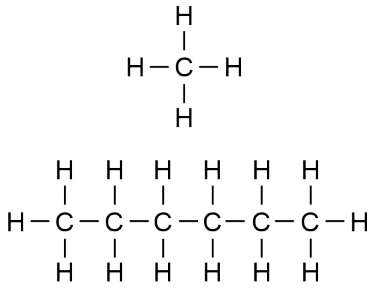
Assessment Schedule – 2015

Chemistry: Demonstrate understanding of aspects of carbon chemistry (90932)

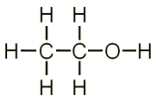
Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	 Propene	• Any TWO correct.		
(b)(i)	Gas	• Correct state.		
(ii)	The boiling point of butane will be **higher** as there are more carbon (C) atoms than in propane (longer C chain). As the molar mass increases, the forces (intermolecular force) **between** the butane molecules / particles increases, so more energy is required to overcome these forces to form gaseous butane; so the boiling point is higher.	• **Higher**, with a valid reason, e.g. longer C chain / more C atoms / stronger attractive forces / more energy required, etc.	• Links greater number of C's to increased (intermolecular) **attractive forces** and increased boiling point.	
(c)	When there is a shortage of oxygen, **incomplete combustion** will occur.	• Incomplete combustion.		
	propane + oxygen → carbon + carbon monoxide + water $C_3H_8 + 3O_2 \rightarrow 2CO + C + 4H_2O$ (accept balanced alternatives with different # CO & C) Equations may have C and/or CO.	• States a product of incomplete combustion.	• Gives a word equation for incomplete combustion / writes unbalanced symbol equation.	• Correct balanced equation for incomplete combustion.
	If there was a lack of oxygen: • the flame would be more yellow – due to specks of C glowing • black smoke produced – black C • a black solid (soot) may be seen on the cooking pot – black C • less heat would be produced (slower cooking) – since there is less oxygen available for complete combustion.	• Describes one observation during incomplete combustion.	• Links one observation to a reaction occurring during incomplete combustion.	
	The C (soot) and CO produced during incomplete combustion are harmful to humans. C (soot) can be inhaled and cause respiratory problems and damage the heart; it is also a carcinogen. CO is a poisonous gas as it binds to red blood cells (preventing oxygen binding) and may cause death.	• States a valid effect of incomplete combustion on human health.	• Links a product of incomplete combustion to an effect on human health.	• Explains TWO effects of incomplete combustion products on **human health**.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	3a	4a	6a	3m	4m	2e including equation and weak explanation	2e

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	**Process 1**: **Fractional** distillation **Process 2**: Cracking **Process 3**: Polymerisation	• TWO processes named.		
(ii)	Alkenes, such as ethene, contain at least one C=C. The **double bond** can be **broken** during polymerisation and C's from adjacent molecules can **form single bonds between them**; forming long chains of C's.	• Alkenes have C=C.	• Explains how C=C breaks and single bonds form, producing long chain (may show single bonds forming on a diagram).	
(b)(i)	Catalyst, heat, pressure.	• States one condition required.		
(ii)	$C_{12}H_{26} \rightarrow 2C_2H_4 + C_8H_{18}$	• Gives correct formulae of products.	• Completes symbol equation.	
(c)	Crude oil consists of a mixture of hydrocarbon molecules of different sizes, which need to be distilled in order to separate into useful fractions, since the fractions have different uses. **Process 1** is carried out in a tall tower. The crude oil is heated and the hot particles rise. 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, and exit from the top of the tower.) 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 (boiling point) at which it will condense**. This determines whereabouts on the tower the particular fraction is collected. Products formed during Process 1 may include: propane, butane, octane, petrol, diesel, kerosene, etc.	• Describes crude oil as a mixture of (different sized) hydrocarbons. • Recognises that separation of fractions is based on differences in boiling points. • Describes the process of fractional distillation. • Names two products that are formed.	• Explains that the crude oil needs to be separated into fractions / different hydrocarbons to enable the fractions to be used. • Links EITHER the boiling point OR the size of the hydrocarbon to where the fraction collects. • Links the size of the hydrocarbon to its boiling point.	• Links the process of fractional distillation to **size of the molecules**, the **temperatures at which they change state** (boiling point), and their **position of collection in the tower**.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	3a	4a	6a	3m	4m	1e with minor error / omission	1e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)		• Correct structure (C bonded to O not H).		
(ii)	Hydrocarbons contain C and H only. This is the case for alkanes and alkenes; however alcohols also contain O, therefore are not hydrocarbons.	• Recognises hydrocarbons contain only C and H OR alcohols contain oxygen.	• Explains why alcohols are not hydrocarbons.	
(iii)	Add sample of each separately to water. Ethanol will dissolve – mix / form a single layer; since (small) alcohols are soluble in water because of the attractions between the alcohol and water, i.e. attraction between alcohol and water is greater than attraction between alcohol molecules. Octane will not dissolve – will form two layers, since alkanes are not soluble in water because there is no attraction between the alkane and water.	• Describes how to distinguish samples, including observations for both substances.	• Links test & observations to physical properties of both substances.	
(b)	Glucose → ethanol + carbon dioxide $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ Fermentation involves the conversion of a solution of sugar molecules (in water) into ethanol and carbon dioxide in warm, anaerobic conditions using yeast as a catalyst. Yeast is a living organism and requires warmth (and moisture) to carry out fermentation. Yeast metabolises / converts the sugars to alcohol when there is a lack of oxygen / via anaerobic respiration.	• Completes word equation. • States two conditions of fermentation (warm, anaerobic, moisture, yeast catalyst).	• Completes symbol equation (unbalanced). • Links one condition to the fermentation process.	• Balanced symbol equation for fermentation. • Explains the fermentation process, including linking yeast to the conditions and products formed.
(c)	Ethanol undergoes **complete combustion** in plentiful oxygen with a blue / invisible / hot flame to produce **CO_2 and H_2O.** CO_2 and H_2O (vapour), produced during complete combustion of ethanol, are significant **greenhouse gases**. CO_2 and H_2O vapour enhance the **greenhouse effect** which leads to increased trapping of infra-red radiation in the atmosphere. This leads to climate change and issues around **global warming** (e.g. rising sea levels, more adverse weather events). The ocean absorbs CO_2 released and this affects seawater chemistry. This can impact on marine food webs at all levels, including a food supply for humans. Advantages of burning ethanol compared to burning heptane include: • ethanol contains fewer C atoms than heptane, so less greenhouse gas emissions (CO_2), which contribute to climate change / global warming • cleaner burning than heptane (heptane is more likely to undergo incomplete combustion); produces less C, CO,	• Recognises that complete combustion occurs. • States the products of complete combustion. • States a valid effect of complete combustion on the environment. • Gives one advantage of using ethanol as a fuel.	• Links a product of complete combustion to an environmental impact. • Links an advantage of burning ethanol to a reason. • Unbalanced symbol equation.	• Evaluates the use of ethanol as a fuel for cars compared to hydrocarbons such as heptane, i.e. links product(s) of complete combustion to TWO environmental effects and explains ONE advantage of using ethanol instead of heptane. • Balanced symbol equation for the complete combustion of ethanol.

	which are harmful to health • ethanol is renewable, whereas alkanes such as heptane are non-renewable. $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence	1a	3a	5a	7a	4m	5m	2e (must include explanation or evaluation)	3e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 20	21 – 24