# Mark scheme

| Question | | | Answer/Indicative content | Marks | Guidance |
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| 1 | a | | $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ ✓ ✓ | 2 (2 x AO 2.1) | **Examiner's Comments**<br><br>The '2' in front of the water tended to be well answered, but it seemed that many candidates may not have realised that the term 'complete combustion' automatically involves oxygen unless stated otherwise. While high scoring candidates realised that the reactant was oxygen, it was sometimes written as O rather than $O_2$. $H_2O$ was also frequently suggested, as were CO, $CO_2$ and OH. |
| | b | | boiling point(s) ✓<br><br>stronger ✓<br><br>energy ✓ | 3 (3 x AO 1.1) | **ALLOW** size / mass / intermolecular force<br><br>**ALLOW** more/higher/ larger/ strong or **AW**<br>**IGNORE** many/ lots of<br><br>**ALLOW** heat<br>**IGNORE** force<br><br>**Examiner's Comments**<br><br>High scoring candidates scored all 3 marks, and others were able to show at least partial understanding. The first line was sometimes left blank and not everyone realised that the forces require more energy to break them. |
| | c | | Cracking ✓ | 1 (AO 1.1) | **Examiner's Comments**<br><br>Most candidates correctly chose cracking. The main alternative choice was polymerisation, showing that at least they were thinking in the correct area of chemistry. |

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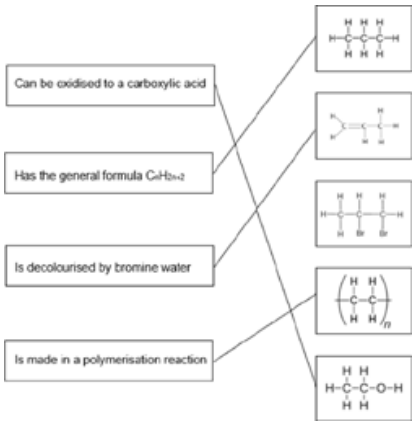
| | d | |  | 4<br>(4 x AO 2.1) | Mark each left-hand box<br>Each box may only have one line<br><br>**Examiner's Comments**<br><br>The alcohol to carboxylic acid was the best known of the links, and most candidates scored at least one of the others. There was no sense of random guesswork, all candidates made sensible suggestions, even when they were wrong. So the '$C_nH_{2n+2}$' box was often connected to the repeating monomer, and the 'made in a polymerisation reaction' box to the propane. The only link that consistently caused problems was the 'Decolourises bromine water', which was in almost every case connected to the dibromopropane. |
| | | | **Total** | **10** | |
| 2 | | | C ✓ | 1<br>(AO 2.1) | **Examiner's Comments**<br><br>Unsaturation was not widely recognised as the answer to this question. |
| | | | **Total** | **1** | |
| 3 | | | Ethane ✓ | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>While most of the higher scoring candidates answered this correctly, it might be productive to look at the types of errors made by the rest. Some candidates understood both what the question was asking and were familiar with the names in a homologous series, but suggested propane or butane. Others gave formulae such as $C_3H_8$ or suggested a range of elements. |
| | | | **Total** | **1** | |
| 4 | | | C ✓ | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>The answer to this question was well known, with A and B the most popular incorrect choices. |
| | | | **Total** | **1** | |

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| 5 | | | D ✓ | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>Some of the higher scoring responses recognised that –OH is the functional group in alcohols. Option C was frequently chosen |
| | | | **Total** | **1** | |
| 6 | a | | Nonane ✓<br><br>(Nonane has) the lowest boiling point as it is the smallest molecule ✓<br><br>Links position to Boiling Point / (column) temperature ✓ | 3<br>(AO 2.1)<br>(2 × AO 1.1) | Links Boiling Point to size – even if not nonane<br><br>**IGNORE** 'low Boiling Point' unless linked to size<br>'More carbons and hydrogens' = size<br><br>**Examiner's Comments**<br><br>The most common suggestion was octacosane, accompanied by the statement that boiling point increases as you go up the column. Such candidates were still able to gain some credit for linking boiling point to molecular size. |
| | b | i | Ethene ✓ | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>Very few candidates could name molecule X as ethene. Ethane was probably the most popular answer, which included a lot of wild guesses.<br><br>One of the more frequent suggestions was 'carbon hydroxide |
| | | ii | $C_nH_{2n+2}$ ✓ | 1<br>(AO 1.1) | **ALLOW** CnH2n+2<br><br>**Examiner's Comments**<br><br>While the concept of a general formula was something that most had great difficulty with, high scoring candidates were able to distinguish themselves. |
| | c | i | 5 (%) ✓ | 1<br>(AO 2.2) | **Examiner's Comments**<br><br>A significant number of candidates did |

