge of trends in properties of hydrocarbons is limited to:</p> <ul style="list-style-type: none"> • boiling points • viscosity • flammability. <p>WS 1.2, 4.1</p>	1	<p>Explain the properties of hydrocarbons in relation to intermolecular forces.</p> <p>Write balanced symbol equations for the combustion of hydrocarbon fuels.</p> <p>Describe the balanced symbol equation including moles present, reactants and products.</p>	<p>Investigate the properties of different hydrocarbons in terms of boiling point, viscosity and flammability with increasing molecular size.</p> <p>Identify the products of combustion of alkanes.</p>	<p>Video clips:</p> <p>BBC Bitesize Combustion of carbon</p> <p>BBC Bitesize Combustion of natural gas</p>	

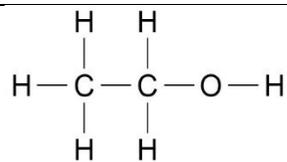
4.7.1.4	<p>Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules.</p> <p>Cracking can be done by various methods including catalytic cracking and steam cracking.</p> <p>The products of cracking include alkanes and another type of hydrocarbon called alkenes.</p> <p>Alkenes are more reactive than alkanes and react with bromine water, which is used as a test for alkenes.</p> <p>There is a high demand for fuels with small molecules and so some of the products of cracking are useful as fuels.</p> <p>Alkenes are used to produce polymers and as starting materials for the production of many other chemicals.</p>	<p>Describe in general terms the conditions used for catalytic cracking and steam cracking.</p> <p>Recall the colour change when bromine water reacts with an alkene.</p> <p>Balance chemical equations as examples of cracking given the formulae of the reactants and products.</p> <p>Give examples to illustrate the usefulness of cracking.</p> <p>Be able to explain how modern life depends on the uses of hydrocarbons.</p> <p>For Combined Science: Trilogy and Synergy students do not</p>	1	<p>Describe the process of cracking.</p> <p>Explain the process of cracking.</p> <p>Write balanced symbol equations for the cracking of alkanes.</p> <p>Describe the balanced symbol equation including moles present, long alkane reactant, specific reaction conditions, and alkene and short alkane products.</p>	<p>Demo or practical: crack paraffin over porous clay pot.</p> <p>Use bromine water to identify alkenes.</p> <p>Test for unsaturation in other compounds.</p> <p>Research uses of common alkenes.</p>	<p>Video clips YouTube: Hydrocarbon Cracking and Why It Is Done</p>	
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		need to know the formulae or names of individual alkenes. WS 1.2					
4.7.2.1	<p>Alkenes are hydrocarbons with a double carbon-carbon bond. The general formula for the homologous series of alkenes is C_nH_{2n}</p> <p>Alkene molecules are unsaturated because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms.</p> <p>The first four members of the homologous series of alkenes are ethene, propene, butene and pentene.</p> <p>Alkene molecules can be represented in the following forms: C_3H_6 or</p>	<p>Students do not need to know the names of individual alkenes other than ethene, propene, butene and pentene.</p> <p>WS 1.2</p> <p>MS 5b</p>	1	<p>Explain what is meant by the formula C_nH_{2n}</p> <p>Grade 9: draw the covalent bonding in:</p> <ul style="list-style-type: none"> • ethene • propene • butene • pentene. <p>Define the term unsaturated.</p>	<p>Recognise substances that are alkenes from their names or from given formulae in these forms.</p>	<p>Video clip YouTube: Alkanes and Alkenes</p>	



