

Assessment Schedule – 2011**Chemistry: Demonstrate understanding of aspects of carbon chemistry (90932)****Evidence Statement**

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \text{H} \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & \text{H} - \text{C} - \text{OH} \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \text{H} \end{array} $ <p>(Accept condensed formulae.)</p>	TWO OF: Draws structural diagrams for butane and methanol.	TWO OF: Explains the differences between the combustion of butane and methanol (incomplete versus complete combustion and products formed).	TWO of Compares and contrasts the incomplete combustion of butane to the complete combustion of methanol with respect to oxygen.
(b)	<p>Butane is undergoing incomplete combustion as shown by the yellow flame. Incomplete combustion means there is not enough oxygen (insufficient percentage) present in the air for all of the carbon atoms in butane to turn into carbon dioxide. Some or all of it turns into carbon monoxide or carbon particles (soot). The hydrogen atoms react with oxygen to form water.</p> <p>Methanol is undergoing complete combustion as shown by the almost invisible flame. This means there is sufficient oxygen present and all the carbon atoms react with oxygen to form carbon dioxide. The hydrogen atoms here also react with oxygen to form water.</p> <p>Energy is released. Complete combustion is a more efficient producer of energy than incomplete combustion.</p>	OR Identifies complete and incomplete combustion reactions.	OR Gives an equation with correct formulae but it is not balanced.	OR Explains TWO of the effects of combustion of fuels. ONE on each of human health AND the environment (makes link between product and effect).
(c)	$2\text{CH}_3\text{OH}(\ell) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$ OR $\text{CH}_3\text{OH}(\ell) + 1\frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ <p>(Candidates are not required to write states in equations.)</p>	OR Correctly identifies both products of the combustion reaction.	OR Gives a limited explanation of two effects of combustion of these fuels on health and / or environment.	Eg, CO poisonous, binds to haemoglobin, etc. CO ₂ , a green house gas, causes heat to be radiated back to earth.
(d)	<ul style="list-style-type: none"> Carbon particles / particulates produced can affect the lungs if breathed in, and can cause respiratory problems including asthma and even lung cancer. (They can also get into the arteries and clog them, leading to heart disease.) Carbon particles / particulates can scatter solar radiation. Large amounts of carbon can act as a blanket, blocking solar radiation, reducing efficiency of photosynthesis CO is a dangerous gas as it acts like a poison by combining with haemoglobin in the blood. CO forms a stable compound with haemoglobin, preventing oxygen from being carried to the parts of the body that need it. The person dies by suffocation. CO₂ is one of the greenhouse gases. It contributes to the greenhouse effect because it causes heat energy to be radiated back to earth and subsequently global warming occurs. 	<p>States TWO effects of burning the fuels.</p> <p>NØ no response or no relevant evidence.</p> <p>N1 partially correct response (ie one formula correct).</p> <p>N2 one correct.</p> <p>A3 two correct.</p> <p>A4 three correct.</p>	<p>Probably incomplete link</p> <p>OR</p> <p>Gives a full explanation of ONE effect.</p> <p>M5 two links made.</p> <p>M6 – all three links made.</p>	<p>E7 two parts correct.</p> <p>E8 three parts correct.</p>

