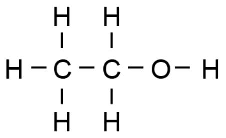
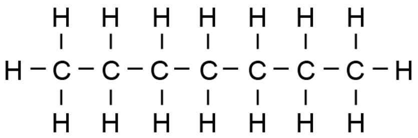
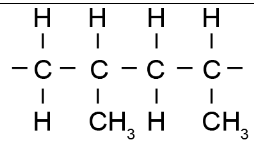
Assessment schedule – 2023

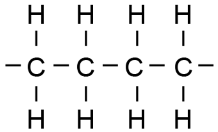
Chemistry: Demonstrate understanding of aspects of carbon chemistry (90932)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	 ethanol  heptane	• Two correct structures drawn.		
(b)	Ethanol undergoes complete combustion in plentiful oxygen with a blue / invisible / hot flame. Gaseous carbon dioxide and water vapour is produced, as shown in the equation below. In the experiment, the ice-bath is used to condense the colourless H_2O vapour, which is observed as a colourless liquid at point B. Observation linked to purpose. The limewater at C is used to indicate the presence of carbon dioxide. The colourless carbon dioxide is observed as bubbles of gas that turn limewater milky / white. No black deposit is observed on the funnel, as carbon (soot) is not produced in complete combustion / only produced in incomplete combustion. (do not need this). $C_2H_5OH(\ell) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(\ell)$ (states not needed)	• Identifies conditions needed for complete combustion, and resulting flame colour. • Links observation to CO_2 OR H_2O • Correct products / word equation.	• Links experiment observations to combustion products at two points . OR Links observations to tests for CO_2 and H_2O. • Unbalanced equation, correct reactants.	• Fully analyses combustion experiment, linking observations to the purpose of the experimental setup. AND Balanced symbol equation.
(c)	Complete combustion of heptane produces carbon dioxide gas and water vapour, both of which are greenhouse gases, so they contribute to the greenhouse effect / global warming, which leads to sea-level rise / adverse weather events which endanger human populations / life. 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. Heptane undergoes incomplete combustion producing carbon dioxide and water vapour. It can also produce carbon particles, which can cause asthma and other respiratory problems in people. It also produces carbon monoxide, which is toxic to humans, and can, in extreme situations, result in death since it replaces oxygen in the blood supply.	• States a valid effect of a combustion product on human health.	• Links the combustion reaction to an impact on human health for complete combustion. OR For incomplete combustion.	• Links the combustion products to an impact on human health for BOTH complete and incomplete combustion.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	1e + 1m	2e

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	Process 1 — Fractional distillation Process 2 — Cracking Process 3 — Polymerisation / addition	• TWO out of 3 processes.	• TWO out of 3 processes correct. AND Polymer drawn correctly	
(ii)	Polypropene (polypropylene) 			
(iii)	Both propene and propane are hydrocarbons containing covalently bonded C atoms. Both undergo complete combustion in excess oxygen, where the covalent bonds between the carbon atoms and carbon and hydrogen atoms are broken, forming carbon dioxide and water. Propane is an alkane containing **only single (covalent) bonds** whereas propene contains a double bond. The single bonds are **stable,** so propane does **not react** to form the long chains of a polymer. Propene is an alkene containing a **double (covalent) bond**, which acts as a **functional group /** is **reactive /** is **easily broken,** allowing propene to act as a monomer. In high temperatures and high pressures, with a catalyst, the **double bond breaks** in the propene molecules, allowing the different molecules to join together with single covalent bonds, forming a long chain called a polymer / polypropene.	• Identifies single bonds in propane OR double bonds in propene. • Correct conditions for either reaction type.	• Explains that covalent bonds between carbon atoms are broken during combustion. OR Both propene and propane can undergo combustion reaction with excess oxygen • Explains why propane cannot form polymers. OR Explains why propene can form polymers.	• Fully explains the reactions of propane and propene including conditions needed.

(b)	polyethene section  Chemical structure and bonding: They are both made up of **long chains of carbon atoms** bonded together with **single covalent bonds**. Both polymers are lightweight / insoluble allowing them to float in the ocean and be washed ashore. Since **neither has a functional group / only have single covalent bonds**, they are **both unreactive** which means they will **not break down in water / dissolve (or air)** so do not biodegrade, causing pollution.	• Correct. • Describes the chemical structure / bonding of ONE polymer. OR Identifies that neither polymer has a functional group. • Long time to break down / doesn't dissolve.	• Explains why the polymers are non-biodegradable / unreactive / do not naturally break down. OR Genuine link between property and effect.	• Fully explains why the structure and physical and chemical properties of polymers cause pollution in the ocean / beach environment.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	1e + 1m	2e with minor error

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Fermentation of **glucose** will produce ethanol. Enzymes in yeast turn the glucose into ethanol and carbon dioxide. The enzymes in the yeast are required to act as a catalyst for the reaction, which occurs in warm, anaerobic conditions. $C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2CH_3CH_2OH + 2CO_2$ glucose ethanol	• Identifies glucose as the reactant. OR Word equation. • 2 / 3 conditions.	• Explanation of fermentation linked to conditions. AND Unbalanced symbol equation.	• Explanation of fermentation linked to conditions. AND Balanced symbol equation.
(b)	Methanol and ethanol are both alcohols, whereas ethane is an alkane. Methanol and ethanol are both soluble in water, as they are both alcohols and contain OH groups. The OH groups of the alcohols are attracted to water molecules. The **alcohols are more attracted to the water** molecules (e.g. methanol – water) **than to each other** (e.g. methanol – methanol), so they dissolve. Ethane is insoluble in water, as it contains only C and H atoms, and there is not sufficient attractions between the water molecules and ethane molecules. The alcohols methanol and ethanol have higher boiling points than ethane, as the presence of the OH group increases the attractive forces between molecules, requiring a greater amount of **heat energy** to break. The boiling point of ethanol is higher than methanol, as there is one more carbon atom in ethanol than in methanol, so ethanol has a **higher molar mass**. As the molar mass increases, **the forces of attraction** (intermolecular force) **between the molecules increase, so more heat energy** is required to overcome these forces to form gaseous ethanol.	• States that both methanol and ethanol are attracted to water. OR States that ethane is not attracted to water. • Recognises boiling point increases with size / molar mass / number of C atoms. • Recognises increased molar mass increases attractive forces	• Explains solubility of EITHER ethane OR an alcohol linking to the attractions between the molecules and water. • Explains that more **heat energy** is required to separate the higher massed molecules • Explains increased molar mass increases attractive forces **between molecules/ intermolecular**	• Fully compares the solubility of all three compounds linking to the attractions with water. • Fully compares the boiling point of all three compounds. Must link to **heat energy**, molar mass and **relative strength of forces between the molecules**

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	3a	4a	2m	3m	2e	3e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 19	20 – 24