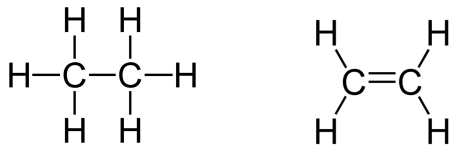
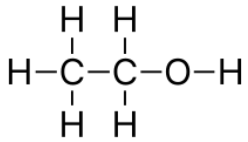
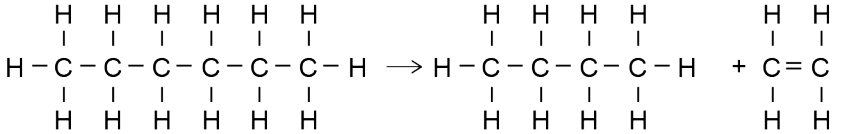
Assessment schedule – 2018 Final

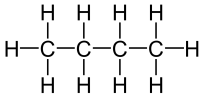
Chemistry: Demonstrate understanding of aspects of carbon chemistry (90932)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)		• BOTH structures correct.		
(ii)	Alkanes and alkenes both have covalent bonding between atoms. They are both made up of the non-metal atoms C and H, which share electrons. Alkanes are saturated hydrocarbons, they have only single bonds between C atoms, whereas alkenes are unsaturated and have at least one double bond between C atoms. (This means that alkanes have the general formula of C_nH_{2n+2} and alkenes C_nH_{2n}.) Both alkanes and alkenes share the same trend in boiling points. As the number of carbon atoms increases in alkanes and alkenes, the boiling point increases. As the number of carbon atoms increases, the molecules also increase in size, resulting in a larger / stronger attractive force between the molecules. This results in more heat energy being required to separate the molecules to allow them to become gases. The boiling point of each alkene is very similar to that of the alkane with the same number of carbon atoms, however the alkene has a boiling point, which is slightly lower than the corresponding alkane. This is because each alkene has 2 fewer H-atoms (electrons) than the alkane with the same number of carbons and so the attractive forces between the molecules is smaller / weaker.	• Describes bonding as covalent. • Single bonds in alkanes or double bond in alkene • Describes trend for both alkane and alkene	• Bonding in both is **covalent** however single bonds in alkanes and double bond in alkenes / different general formulae. OR Links lower boiling point of alkene to smaller number of H's. • Links greater number of carbons / higher molar mass to increased forces between molecules (intermolecular forces) to more energy required to overcome and hence a higher boiling point.	• Compares and contrasts boiling points of alkanes and alkenes, with links to structure and bonding.

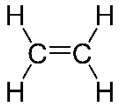
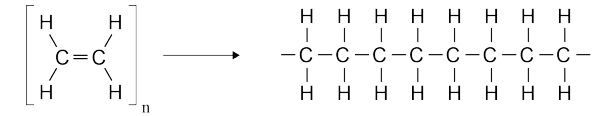
(b)(i)	 (ii) Hydrocarbons are composed of C and H only, ethanol has an -OH group therefore is not a hydrocarbon. (iii) Cracking is a chemical process where the bonds in the larger hexane are broken so that smaller hydrocarbons are produced such as ethene and butane. High temperatures, or catalysts, are needed to break the covalent bonds between the C atoms. $C_6H_{14} \longrightarrow C_4H_{10} + C_2H_4$  Hexane $\xrightarrow{\text{heat/catalyst}}$ Butane + Ethene [allow other correct equations] $C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2CH_3CH_2OH + 2CO_2$ Glucose → Ethanol 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.	• Correct structure. • Describes what cracking is. OR Glucose converted into ethanol.	• Explains that ethanol contains an -OH group (or O atom) therefore is not a hydrocarbon since it is composed of more than C and H. • Describes the process and links to the conditions required for either process.	• Both processes described, and conditions explained. AND Both equations correctly balanced.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	3a	4a	6a	3m	4m	1e	2e