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| | | | | | not attempt this question and, of those who did, few appreciated that the percentages should have added up to 100%.<br><br>**Assessment for learning**<br><br>Lists of percentages often add up to 100. |
| | | ii | Idea that the supply of fuel oil is larger than the demand so there is unused fuel oil (that can be cracked to provide petrol) /<br><br>Idea that the demand for diesel oil is higher than the supply so there isn't any spare diesel oil (that can be cracked to provide petrol) ✓ | 1<br>(AO 2.1) | **Examiner's Comments**<br><br>Many candidates saw that fuel oil was in greatest supply, and the most successful realised that the crucial factor was that, in this case, the supply was greater than the demand. Almost no candidates identified the unsatisfied demand for diesel as a reason why diesel is not cracked to petrol.<br><br>**Assessment for learning**<br><br>The numbers in a table are never meaningless. If you can spot what the table is trying to tell you, you've cracked it! |
| | | | **Total** | **7** | |
| 7 | a | | $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$<br><br>Formulae ✓<br>Balancing ✓ | 2<br>(2 × AO 2.2) | **ALLOW** any correct multiple, including fractions<br>**DO NOT ALLOW** and / & instead of '+'<br><br>Balancing mark is dependent on the correct formulae but<br>**ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae<br>e.g., $C_3h_8 + 5O_2 \rightarrow 3Co_2 + 4H2O$<br><br>**Examiner's Comments**<br><br>Many candidates gained the first mark by using the correct formulae, and the |

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<tr><td></td><td></td><td></td><td></td><td></td><td>highest scoring candidates went on to balance the equation correctly. One of the more common formula mistakes was to use atomic oxygen.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>All points plotted correctly scores 2 marks ✓✓</td><td>2<br>(2 × AO 2.1)</td><td>ALLOW ± ½ square<br>3 or 4 points plotted correctly scores 1 mark<br><br><table><tr><th>Alkane</th><th>Energy given out (kJ)</th></tr><tr><td>methane</td><td>55.6</td></tr><tr><td>ethane</td><td>52.6</td></tr><tr><td>propane</td><td>50.4</td></tr><tr><td>butane</td><td></td></tr><tr><td>pentane</td><td>48.7</td></tr><tr><td>hexane</td><td>48.4</td></tr></table></td></tr>
<tr><td></td><td></td><td>ii</td><td>Curve of best fit through the points ✓</td><td>1<br>(AO 2.1)</td><td>ALLOW correctly drawn curve of best fit through incorrectly plotted points<br>ALLOW clumsy drawing, allow the line to miss an occasional point by a square or so. If 2 squares out, should be a clear reason. Beware smooth artistic curve which doesn’t represent what figures show.<br>DO NOT ALLOW straight line dot-to dot.</td></tr>
<tr><td></td><td></td><td>iii</td><td>Answer ± 0.1kj of their own graph ✓</td><td>1<br>(AO 2.1)</td><td><u>Examiner’s Comments</u><br><br>The points on the graph were accurately plotted, any mistakes usually being by exactly half a kilojoule.<br><br>Good curves of best fit were drawn, with most going through all the points and avoiding the corners of the graph paper. The curve was challenging freehand, especially for left-handed candidates, so allowance was made for wavy lines that followed the points. As usual, lines drawn from point to point with a ruler did not gain credit.</td></tr>
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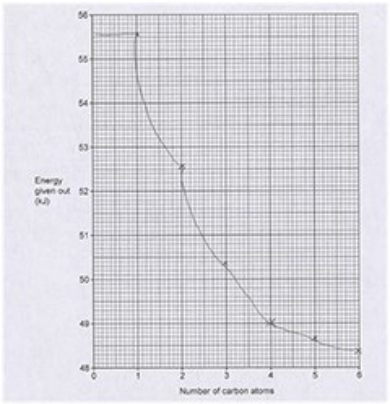
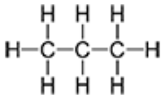
| | | | | | The estimates were almost universally accurate.<br><br>Exemplar 1<br><br>  <br><br><br>Some candidates got both marks for accurately plotting the points but were uncertain of what to do at the ends of the graph. In this case it is also one of the few graphs where the rest of the line is not drawn well.<br><br>**OCR support**<br><br>Our candidate exemplars are really useful resources for teacher development but also for supporting students. For example, this one from the Maths series (June 2022) indicates how different responses for a graph question gained their marks. |
| | | iv | Exothermic ✓ | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>A large number of candidates knew that this was an exothermic reaction, with a few suggesting endothermic. A small minority appeared not to have come across either term. |
| | c | |  | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>Examiners were pleased to see that |

