C5.1 Separate Science Mastery Quiz: Carbon Chemistry

Mark Scheme

Section A

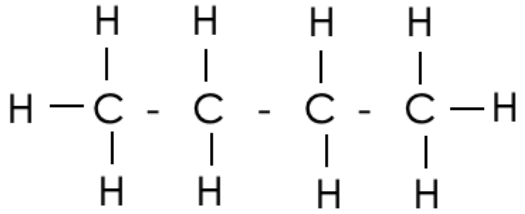
Qu	Answer	Marks	Supporting information for fix-it tasks
1	A	1	Answering B or C suggests that students are unable to identify where crude oil comes from. *To fix it, review where crude oil is found and where it has come from.*
2	B	1	Answering A suggests that students have confused crude oil with a single hydrocarbon, which is a common error. Answering C suggests that students are not clear on the definition of a molecule. *To fix it, review the definitions of compound, mixture and molecule and give students example formulae and mixtures to classify.*
3	B	1	Answering A or C means students are mixing up the naming of alkanes. *To fix it, review the general formula for alkanes and the acronym for naming the first four: monkeys eat peanut butter.*
4	B	1	Answering A shows students have doubled the number of carbons but forgotten the +2. Answering C shows that students have added two before doubling, so have used the incorrect order of operations. *To fix it, give students lots of practice working out the number of carbons and hydrogens in different alkanes.*
5	A	1	Answering B or C suggests that students cannot recall that covalent bonding is between non-metals atoms. This is a common error where students struggle to relate large molecules to simple molecules. *To fix it, review the definition of a covalent bond and the full dot and cross diagrams for the first four alkanes.*
6	C	1	Answering A shows that students have added the given numbers together. Answering B shows that students have seen the formula of the product is C_nH_{2n} and assumed that both products would have the same general formula.

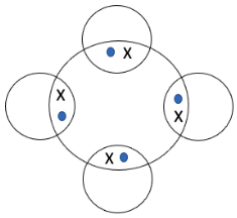
			To fix it, give students practice determining products from cracking equations.
7	A	1	Answering B suggests that students have confused cracking and fractional distillation. Answering C shows that students are not clear that shorter hydrocarbon chains are more useful/more in demand. *To fix it, review the uses of short chain and long chain hydrocarbons and get students to explain why there may be higher demand for petrol hydrocarbons rather than kerosene hydrocarbons.*
8	D	1	Answering A or B show that students have confused the test for saturation with the test for carbon dioxide, which is a common error. Answering B shows that students recognise the colour change is to colourless. Answering C shows that students have recognised that bromine water is used for the test but have confused a positive result with that of a positive test for carbon dioxide. *To fix it, review the test for saturation and give students examples of compounds (ethane, ethene, propane, propene etc) to determine if they would test positive or negative for saturation.*
9	C	1	Answering A suggests that the students have just read the stages in order. Answering B shows that students have not understood that the reason that hydrocarbons evaporate is because the crude oil is heated. *To fix it, review the process of fractional distillation and get students to summarise the steps in their own words.*
10	A	1	Answering B suggests that students have confused melting and boiling points. Answering C suggests the common misconception that the different hydrocarbons themselves have different temperatures rather than boiling points. *To fix it, show students a simple model using distillation to show that the whole mixture is heated and the compounds within in boil at different temperatures.*
11	B	1	Answering A or C suggests that students are mixing up the products with oxygen as a reactant. *To fix it, review the definition of a combustion reaction and get students to write the general equation for the combustion of alkanes.*

