Mark scheme

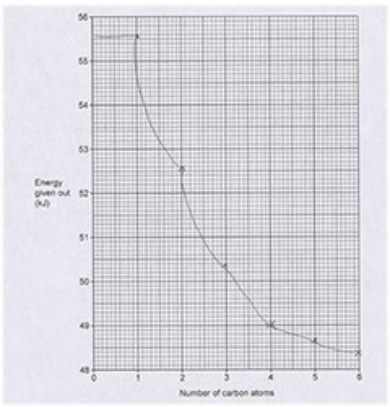
<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>B ✓</td><td>1
(AO 2.2)</td><td><u>Examiner's Comments</u>

Many candidates chose the most exothermic change, C.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>C ✓</td><td>1
(AO 1.2)</td><td><u>Examiner's Comments</u>

While many candidates recognised that for an exothermic change the energy of the products is lower than the energy of the reactants, and that the placement of the activation energy was incorrect. This however lead many to choose D as the most popular incorrect response. Some appreciated that activation energy is shown by an upwards arrow and chose B.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>A</td><td>1
(AO 1.2)</td><td><u>Examiner's Comments</u>

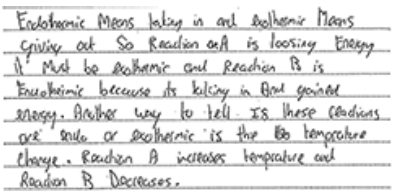
Candidates appreciated that the activation energy is represented by an upwards arrow, and B and C were popular incorrect responses.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>4</td><td></td><td>i</td><td>All points plotted correctly scores 2 marks ✓✓</td><td>2
(2 × AO 2.1)</td><td>ALLOW ± ½ square
3 or 4 points plotted correctly scores 1 mark

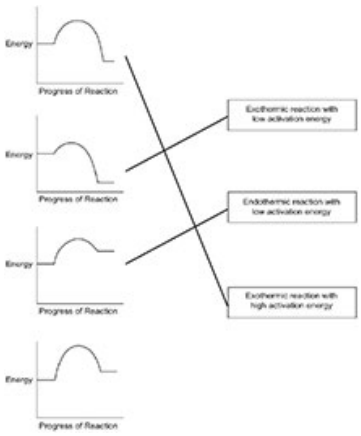
<table><tr><th>Alkane</th><th>Energy given out (kJ)</th></tr><tr><td>methane</td><td>55.6</td></tr><tr><td>ethane</td><td>52.6</td></tr><tr><td>propane</td><td>50.4</td></tr><tr><td>butane</td><td></td></tr></table></td></tr>
</table>

					<table><tr><td>pentane</td><td>48.7</td></tr><tr><td>hexane</td><td>48.4</td></tr></table>
		ii	Curve of best fit through the points ✓	1 (AO 2.1)	**ALLOW** correctly drawn curve of best fit through incorrectly plotted points **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. **DO NOT ALLOW** straight line dot-to dot.
		iii	Answer ± 0.1kj of their own graph ✓	1 (AO 2.1)	**Examiner's Comments** The points on the graph were accurately plotted, any mistakes usually being by exactly half a kilojoule. 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. The estimates were almost universally accurate. Exemplar 1  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. **OCR support** 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 (AO 1.1)	**Examiner's Comments** 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.
			Total	**5**	
5	a		**Level 3 (5–6 marks)** Analyses the information to correctly identify the reaction type in BOTH reaction A AND reaction B **AND** Uses knowledge and understanding to explain why reaction A is exothermic AND reaction B is endothermic *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated*. **Level 2 (3–4 marks)** Analyses the information to correctly identify the reaction type in BOTH reaction A AND reaction B **OR** Uses knowledge and understanding to explain why reaction A is exothermic AND reaction B is endothermic **OR** Analyses the information to correctly	6 (2 × AO1.1) (4 × AO3.2b)	**AO1.1 Demonstrates knowledge and understanding of exothermic and endothermic reactions** • Exothermic reactions increase the temperature (of the surroundings) • Endothermic reactions decrease the temperature (of the surroundings) • In exothermic reactions energy is given out / exothermic reactions have a negative energy change • In endothermic reactions energy is taken in / endothermic reactions have a positive energy change • In exothermic reactions, the energy of the products is lower than the energy of the reactants • In endothermic reactions, the energy of the products is

			identify the reaction type in EITHER reaction A OR reaction B **AND** uses knowledge and understanding to explain why reaction A is exothermic OR reaction B is endothermic *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence*. **Level 1 (1–2 marks)** Analyses the information to correctly identify the reaction type in EITHER reaction A OR reaction B **OR** Uses knowledge and understanding to explain why reaction A is exothermic OR reaction B is endothermic **OR** Correctly calculates the temperature change of reaction A or reaction B *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant*. **0 marks** *No response or no response worthy of credit*.		higher than the energy of the reactants **AO3.2b Analyses information and ideas to draw conclusions** • Reaction A has a temperature increase • Reaction A has a temperature change of + 6.6˚C • Reaction A has a negative energy change • Reaction A is exothermic • Reaction B has a temperature decrease • Reaction B has a temperature change of − 5.1˚C • Reaction B has a positive energy change • Reaction B is endothermic **<u>Examiner's Comments</u>** Most candidates attempted this Level of Response Question and the majority scored some marks. Many candidates ascribed the increase in temperature to an increase in energy and an endothermic reaction and the decrease in temperature to energy loss and an exothermic reaction, restricting their answer to Level 1. Candidates who used the sign of the energy change to identify the type of change correctly often gave detailed responses including all of the information from the table gaining full or almost full marks. Exemplar 2 Reaction A is an Endothermic reaction because the temperature increases at the end of the reaction so its keeping the heat in aswell as its Energy change decreases by -15°C so it is Endothermic. Reaction B is an exothermic Reaction because the temperature decreases at the end of the Reaction so its releasing some heat aswell as its Energy change increases by +26°C. A is endothermic and B is exothermic is incorrect. The temperature increase and decrease and energy decrease

					and increase have been correctly assigned to A and B. This is Level 1, 2 marks. Exemplar 3  Reaction A and B have been correctly ascribed as exothermic and endothermic. The temperature and energy changes have been correctly described and ascribed. This is Level 3, 6 marks. **Key point call out – Level of Response** Often candidates interpret the level of response questions as requiring a very long answer, and this can be demotivating for some or encourage others to write far more than is necessary. This exemplar shows that succinct answers can gain full marks and every line available on the page does not need to be filled to be successful.
	b	i	Thermometer ✓	1(AO1.2)	**ALLOW** temperature probe **<u>Examiner's Comments</u>** Thermometer was very well known. Ruler and beaker were also seen.
		ii	**Any two from**: Put a lid on the beaker ✓ Use a polystyrene cup / idea of using a container made from a material that is a better insulator than glass ✓ Idea of wrapping insulating material around the beaker ✓	2(2 × AO3.3b)	**IGNORE** tin/aluminium foil **<u>Examiner's Comments</u>** Many candidates suggested a lid, more successful considered insulation. Heating with a Bunsen burner was a common incorrect response.

	c			3(3 × AO1.1)	**Examiner's Comments** All combinations of lines were seen, with responses for reaction 2 most commonly correct.
			Total	**12**	