

Organic Chemistry

Q1. (2018)

2		A ✓	1	1.2	
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Q2. (2018)

5		D ✓	1	2.2	
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Q3. (2018)

9		C ✓	1	1.1	
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Q4. (2018)

11		B ✓	1	2.1	
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Q5. (2018)

12		B ✓	1	1.1	
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Q6. (2018) – 24b, 24c

A)

(b)	MAX TWO FROM: Idea that (fractionating) column has a temperature gradient ✓ Idea that crude oil contains a range of molecular sizes ✓ Idea that molecules or fractions or hydrocarbons or alkanes have different boiling points ✓ Idea that molecules or fractions or hydrocarbons or alkanes condense at different levels (in the fractionating column) ✓ PLUS AT LEAST ONE FROM: Larger molecules have higher boiling points / OR A ✓	3	3 x 1.1	DO NOT ALLOW just idea that molecules or fractions have different melting points NB This marking point gains TWO MARKS as it also includes M3 above ALLOW longer chains molecules for larger molecules ALLOW bitumen or fuel oil as a named large molecule / LPG or petrol as a named small molecule ALLOW bonds between molecules for forces between molecules ALLOW heat for energy BUT the larger the molecule the stronger the intermolecular forces therefore the higher the boiling point scores 3 / OR A
	Intermolecular forces between larger molecules are strong(er) / OR A / larger molecules have more intermolecular forces / OR A ✓ The stronger the intermolecular forces the higher the boiling point or more energy is required to break these forces / OR A ✓ During boiling intermolecular forces are broken ✓			

B)

(c)	A ✓ Idea that (LPG fraction) has the lowest boiling point ✓	2	3.2b 1.1	Second mark is dependent on correct choice of A ALLOW -2(°C) ALLOW A / LPG is a gas at room temperature ALLOW idea that LPG is collected at the top of the tower so must have the lowest (boiling) temperature IGNORE just quoting data from the table
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Q7. (2018)

A)

25	(a)		All points plotted correctly scores 2 marks ✓✓ Straight line of best fit through the points ✓	3	3 x 2.1	ALLOW ± ½ square 3 or 4 points plotted correctly scores 1 mark ALLOW correctly drawn line of best fine through incorrectly plotted points; this may be a curve

Name	Number of carbon atoms	Boiling point (°C)
methanol	1	65
ethanol	2	79
propanol	3	97
pentanol	5	138
hexanol	6	156

B)

	(b)	(i)	Answer $\pm 2^{\circ}\text{C}$ of their own graph ✓	1	2.1	
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C)

		(ii)	<pre> H H H H H — C — C — C — C — O — H H H H H ✓ </pre>	1	2.1	ALLOW diagram with $-\text{OH}$ BUT DO NOT ALLOW $-\text{HO}$ ALLOW diagram showing butan-2-ol eg <pre> H H H O H H — C — C — C — C — H H H H H </pre>
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D)

	(c)		$-\text{OH}$ ✓	1	1.1	ALLOW hydroxy / hydroxyl
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E)

	(d)		CH_3COOH ✓	1	2.2	ALLOW $\text{C}_2\text{H}_4\text{O}_2$ ALLOW displayed formula, ie <pre> H O H — C — C — O — H H O </pre> DO NOT ALLOW $\text{CH}^{\text{S}}\text{COOH}$ / CH_3COOH
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Q8. (2019)

6			C ✓	1	2.1	
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Q9. (2019)

7			C ✓	1	1.1	
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Q10. (2019)

8			A ✓	1	1.2	
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Q11. (2019)

A)

17	(a)		3	1.1													
		<table><tr><th>Name of alkane</th><th>Molecular formula</th><th>Structure</th></tr><tr><td>Methane</td><td>CH₄</td><td><pre> H H-C-H H</pre></td></tr><tr><td>Ethane</td><td>C₂H₆ ✓</td><td><pre> H H H-C---C-H H H</pre></td></tr><tr><td>Butane ✓</td><td>C₄H₁₀</td><td><pre> H H H H H-C---C---C---C-H H H H H</pre> ✓</td></tr></table>	Name of alkane	Molecular formula	Structure	Methane	CH ₄	<pre> H H-C-H H</pre>	Ethane	C ₂ H ₆ ✓	<pre> H H H-C---C-H H H</pre>	Butane ✓	C ₄ H ₁₀	<pre> H H H H H-C---C---C---C-H H H H H</pre> ✓			
Name of alkane	Molecular formula	Structure															
Methane	CH ₄	<pre> H H-C-H H</pre>															
Ethane	C ₂ H ₆ ✓	<pre> H H H-C---C-H H H</pre>															
Butane ✓	C ₄ H ₁₀	<pre> H H H H H-C---C---C---C-H H H H H</pre> ✓															