12	B	1	Answering A shows that students know there is a limiting reactant involved but not identified this as oxygen. Answering C shows that students have not understood that oxygen is in excess for complete combustion reactions. *To fix it, review the difference between complete and incomplete combustion.*
13	A	1	Answering B shows that students have recognised combustion as exothermic but not selected the correct definition of an exothermic reaction. Answering C or D suggests that students have not recognised combustion as exothermic, although answering C shows that they have recognised energy is transferred to the surroundings. *To fix it, remind students of the definitions of exothermic and endothermic reactions and show students a reaction profile for alkane combustion, asking them to explain what it shows.*
14	B	1	Answering A suggests that students are mixing up alkanes and alkenes and unclear on the naming conventions for polymers. Answering C shows that students have confused the monomer with the homologous group. *To fix it, ask students to determine the name of the polymer that would be formed from different monomers.*
15	B	1	Answering A shows that students are not clear on what incomplete combustion means. Answering C shows that students are aware that sulfur is related to general pollution but have not made the link between sulfur and sulfur dioxide. *To fix it, review the disadvantages of burning hydrocarbons and explain how this is linked to acid rain.*
16 (SS)	C	1	Answering A or B shows that students are not secure on the naming of different homologous groups. *To fix it, give students lots of practice naming compounds from given written and full structural formulae.*
17 (SS)	C	1	Answering A or B shows that students are not clear on the meaning of a functional group. *To fix it, review the functional groups of each of the homologous series and get students to highlight/circle them on diagrams.*

18 (SS)	B	1	Answering A shows that students are not clear on the difference between carboxylic acids and esters. Answering C shows that students have confused polymerisation reactions with the formation of esters. *To fix it, show students how esters are still small molecules so are not polymers but can be added together to create poly(esters) through condensation polymerisation.*
19 (SS)	A	1	Answering B shows that students are not secure with deriving the monomer formula from a polymer. Answering C shows that students have identified the atoms but not the importance of the double bond in the monomer. *To fix it, review why alkenes can form polymers but alkanes cannot.*
20 (SS)	A	1	Answering B shows that students have confused addition and condensation polymerisation. Answering C shows that students have confused the process of making an ester with condensation polymerisation. *To fix it, review the processes of addition and condensation polymerisation using diagrams.*

Section B

Qu	Model answer	Indicative marks	Supporting information *Suggestions for fix-it tasks*
1a		2 Allow 1 for correct number of hydrogen atoms	
1b	C_4H_{10}	1	
2a	Methane: Gas Hexane: Liquid	2	
2b	• Both are hydrocarbons/contain hydrogen and carbon atoms • Methane has 1 carbon atom, hexane has 6 • Methane has 4 hydrogen atoms, hexane has 14 • Both contain covalent bonds	4	*To fix-it, go through each of the suggested points and*

	• Methane only contains C-H bonds, hexane also contains C-C bonds • Both are small molecules • Hexane is a larger molecule than methane • Methane is a gas at room temperature whereas hexane is a liquid • Hexane has a higher melting point than methane • Hexane has a higher boiling point than methane • There are weak forces between molecules in both methane and hexane • The intermolecular forces between molecules of hexane are stronger than in methane • Hexane is more viscous than methane • Methane is more flammable than hexane • Both produce carbon dioxide and water through combustion		*get students to identify whether they are comparing structure or properties, then repeat the question for two different alkanes.*
2c	Boiling point increases as the number of (carbon) atoms increases Because the intermolecular forces increase	2	
2d		2	
3a	COOH	1	*Many students write carboxyl group rather than the formula, which is a common error in exam questions*
3b	In alcoholic drinks or as a solvent	1	
3c	Ester + water	2	
3d	Level 0 (0 marks): no relevant content Level 1 (1-2 marks): relevant points may be made but are not connected Level 2 (3-4 marks): relevant points are made and there is an attempt at linking **or** a conclusion Level 3 (5-6 marks): relevant points are logically linked with a justified conclusion Suggested points: *Advantages of fermentation* • Low energy usage • Raw material used is renewable		

	Disadvantages of fermentation • Produces low purity ethanol • Relatively low rate of reaction *Advantages of hydration* • High energy usage, therefore expensive • Raw material used is non-renewable *Disadvantages of hydration* • Produces high purity ethanol • Relatively high rate of reaction		