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| | | | | | most candidates drew the formula correctly; well over two-thirds of candidates. |
| | | | **Total** | **8** | |
| 8 | | | **A** | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>Answers were almost evenly split between A, C and D. |
| | | | **Total** | **1** | |
| 9 | | | **B** | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>The formula for ethanol was recognised by half the candidates, with D being the most common alternative. |
| | | | **Total** | **1** | |
| 10 | | | **C** | 1<br>(AO 1.1) | **Examiner's Comments**<br><br>The vast majority of candidates assumed that water was the substance that cannot be produced during combustion.<br><br>**Assessment for learning**<br><br>Remember that the first line of questions like these usually contains a very important clue, in this case that methane is a hydrocarbon. If candidates highlight or mark any important facts in the introductory line it helps focus on what the question is asking. |
| | | | **Total** | **1** | |
| 11 | a | | A ✓<br><br>C ✓<br><br>E ✓ | 3(AO2.1) | 2 correct ticks = 2 marks<br>1 correct tick = 1 mark<br><br>**Examiner's Comments** |

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| | | | | | All the compounds were chosen almost equally, although A less than the others. |
| | b | | Alkenes ✓ | 1(AO2.1) | **Examiner's Comments**<br><br>While many candidates recognised that the other compounds were alkenes, those who didn't appeared not to recognise the any names given and seemed to choose fairly randomly. |
| | c | | Carbon dioxide ✓<br><br>Water ✓ | 2(AO1.1) | **ALLOW** $CO_2$, but **NOT** CO2 / $CO^2$<br><br>**ALLOW** $H_2O$ but **NOT** H2O / $H^2O$<br><br>**Answers can be in either order**<br><br>**Examiner's Comments**<br><br>Carbon dioxide was far better known as a product than water, and hydrogen was often given as the second product.<br><br>Exemplar 1<br><br>  <br><br><br>A large minority of candidates gave this response, suggesting that even though they didn't know the response, they were interacting intelligently with the context of the question. |
| | d | | Crude oil is <u>heated</u> as it enters a fractionating column ✓<br>The vapours get <u>colder</u> as they rise. ✓<br><br>The vapours <u>condense</u> to a liquid at different points. ✓<br><br>The separated parts of crude oil are called <u>fractions</u>. ✓ | 4(AO1.1) | **Examiner's Comments**<br><br>Candidates showed a clear understanding of which terms might apply to which gaps, even if they did not choose the correct one from each pair. For example, the main alternative to 'condense' was 'evaporate', and for 'fractions' was 'polymers'.<br><br>The most frequent error was to suggest that the vapours get hotter as they rise up the column. |
| | e | | Idea that a finite resource is no longer being made or is being made extremely slowly ✓ | 1(AO1.1) | **ALLOW** fixed amount / will run out/ limited supply / non-renewable<br><br>**Examiner's Comments** |

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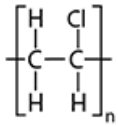
| | | | | | Most candidates clearly understood that it is a resource that will run out. The main error was to suggest exactly the opposite, that it can be re-used. |
| | | | **Total** | **11** | |
| 12 | | i | Idea that chloroethene does not contain carbon and hydrogen <u>only</u> / Chloroethene contains chlorine ✓ | 1(AO2.1) | **<u>Examiner's Comments</u>**<br><br>The answer 'because it has three hydrogens and not four' was frequently seen, and while it gets part of the way there, it wasn't enough to gain a mark.<br><br>Another frequent answer was 'because it has a double bond', showing that candidates had looked at the formula but unfortunately chosen the wrong feature. |
| | | ii |  <br>Correct displayed formula ✓<br>Use of brackets and 'n' ✓ | 2(AO2.1) | **ALLOW** square or round brackets<br><br>**ALLOW** 'n' in front of the brackets<br><br>**Second mark is dependent on first**<br><br>**<u>Examiner's Comments</u>**<br><br>Almost all candidates drew in a double bond, not realising that it breaks to form the polymer. |
| | | | **Total** | **3** | |
| 13 | | | C ✓ | 1(AO2.2) | **<u>Examiner's Comments</u>**<br><br>High scoring candidates realised that the other product must be $C_6H_{14}$, with many others showing partial understanding by suggesting $C_6H_{12}$. |
| | | | **Total** | **1** | |
| 14 | | | D ✓ | 1(AO1.1) | **<u>Examiner's Comments</u>**<br><br>Higher scoring candidates often recognised D as the formula of propanoic acid, with options B & C being the most common alternatives. |
| | | | **Total** | **1** | |
| 15 | | | D ✓ | 1(AO1.1) | **<u>Examiner's Comments</u>** |

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| | | | | | Higher scoring candidates often knew that the monomers in DNA are nucleotides. |
| | | | **Total** | **1** | |
| 16 | | | A ✓ | 1(AO1.1) | **Examiner's Comments**<br><br>Most candidates were clearly familiar with the fractionation of crude oil, and all but the lowest scoring answered this confidently and correctly. This familiarity was confirmed by their answers to Question 16. |
| | | | **Total** | **1** | |
| 17 | | | D ✓ | 1(AO1.2) | **Examiner's Comments**<br><br>A few candidates knew the chemical test for ethene, while most went for options B or C. |
| | | | **Total** | **1** | |