

1.1	condenses		1	AO1 5.7.1.2
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1.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
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1.3	propane	do not accept prop <u>e</u> ne	1	AO2 5.7.1.1
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1.4	C_nH_{2n+2}		1	AO1 5.7.1.1
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1.5	$\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
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1.6	bromine water		1	AO1 5.7.1.4
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2.1	heat or vaporise (oil)	maximum of 3 marks if incorrect reference made to cracking ignore fractional distillation ignore fracking	1	AO1 5.7.1.2
	temperature gradient in column	allow column is cooler at the top or allow column is hotter at the bottom	1	
	(vapour) condenses (into fractions)		1	
	depending on boiling point of fraction	allow at different levels	1	

3.1	a temperature between 400 (°C) and 500 (°C) inclusive	allow a temperature range entirely within 400 (°C) and 500 (°C) inclusive	1	AO3 4.7.1.2
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3.2	(diesel oil has a) lower boiling point / range than heavy fuel oil (but diesel oil has a) higher boiling point / range than kerosene	ignore quoted values for boiling points ignore references to melting points ignore references to intermolecular forces or chain length allow temperature of vaporisation / condensation for boiling points throughout allow the boiling range (of diesel oil) is between those of heavy fuel oil and kerosene for 2 marks.	1 1	AO2 4.7.1.2
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3.3	any two from: • (too) viscous • not (very) flammable • boiling point (too) high	ignore references to cost allow references to difficulty of flow allow references to difficulty of ignition / burning do not accept bitumen takes more energy to burn allow not (very) volatile	2	AO2 4.7.1.3
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3.4	C_6H_{14}		1	AO2 4.7.1.1
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3.5	high temperature	ignore references to pressure allow a quoted temperature above 320 °C ignore hot / heat	1	AO1 4.7.1.4
	any one from: • steam • catalyst	ignore name of catalyst allow alumina allow aluminium oxide allow porous pot allow zeolite	1	

3.6	greater demand (for smaller molecules)	allow converse argument for larger molecules	1	AO1 4.7.1.4
	any one from: (because smaller molecules are) • more useful • better fuels • used to make alkenes • used to make polymers	allow a named polymer ignore plastics	1	

3.7	C_3H_6		1	AO2 4.1.1.1 4.7.1.4
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4.1	(add) bromine (water)	do not accept bromide	1	AO1
	(changes from) orange to colourless	dependent on correct test in MP1 allow (changes from) brown to colourless ignore clear	1	4.7.1.4 4.7.2.1 4.7.2.2

5.1	$\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
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5.2	C_3H_6		1	AO2 5.1.1.1 5.7.1.4
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5.3	bromine (water)	do not accept bromide	1	AO1 5.7.1.4
	(colour change) orange	} allow 1 mark for colourless (to) orange	1	
	(to) colourless		1	
		ignore clear		

6.1	plankton	allow biomass allow (marine) animals / organisms ignore plants	1	AO1 5.7.1.1
	buried in mud	allow compressed under mud allow compressed in sedimentary rock ignore fossilised	1	
	over a long period of time or over millions of years		1	

6.2	crude oil heated (hydrocarbons / liquids) evaporate vapours / gases condense fractions have different boiling points or fractions collect at different levels depending upon boiling point	allow (hydrocarbons / liquids) vaporise / boil	1 1 1 1	AO1 5.7.1.2
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6.3	C_nH_{2n+2}		1	AO1 5.7.1.1
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6.4	(as number of carbon atoms increase) the time increases	MP2 dependent on correct response in MP1	1	AO3 5.7.1.3
	(because) the viscosity increases		1	

7.1	(remains) orange	must be in this order allow no (colour) change	1	AO2 4.7.1.4
	(becomes) colourless	ignore initial colour ignore clear	1	

8.1	plankton or (ancient) biomass	allow microscopic plants / animals	1	AO1 5.7.1.1
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8.2	propane	allow C ₃ H ₈	1	AO1 5.7.1.1
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8.3	Level 2: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO3
	Level 1: Relevant features are identified and differences noted.	1–3	AO1 AO2
	No relevant content	0	
	Indicative content - methane has 1 carbon atom, hexane has 6 - methane has 4 hydrogen atoms, hexane has 14 - both contain C – H bonds - only hexane contains C – C bonds - both are hydrocarbons - hexane has a higher melting point than methane (or converse) - hexane has a higher boiling point than methane (or converse) - methane is a gas at room temperature - hexane is a liquid at room temperature - both are small molecules - hexane has larger molecules than methane - weak forces between molecules - forces between hexane molecules stronger than between methane molecules - hexane is more viscous than methane - both are flammable - methane is more flammable than hexane (or converse) - possible products of combustion from both are: carbon, carbon monoxide, carbon dioxide, water - neither conduct electricity		5.2.2.4 5.7.1.1 5.7.1.3