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)		• Structure correct.		
(ii)	When butane reacts with a plentiful supply of air, complete combustion occurs since there is enough oxygen for the alkane to react fully with it. When the butane burns completely, all the carbon reacts to produce carbon dioxide and the hydrogens form water. $C_4H_{10} + 13 / 2\ O_2 \rightarrow 4\ CO_2 + 5\ H_2O$ When butane reacts with a limited supply of air or oxygen, water is still produced, but carbon monoxide and / or carbon (soot) are produced instead of carbon dioxide since there is not enough oxygen for all of the carbon to react to produce carbon dioxide. Any of: $C_4H_{10} + 3\ O_2 \rightarrow 3\ C + CO + 5\ H_2O$ $C_4H_{10} + \frac{7}{2}\ O_2 \rightarrow 2\ C + 2\ CO + 5\ H_2O$ $C_4H_{10} + \frac{9}{2} O_2 \rightarrow 4\ CO + 5\ H_2O$ $C_4H_{10} + \frac{5}{2}\ O_2 \rightarrow 4\ C + 5\ H_2O$	• Complete combustion occurs when oxygen plentiful. OR Incomplete combustion occurs when reduced % oxygen. • Carbon dioxide produced during complete combustion. OR Carbon and / or carbon monoxide produced during incomplete combustion.	• Links complete combustion to amount of O_2 and the production of CO_2 and incomplete combustion to the amount of O_2 production of CO and / or C (soot).	• Links complete and incomplete combustion to the amount of oxygen and products produced. AND One balanced symbol equation.

(b)	Ethanol has a higher flashpoint than petrol, which means that a higher temperature is required to ignite it, which is a disadvantage. Also, ethanol releases less energy per litre of fuel than petrol – another disadvantage since more of it is required. Ethanol is produced by fermentation (yeast converts sugar into ethanol) and so is a renewable energy source – won't run out. In contrast, petrol is made from crude oil and so is non-renewable and will run out at some stage. Ethanol undergoes complete combustion in plentiful oxygen, producing CO_2 and H_2O. CO_2 is a greenhouse gas and contributes to climate change; however ethanol is carbon-neutral since corn and sugarcane (which ethanol is produced from) absorb CO_2 as they grow and therefore offset the CO_2 produced when the ethanol is made and burned. Petrol is made up of hydrocarbons, which do not burn as cleanly – they are more likely to undergo incomplete production producing C (soot) and CO which are harmful to human health. Petrol contains locked up carbon so is not carbon neutral. The hydrocarbons in petrol contain more C atoms than ethanol and so produce more greenhouse gas emissions (CO_2), which contribute to climate change.	• Identifies one disadvantage of using ethanol as a fuel. • Identifies one advantage of using ethanol as a fuel. • Identifies one effect of a fuel on human health. • Identifies one effect of a fuel on the environment.	• Explains disadvantages of a fuel in terms of flashpoint and energy released. • Explains one advantage of using ethanol as a fuel. • Explains one effect of a fuel on human health and the environment.	• Evaluates the feasibility of ethanol as a fuel compared to petrol – including reference to both the information given in the table and knowledge of the effects both fuels on human health and the environment.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	3a	5a	6a	2m	3m	1e (Part b only)	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	Ethene	• Correct name.		
(ii)	Ethene is an alkene containing a double (covalent) bond, which acts as a functional group / is reactive, allowing ethene to act as a monomer.  High temperatures and high pressures, with a catalyst are required to break the strong double bond in the ethene molecules, allowing the different molecules to join together with single covalent bonds forming a long chain polymer, polyethene.  many ethene molecules poly (ethene)	• Ethene contains double bond. • High temp, pressure and catalyst are required.	• Explains how ethene molecules are linked to form polyethene molecules via the breaking of double bonds to form single bonds. • Explains why the conditions are required.	• Elaborates on the polymerisation reaction, including explaining why ethene can form polyethene; conditions identified and structure of polyethene given.
(b)	A = ethanol B = propane C = ethane Ethanol is an alcohol and contains an -OH group. The OH group of ethanol is attracted to water molecules. The attraction between the OH group on ethanol and water is greater than the attraction between ethanol molecules, so it dissolves. Propane and ethane are both alkanes containing only C-C and C-H bonds. The attraction between propane / ethane and water is less than the attraction between the molecules themselves (or they do not form attractions with water) and so they cannot dissolve in it. Ethanol is the only soluble molecule of the three therefore substance A is ethanol. Propane is an alkane containing 3 C atoms and ethane has 2 C atoms. When alkanes are completely combusted in air / oxygen, all of the C atoms react with the oxygen to form CO_2. Therefore, when propane reacts, it will form 3 CO_2 molecules since it has 3 Cs and ethane will form 2 CO_2 molecules since it has 2 C atoms. [candidates may justify using balanced equations]	• All three compounds correct. • Alcohols / ethanol is soluble, or alkanes / propane & ethane are not.	• Links structure / attraction of ethanol to solubility in water. OR Links structure / attraction of alkanes to lack of solubility in water. • Links number of C atoms in alkanes to number of CO_2 molecules formed in complete combustion.	• Fully justifies all three choices with reference to structure and properties of the functional groups.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	4a	5a	2m	3m	1e	2e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19 – 24