Assessment schedule – 2020

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

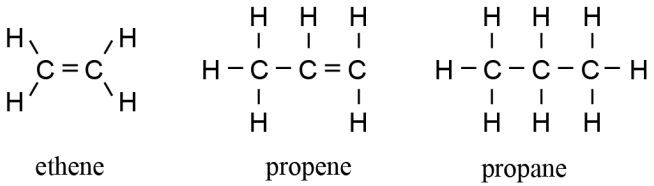
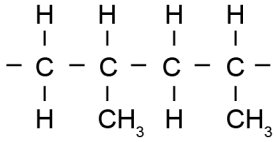
Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	Complete combustion requires a plentiful supply of oxygen / air.	• Correct answer.		
(ii)	pentane + oxygen → carbon dioxide + water $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6H_2O$	• Word equation correct. • Correct formulae for reactants.	• Correct unbalanced equation.	• Correct balanced equation.
(b)(i) (ii)	Equations C and D show incomplete combustion of hexene. Incomplete combustion produces water, and then any combination of carbon dioxide, carbon monoxide and carbon is possible, as well as just carbon monoxide. Equation B shows the complete combustion of hexene, since only carbon dioxide and water are produced. In Equation A, hydrogen is not a product of incomplete combustion, and the formula of oxygen is incorrect.	• Two correct equations identified OR one correct equation linked to a valid reason.	• Correct equations identified for incomplete combustion, linked to products.	• Correct equations identified with comprehensive reasons – must reference all four equations.
(c)	Carbon dioxide gas and water vapour are both greenhouse gases, so they contribute to the greenhouse effect, which leads to global warming due to increased trapping of infra-red radiation / heat, and this affects the environment with rising sea levels / melting of polar ice (example). CO_2 is absorbed by the ocean / reacts with water in clouds to form (carbonic) acid, and this decreases the pH of the ocean, affecting marine ecosystems / causes acid rain which can erode buildings, etc. Carbon particles can produce visual pollution in the environment, e.g. blackening of limestone walls and monuments, as carbon particles are deposited on them, or slows down photosynthesis, due to carbon particles coating leaves, preventing entry / exit of gases and water, or carbon particles in waterways affecting fish and plants, etc.	• States a valid effect on the **environment** for one product.	• Links a product to an explanation of the effect on the environment.	• Discusses three effects of combustion products on the environment.

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

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Ethanol is made by a process of fermentation, which 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 into alcohol when there is a lack of oxygen. $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	• Correct name of process. OR A correct description of process.	• Explains process linked to anaerobic conditions. • Correct, but unbalanced equation.	• Explains the process and all conditions required (yeast and anaerobic, and warmth). AND Correctly balanced equation.
(b)	The name of the process is fractional distillation. Hydrocarbons of different molecular masses have different boiling points. Smaller molecules have a smaller mass, and therefore weaker intermolecular forces between molecules, and hence lower boiling points. When the heated crude oil vapour enters the tower, the smaller hydrocarbons with the lower boiling points condense into liquids higher up in the tower where it is cooler, or remain as gases, and exit from the top of the tower. As there are so many different alkanes formed, a tall tower is needed so that there is a temperature gradient to allow the different alkanes to form, which can then be collected.	• Fractional distillation is the name of the process. • Recognises the separation of the fractions depends on boiling point OR small hydrocarbons have a lower boiling point OR larger hydrocarbons have a higher boiling point. • Recognises different temperatures in different parts of the tower.	• Links the small size of the hydrocarbon to its boiling point and where the fraction collects in the tower. • Explains why a tall tower is needed in terms of the temperature gradient.	• Links the small size of the hydrocarbon to the size of the intermolecular forces, the boiling point and where / how the fraction is collected in the tower. AND Explains why a tall tower is needed.
(c)(i)	Crude oil contains mainly large hydrocarbons. These need to be cracked into small alkenes, including ethene which is then reacted to produce ethanol.	• Identifies the need to produce ethene. OR Identifies that crude oil is composed of large hydrocarbons.	• Explains that the large hydrocarbons in crude oil need to be cracked to form ethene.	
(ii)	$C_{12}H_{26} \rightarrow C_4H_{10} + C_6H_{12} + C_2H_4$ $C_{18}H_{38} \rightarrow C_4H_8 + 2C_3H_6 + C_6H_{14} + C_2H_4$	• THREE products correct (not including C_4H_8 or C_6H_{12}).	• ONE correct unbalanced equation.	

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

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	 ethene propene propane	• TWO structures correct.		
(ii)	Polymers can be made from ethene and propene because alkenes contain a C=C. The **C to C double bond** can be broken during polymerisation, and **carbon atoms from adjacent molecules** can then form **single bonds** between them, forming **long chains** of carbons. High temperature / pressure / catalyst required. Propane only contains carbon to carbon single bonds so this process cannot occur.	• Links formation of polymer to presence of double bond. • One condition stated.	• Explains that double bonds break, forming single bonds between monomers / long chains.	• Detailed explanation of polymer formation, including conditions. AND Propane only contains C–C single bonds, so cannot undergo this process.
(iii)		• Correct.		
(iv)	Plastic bags made from polyethene are waterproof, relatively strong, light, cheap to make, stretchy, resistant to spills, so they are useful for carrying a variety of supermarket goods. However they are unreactive, so they don't break down easily, they are light so they float in the ocean. They are not strong enough for more than one or two uses or for carrying heavy loads so they are replaced regularly and are thrown away.	• States a property of polyethene.	• Links a property to the use of plastic bags or not using the bags.	• Links properties to BOTH the use of plastic bags and the reasons why they should not be used. .
(b)	The liquid is octane. Octane is insoluble in water, so two layers will form. Methanol is soluble in water, so you would see a mixture (one layer seen). Octane is more likely to burn with a smoky flame, as it tends to undergo incomplete combustion with soot / C as a product, compared to methanol, which tends to undergo complete combustion, so no soot is formed and the flame is colourless.	• Correct liquid with a reason.	• Correct liquid with one observation explained with reference to both methanol and octane.	• Correct liquid with comprehensive explanation.

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 8	9 – 13	14 – 18	19 – 24