TWO	<p>Crude oil consists of a mixture of hydrocarbon molecules of different sizes.</p> <p>Crude oil is heated and turned into a vapour to enter the fractionating tower.</p> <p>Hydrocarbons of different molecular masses have different boiling points. Larger molecules have higher boiling points. When the heated crude oil vapour enters the tower, the larger, heavier hydrocarbons with the higher boiling points condense into liquids lower down in the tower, while the smaller, lighter hydrocarbons with the lower boiling points rise up the tower and condense back into a liquid at the lower temperatures near the top of the tower. The smallest hydrocarbons (C1 – C4) remain gases at room temperature.</p> <p>The temperature at which a specific hydrocarbon condenses is related to its molecular mass, particularly the number of carbon atoms. The lower / higher its molecular mass is, the lower / higher the temperature at which it will condense. (This determines where on the tower the particular fraction is collected.)</p>	<p>TWO OF: Describes crude oil as a mixture of different sized hydrocarbons.</p> <p>OR Describes the process of fractional distillation.</p> <p>OR Recognises that the separation of the lighter and heavier fractions depends on differences in the boiling points / mass.</p> <p>NØ no response or no relevant evidence.</p> <p>N1 partially correct description.</p> <p>N2 one correct.</p> <p>A3 two correct.</p> <p>A4 three correct.</p>	<p>EITHER</p> <p>Explains that the temperature at which the hydrocarbon condenses will determine where the fraction collects.</p> <p>OR</p> <p>The size of the hydrocarbon is related to the position it is collected in the tower.</p> <p>M5 explains one aspect of the process.</p> <p>M6 explains both aspects.</p>	<p>Explanation links the process of fractional distillation to size of the molecule and the temperatures at which they change state and their position of collection in the tower. And links molecule size / boiling point to bonds between molecules/attractive forces</p> <p>E7 explanation for one type of hydrocarbon.</p> <p>E8 explanation for two or more types of hydrocarbon.</p>
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THREE (a)	$\begin{array}{c} \text{H} & \text{CH}_3 \\ & \\ \text{C} = & \text{C} \\ & \\ \text{H} & \text{H} \end{array} - \left(\begin{array}{c} \text{H} & \text{CH}_3 & \text{H} & \text{CH}_3 \\ & & & \\ \text{C} - & \text{C} - & \text{C} - & \text{C} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} \right)_n$	TWO of: draws the structure of a propene molecule and a section of a polypropene molecule with at least TWO monomers.	EITHER	BOTH
(b)	<p>The chemical reaction requires heat, high pressure and a catalyst.</p> <p>Many small propene molecules are joined together to form long-chain molecules. The (covalent) double bond between each carbon atom in the propene molecule is broken and a single covalent bond formed between these carbon atoms and between carbon atoms of neighbouring molecules, forming long carbon chains which are the forms of the polypropene molecule.</p>	OR states that the small propene molecules are joined to form the long-chain polypropene molecule.	Explains how propene molecules are linked to form polypropene molecules via the breaking of a double bond to form single bonds.	<p><i>Must have correct structure or indicate an understanding of polymerisation process</i></p> <p>Explains the polymerisation reaction, including conditions that are required and links to double bond being broken and single bond formed.</p>
(c)	<p>Identified uses are linked to properties such as:</p> <ul style="list-style-type: none"> • Low chemical reactivity (eg with air, water and living organisms). • Insolubility in water. • Ability to be moulded or extruded into a wide range of shapes with moderate heating. • Insulator • Good for ropes used in water, as low density and floats. (<i>not good for other rope applications as UV degrades it</i>) • Recyclable, reshape and use for garden chairs, bins etc. 	<p>OR</p> <p>Correctly describes TWO uses of polypropene.</p> <p>OR</p> <p>Correctly states the three conditions required for the reaction.</p> <p><i>No linking to property.</i></p> <p>NØ no response or no relevant evidence.</p> <p>N1 draws propene OR polypropene OR describes ONE use of polypropene.</p> <p>N2 one correct answer.</p> <p>A3 two correct answers.</p> <p>A4 three correct answers.</p>	<p>OR</p> <p>Links ONE property of polypropene to ONE named use of polypropene.</p> <p>Eg: low chemical reactivity linked to being used for food containers.</p> <p>M5 explains one link.</p> <p>M6 explains both links.</p>	<p>AND</p> <p>Links 2 properties of polypropene to TWO named uses. <i>Eg: low chemical reactivity linked to being used for food containers = 1.</i></p> <p>E7 explanation correct, may miss some conditions. State two named uses and link one of these to a property.</p> <p>E8 Names 2 uses and links to 2 different properties.</p>

FOUR	<p>Hexane has 6 carbons and is a bigger molecule, so it would be slightly harder to vaporise and therefore ignite and its size means it would likely burn with an orange flame producing soot.</p> <p>Hexane forms 2 layers when mixed with water (immiscible / insoluble) because there are no attractive forces between the water and the hexane molecules to allow solubility.</p> <p>Ethanol has only 2 carbons, so it is easy to ignite and will burn with an almost colourless flame.</p> <p>Ethanol is soluble (miscible) in water because there are attractive molecules between ethanol and water.</p> <p>Ethanol will boil before hexane as it has less mass and hence weaker attractive forces between the molecules.</p>	<p>Describes a test to distinguish the molecules.</p> <p>AND describes ONE correct observation.</p> <p>NØ no response or relevant evidence.</p> <p>N1 partial description of a test.</p> <p>N2 one correct test or observation.</p> <p>A3 criteria met – correct test and observation.</p> <p>A4 two correct tests and two correct observations.</p>	<p>Explains a test with observations that will correctly distinguish the molecules and links to the property of that molecule.</p> <p>M5 one test for one molecule with link to property.</p> <p>OR</p> <p>Two physical tests for one molecule linked to property.</p> <p>M6 one test for two molecules with link to a property.</p>	<p>Correctly links properties of one molecule to tests and observations that correctly distinguish both molecules.</p> <p>E7 two tests for two molecules, one test of which is linked to a property</p> <p>E8 two tests for two molecules linked to two properties</p>
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Bpt hexane = 95.3°C Density hexane = 0.6995 g mL⁻¹

Bpt EtOH = 78.1 Density EtOH = 0.789 g mL⁻¹

Boiling point of ethanol = 78.1°C

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 9	10 – 16	17 – 24	25 – 32