B)

	(b)	Hydrocarbon because contains only carbon and hydrogen ✓ Saturated because contains single (covalent) bonds <u>only</u> / AW ✓	2	2.1	ALLOW fits the general formula C_nH_{2n+2} ALLOW has only H and C ✓ DO NOT ALLOW contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen ALLOW does not have a double bond IGNORE 'saturated because not an alkene/ because all its carbons have 4 bonds
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C)

17	(c)	Ethane – bromine water remains orange / orange-brown ✓ Ethene – bromine water is decolourised / turns colourless ✓	2	2.2	IGNORE No change IGNORE turns clear / disappears
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D)

	(d)	Alkene(s) ✓	1	1.1	
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E)

	(e)	C₅H₁₂ + 8O₂ → 5CO₂ + 6H₂O Formulae ✓ Balancing ✓	2	2.2	ALLOW any correct multiple, including fractions DO NOT ALLOW 'and'/'&' instead of '+' Balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae eg C₅H₁₂ + 8O₂ → 5CO₂ + 6H₂O
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Q12. (2019)

A)

20	(a)	Z ✓	1	2.1	
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B)

	(b)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 40.31(kg) award 2 marks $\frac{29}{100} \times 139$ ✓ = 40.31(kg) ✓	2	2.2	ALLOW 40.3 / 40 ✓✓ ALLOW ecf for one mark if 26% or 28% used (=36.14 or 38.92) ✓
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D)

	(c)	C ₁₆ H ₃₄ ✓	1	2.1	ALLOW H ₃₄ C ₁₆
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E)

	(d)	(i)	Any two from: idea that decane boils / evaporates / turns into gaseous decane ✓ Idea that decane (vapour or gas) reacts /breaks down as it comes into contact with the porcelain chips ✓ Idea that large molecules of decane produce smaller molecules like ethene ✓	2	1.2	ALLOW passed over hot catalyst ALLOW liquid decane reacts with chips BOD
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F)

		(ii)	C ₆ H ₁₄ ✓	1	2.2	ALLOW H ₁₄ C ₆ ALLOW if the candidate tries to write an (erroneous) equation for cracking and gives it as a product
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Q13. (2020)

7			c ✓	1	1.1	
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Q14. (2020)

8			c ✓	1	1.1	
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Q15. (2020)

10			B ✓	1	2.1	
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Q16. (2020)

12			B ✓	1	2.2	
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Q17. (2020)

A)

19	(a)	(i)	Waxes and tar ✓	1	2.1	
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B)

		(ii)	Waxes and tar ✓	1	2.1	
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C)

	(b)	(i)	High temperature / catalyst ✓	1	1.1	ALLOW stated temperature above 500°C IGNORE temperature/heat without qualification ALLOW named catalyst eg zeolite / aluminium oxide / silicon oxide
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D)

		(ii)	product of cracking more in demand / makes up the shortfall / more useful ✓ gives examples from the table ✓	2	2.1	
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Q18. (2020)

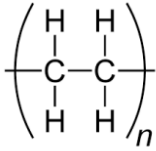
A)

22	(a)		Any two from: Have the same general formula / both have the formula C _n H _{2n+2} ✓ Idea that they differ from each other by CH ₂ ✓ They are both saturated / idea that their carbon atoms are joined to each other by (only) single (covalent) bonds ✓	2	1.1	ALLOW have similar chemical properties ALLOW show trends in physical properties
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B)

	(b)	(i)	(Ethene) molecules have a (carbon to carbon) double bond / (Ethane) molecules do not have a (carbon to carbon) double bond or only have single bonds ✓	1	2.2	
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C)

		(ii)	 Single bond between the carbon atoms ✓ Single bonds to the side of each carbon atom ✓	2	2.1	
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Q19. (2021)

5			D ✓	1	1.1	
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Q20. (2021)

7			C ✓	1	2.1	
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Q21. (2021)

8			A ✓	1	2.1	
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Q22. (2021)

11			B ✓	1	2.2	
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Q23. (2021)

14			B ✓	1	1.1	
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Q24. (2021)

15			D ✓	1	2.1	
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Q25. (2021)

A)

17	(a)		Contains carbon and hydrogen ✓ only ✓	2	1.1	Second marking point is dependent on the first ALLOW (formula) has only ✓ C and H ✓ DO NOT ALLOW contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen DO NOT ALLOW contains carbon and hydro
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B)