8.4	C_8H_{18}		1	AO2 5.3.1.1 5.7.1.4
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8.5	bromine (water) turns (from orange / brown) to colourless	MP2 is dependent on MP1 allow decolourises ignore clear	1 1	AO1 5.7.1.4
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9.1	all five points plotted correctly	allow a tolerance of $\pm \frac{1}{2}$ a small square allow 1 mark for three or four points plotted correctly	2	AO2 4.7.1.3
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9.2	98 (°C)	allow a value in the range 92 to 104 (°C)	1	AO3 4.7.1.3
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9.3	the boiling point is lower than 0 (°C)	allow the graph cannot show negative temperatures	1	AO3 4.7.1.3
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9.4	gas	allow (g)	1	AO2 4.2.2.1
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9.5	C_9H_{20}		1	AO2 4.7.1.1
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9.6	(nonane) has a higher boiling point	allow converse for the other alkanes	1	AO2 4.7.1.2
	(so nonane) condenses where the column has a higher temperature	allow (so nonane) collects where the column has a higher temperature	1	

10.1	(test) (add) bromine (water)		1	AO1 4.7.1.4 4.7.2.2
	(result) (changes from) brown / orange to colourless	ignore clear	1	

11.1	(steam / catalytic) cracking	allow thermal decomposition	1	AO1 4.7.1.4
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11.2	high temperature steam / catalyst	allow a temperature in the range 300 – 900 °C	1 1	AO1 4.7.1.4
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12.1	butane		1	AO2 5.7.1.1
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12.2	(molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1
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12.3	$\text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{10} + 2\text{C}_2\text{H}_4 + \text{C}_2\text{H}_6$ OR $\text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{10} + 2\text{C}_3\text{H}_6 + \text{H}_2 \text{ (2)}$ OR $\text{C}_{11}\text{H}_{24} \rightarrow \text{C}_5\text{H}_{10} + 2\text{C}_2\text{H}_6 + \text{C}_2\text{H}_2 \text{ (2)}$	 allow 1 mark for $2\text{C}_2\text{H}_4$ allow 1 mark for C_2H_6 allow 1 mark for $2\text{C}_3\text{H}_6$ allow 1 mark for H_2 allow 1 mark for $2\text{C}_2\text{H}_6$ allow 1 mark for C_2H_2	2	AO2 5.1.1.1 5.3.1.1 5.7.1.4
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12.4	C_2H_6 is useful as a fuel (because more) flammable (than larger molecules) OR C_2H_4 / C_3H_6 / C_5H_{10} is used to make polymers (1) (because more) reactive (than alkanes) (1)	allow smaller molecule so useful as a fuel allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make plastics allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make other chemicals if a named product is given, allow 1 mark for a correct use and 1 mark for a correct linked reason	1 1	AO1 5.7.1.3 5.7.1.4
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13.1	crude oil is heated to vaporise (the hydrocarbons)		1	AO1 AO2 4.7.1.2
	there is a temperature gradient in the (fractionating) column	allow a (fractionating) column is cooler going up	1	
	(so) the gases condense at different levels or (so) lubricating oil condenses below naphtha (and petroleum gases do not condense)		1	
	(because of their) different boiling points		1	

13.2	detergents solvents		1 1	AO1 4.7.1.2
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13.3	$\text{C}_9\text{H}_{20} + 14\text{O}_2 \rightarrow 9\text{CO}_2 + 10\text{H}_2\text{O}$	allow multiples allow 1 mark for $\text{C}_9\text{H}_{20} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ with incorrect / no multipliers	2	AO2 4.1.1.1 4.3.1.1 4.7.1.3
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13.4	as molecular size increases viscosity increases (and) heavy fuel oil has larger molecules (than kerosene)	allow converse statements	1 1	AO2 4.7.1.3
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13.5	(name of process) cracking		1	AO1 4.7.1.4
	(conditions) high temperature	allow a stated temperature in the range 300 to 900 °C	1	
	steam / catalyst		1	

14.1	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$		1	AO2 5.7.1.3
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14.2	hydrocarbon molecules in petrol have fewer carbon atoms than those in diesel petrol has a lower boiling point (range) than diesel	allow converse throughout allow petrol is more flammable than diesel allow petrol is less viscous than diesel	1 1	AO3 5.7.1.3
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15.1	(crude oil) is heated to vaporise (the hydrocarbons)	allow (crude oil) is heated to evaporate the hydrocarbons	1	AO1 5.7.1.2
	temperature (of column) decreases from bottom to top	allow the column gets cooler going up	1	
	(so) the fractions / hydrocarbons condense at different heights (in the column)		1	
	(because) the fractions / hydrocarbons have different boiling points		1	

15.2	(to make) smaller (hydrocarbon) molecules any one from: (which are) • more useful molecules • useful as fuels • starting materials	 allow (which are) in higher demand allow (which are) alkenes for the production of other chemicals	1 1	AO1 5.7.1.4
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15.3	C_2H_4		1	AO2 5.7.1.1 5.7.1.4
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