4.7.2.2	<p>Alkenes are hydrocarbons with the functional group C=C.</p> <p>It is the generality of reactions of functional groups that determine the reactions of organic compounds.</p> <p>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.</p> <p>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.</p> <p>The addition of hydrogen to an alkene (unsaturated) takes place in the presence of a</p>	<p>Draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions with hydrogen, water, chlorine, bromine and iodine.</p> <p>WS 1.2</p>	3	<p>Write balanced symbol equations for the combustion of alkenes in oxygen.</p> <p>Describe the balanced symbol equation including moles present, reactants and products.</p> <p>Write the reaction between an alkene and hydrogen, giving suitable examples.</p> <p>Describe the reaction including moles present, reactants and products.</p> <p>Write the reaction between an alkene and water, giving suitable examples.</p> <p>Describe the reaction including moles present, reactants and products.</p>		<p>Video clip YouTube: Halogenation</p>	<p>Past paper question 3 specimen paper 2 set 2</p>
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	<p>catalyst to produce the corresponding alkane (saturated).</p> <p>The addition of water to an alkene takes place by reaction with steam in the presence of a catalyst to produce an alcohol.</p> <p>Addition of a halogen to an alkene produces a saturated compound with two halogen atoms in the molecule, for example ethene reacts with bromine to produce dibromoethane.</p>			<p>Write the reaction between an alkene and a halogen molecule, giving suitable examples.</p> <p>Describe the reaction including moles present, reactants and products.</p>			
4.7.2.3	<p>Alcohols contain the functional group –OH.</p> <p>Methanol, ethanol, propanol and butanol are the first four members of a homologous series of alcohols.</p> <p>Alcohols can be represented in the following forms:</p> <p>CH_3CH_2OH</p> <p>or</p>	<p>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. Recall the main uses of these alcohols.</p> <p>Know the conditions used for fermentation of sugar using yeast.</p>	2	<p>Grade 9: draw the covalent bonding in:</p> <ul style="list-style-type: none"> • methanol • ethanol • propanol • butanol. <p>Describe what happens to one of the first four alcohols during the reactions:</p> <ul style="list-style-type: none"> • dissolving in water to form a neutral solution • reacting with sodium to produce hydrogen • burning in air 	<p>Research uses of the first four alcohols.</p> <p>Opportunities when investigating reactions of alcohols. AT 2, 5, 6</p>	<p>Video clip YouTube: What are alcohols?</p>	



Aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast.

Be able to recognise alcohols from their names or from given formulae.

Students do not need to know the names of individual alcohols other than methanol, ethanol, propanol and butanol.

Students are not expected to write balanced chemical equations for the reactions of alcohols other than for combustion reactions.

- oxidising to produce carboxylic acids
- use as fuels and solvents.

4.7.2.4

Carboxylic acids have the functional group $-\text{COOH}$.

The first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid.

Describe what happens when any of the first four carboxylic acids react with carbonates, dissolve in water, react with alcohols.

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Grade 9: draw the covalent bonding in:

- methanoic acid
- ethanoic acids
- propanoic acid
- butanoic acid.

Research uses of the first four carboxylic acids.

Research some of the uses of esters and try to work out the alcohols and

Video clip
YouTube:
[Carboxylic Acids and Esters](#)

Past paper question 1
specimen paper 2 set 1

<p>The structures of carboxylic acids can be represented in the following forms:</p> <p>CH_3COOH</p> <p>or</p> $ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}=\text{O} \\ \quad \\ \text{H} \quad \text{O}-\text{H} \end{array} $	<p>(HT only) Explain why carboxylic acids are weak acids in terms of ionisation and pH.</p> <p>Recognise carboxylic acids from their names or from given formulae.</p> <p>Students do not need to know the names of individual carboxylic acids other than methanoic acid, ethanoic acid, propanoic acid and butanoic acid.</p> <p>Students are not expected to write balanced chemical equations for the reactions of carboxylic acids.</p> <p>Students do not need to know the names of esters other than ethyl ethanoate.</p>		<p>Describe what happens to one of the first four acids during the reactions:</p> <ul style="list-style-type: none"> • dissolving in water to produce acidic solutions • reacting with carbonates to produce carbon dioxide • not ionising completely when dissolved in water (they are weak acids) • reacting with alcohols in the presence of an acid catalyst to produce esters, for example ethanoic acid reacts with ethanol to produce ethyl ethanoate and water. 	<p>carboxylic acids used to make them.</p> <p>Opportunities within investigation of the reactions of carboxylic acids.</p> <p>AT 2, 5, 6</p>		
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