

[Crude oil as a mixture, fractional distillation, hydrocarbons]

Q1.a(2018)

fractional distillation ✓	1	1.1	ALLOW fractionation
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Q1.b(2018)

A – LPG ✓	2	2 x 1.1	ALLOW petroleum gases ALLOW methane / ethane / propane / butane
B – bitumen ✓			ALLOW tar (if blank check diagram)

Q2.a(2018)

Molecules in petrol are smaller (than those in diesel)/ORA ✓	1	1.1	ALLOW (molecules in) petrol are smaller (number)/ shorter/fewer carbons / ORA IGNORE diesel is higher/petrol is lower/more in diesel/less in petrol
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Q2.b(2018)

Any 3 from: Recognise intermolecular forces/intermolecular bonds are present ✓ Intermolecular forces/intermolecular bonds are smaller/weaker in petrol (molecules than in fuel molecules) ✓ Less energy/heat required to overcome forces in petrol / ORA ✓ Petrol boils at a lower temperature/has a lower boiling range / ORA ✓	3	3 x 1.1	ALLOW bonds between molecules ALLOW bonds between molecules ALLOW bonds IGNORE doesn't boil at a high temperature
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Q3.(2018)

C ₉ H ₂₀ ✓	1	3.1a	ALLOW H ₂₀ C ₉
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Q4.(2018)

alkane(s) ✓

Q5.(2019)

CH ₄ ✓	1	1.2	ALLOW C ₁ H ₄
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Q6.a(2019)

<p>x-axis labelled number of carbon atoms and y-axis labelled energy released (kJ / mol) ✓</p> <p>sensible scale on axis labelled energy, linear and at least half the grid C1 to C8 ✓</p> <p>Points plotted correctly to within $\pm\frac{1}{2}$ square on a linear scale ✓</p> <p>Line of best fit is a straight line using plotted points ✓</p>	4	3×2.2	<p>Axes inverted does not score this mark BUT all other marks are available</p> <p>7 or more cm squares The numbers on C atom axis need to be linear BUT only from 3</p> <p>1.2 ALLOW 5 points plotted correctly</p> <p>DO NOT ALLOW straight line through the origin</p>
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Q6.b(2019)

Energy = 800 – 1000 (kJ) ✓

1	2.2	ALLOW 700 – 1000 (kJ)
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Q7.(2019)

<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6marks) Detailed explanation relating boiling points from table to intermolecular forces and average number of carbon atoms per chain.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Detailed explanation relating boiling points from table to average number of carbon atoms per chain. OR Detailed explanation relating boiling points from table to intermolecular forces. OR Detailed explanation relating intermolecular forces and average number of carbon atoms per chain.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) An attempt to relate boiling points from table to average number of carbon atoms per chain. OR An attempt to relate boiling points from table to intermolecular forces. OR An attempt to relate intermolecular forces and average number of carbon atoms per chain.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	<p>3×3.1a 3×1.1</p>	<p>AO1.1 Demonstrate knowledge and understanding of scientific ideas concerning the separation of crude oil by fractional distillation</p> <ul style="list-style-type: none"> Longer/larger/more carbon hydrocarbons have stronger inter-molecular forces Stronger/more intermolecular forces result in a higher boiling point More energy needed to overcome stronger intermolecular forces Different fractions condense at different heights/ boiling points/temperatures so get separated Longer/larger hydrocarbons have stronger inter-molecular forces <p>AO3.1a Analyse information and ideas to interpret data from table</p> <ul style="list-style-type: none"> Fractions with lower boiling points condense further up column Column cooler at the top/hotter at the bottom As column height increases, boiling points decrease / ORA As column height increases, number of carbon atoms per chain decreases /ORA larger molecules have higher b.pt. / ORA
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Q8.(2020)

D ✓

Q9.a(2020)

cracking ✓

1	1.2	IGNORE answers based upon turning large molecules into small molecules or producing more useful molecules etc. ALLOW thermal decomposition IGNORE references to catalytic/steam
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Q9.b(2020)

demand for petrol exceeds supply (and supply for fuel oil exceed demand) ORA ✓

fuel oil is turned into petrol ✓

1	3.2b	ALLOW demand for petrol is larger than demand for fuel oil
1	3.2b	IGNORE answers based upon turning large molecules into small molecules or producing more useful molecules etc.

Q9.c(2020)

any answer in the range -60 to -30 °C ✓

1	3.2b	Correct value = -42 °C
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Q9.d(2020)

C₇H₁₆ ✓

1	2.2	ALLOW H ₁₆ C ₇ DO NOT ALLOW incorrect placements of subscripts e.g. C7H16 etc.
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Q10.(2021)

B ✓

Q11.(2021)

Fractional distillation ✓

1	1.2	DO NOT ALLOW just distillation
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Q12.(2021)

Y

W

Z

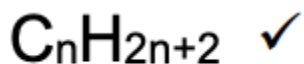
X

✓

Q13.a(2021)

Alkanes ✓

Q13.b(2021)



Q13.c(2021)

Any value between -25 and 0°C ✓

Q14.(2022)

D ✓

Q15.(2022)

A ✓

Q16.a(2023)

Fractional distillation ✓	1	1.2	IGNORE distillation unqualified IGNORE simple distillation
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Q16.b(2023)

Cool ✓

Condense / turn into a liquid ✓

Q16.c(2023)

Gases	☒	
Naphtha	☐	
Residue	☐	✓

Q16.d(2023)

Alkane	☒	
Hydrocarbon	☒	
Mixture	☐	
Polymer	☐	✓✓

Q16.e(2023)

35 (°C) ✓	1	3.2b	ALLOW 30 – 40 (°C)
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Q16.f(2023)

First check answer on answer line
If answer = 47% award 3 marks

$(75 \div 160) \times 100$ ✓

= 46.875 / 46.88 / 46.9 ✓

= 47(%) ✓ (2 significant figures)

3

2 x 2.2

1.2

ECF from M2
ALLOW $(160 \div 75) \times 100 = 213.333333$ for M2
and 210 for M3

Q17.(2024)

Crude oil is a **compound** / **feedstock** / **renewable resource** used by the petrochemical industry. ✓

Q18.a(2024)

(g)



(l)



(s)



✓

Q18.b(2024)

X drawn at the top of the column ✓	1	1.2	ALLOW X anywhere above the petrol fraction level including the exit pipe DO NOT ALLOW X outside of the column or pipe
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Q19.a(2024)

R ✓

1

3.2b

ALLOW 36

Q19.b(2024)

Q ✓

1

3.2b

ALLOW 126