	(b)		Contains (carbon to carbon) single bonds only / Contains single (covalent) bonds only ✓	1	1.1	ALLOW has no (carbon to carbon) double bonds IGNORE has the maximum amount of hydrogen atoms
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C)

	(c)	Answer in range 135 – 185 (°C) ✓	1	3.2a	ALLOW answer written in table if answer line is blank
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D)

	(d)	Idea that hydrocarbons have different boiling points ✓ And any two from: Larger molecules or longer chains have higher boiling points / ORA ✓ Larger molecules or longer chains have stronger intermolecular forces / ORA ✓ Idea that stronger intermolecular forces results in higher boiling point / ORA ✓	3	1 x 2.1 2 x 1.1	ALLOW pentadecane for larger molecules or hexane for smaller molecules throughout the question IGNORE melting points ALLOW molecules with higher mass have higher boiling points / ORA ALLOW larger molecules or longer chains have more intermolecular forces / ORA ALLOW idea that stronger intermolecular forces results in more energy needed (to boil) / ORA
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E)

	(e)	$C_9H_{20} + 14O_2 \rightarrow 9CO_2 + 10H_2O$ right hand side correct ✓ left hand side correct ✓	2	2.1	
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Q26. (2021) – 21c

	(c)	(i)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ Formulae ✓ Balancing ✓	2	1.1 2.1	ALLOW any correct multiple, including fractions DO NOT ALLOW and / & instead of '+' balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. $C_2H_5Oh + 3O_2 \rightarrow 2CO_2 + 3H_2O$
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Q27. (2022)

4			D ✓	1	1.2	
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Q28. (2022)

5			D ✓	1	1.1	
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Q29. (2022)

6			D ✓	1	1.1	
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Q30. (2022)

7			A ✓	1	1.1	
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Q31. (2022)

14			C ✓	1	2.2	
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Q32. (2022)

A)

16	(a)	A ✓ C ✓ E ✓	3	2.1	2 correct ticks = 2 marks 1 correct tick = 1 mark
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B)

	(b)	Alkenes ✓	1	2.1	
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C)

	(c)	Carbon dioxide ✓ Water ✓	2	1.1	ALLOW CO ₂ but NOT CO ₂ / CO ₂ ² ALLOW H ₂ O but NOT H ₂ O / H ₂ O Answers can be in either order
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D)

	(d)	Crude oil is <u>heated</u> as it enters a fractionating column ✓ The vapours get <u>colder</u> as they rise. ✓ The vapours <u>condense</u> to a liquid at different points. ✓ The separated parts of crude oil are called <u>fractions</u> . ✓	4	1.1	
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Q33. (2022) – 19e

A)

	(e)	(i)	Idea that chloroethene does not contain carbon and hydrogen <u>only</u> / Chloroethene contains chlorine ✓	1	2.1	
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B)

		(ii)	$\left[\begin{array}{cc} \text{H} & \text{Cl} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$	2	2.1	ALLOW square or round brackets ALLOW 'n' in front of the brackets Second mark is dependent on first
			Correct displayed formula ✓ Use of brackets and 'n' ✓			

Q34. (2023)

5	B	1	1.1	
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Q35. (2023)

7	C	1	1.1	
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Q36. (2023)

A)

18	(a)	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$	2	2 x 2.2	ALLOW any correct multiple, including fractions DO NOT ALLOW and / & instead of '+' Balancing mark is dependent on the correct formulae but ALLOW 1 mark for a balanced equation with a minor error in subscripts / formulae e.g., $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
		Formulae ✓ Balancing ✓			

B)

	(b)	(i)	All points plotted correctly scores 2 marks ✓✓	2	2 x 2.1	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><tr><td>pentane</td><td>48.7</td></tr><tr><td>hexane</td><td>48.4</td></tr></table>	Alkane	Energy given out (kJ)	methane	55.6	ethane	52.6	propane	50.4	butane		pentane	48.7	hexane	48.4
Alkane	Energy given out (kJ)																			
methane	55.6																			
ethane	52.6																			
propane	50.4																			
butane																				
pentane	48.7																			
hexane	48.4																			

C)

		(ii)	Curve of best fit through the points ✓	1	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.
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D)

		(iii)	Answer ± 0.1 kJ of their own graph ✓	1	2.1	
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E)

	(c)		<pre> H H H H - C - C - C - H H H H ✓ </pre>	1	1.1	
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Q37. (2023)

A)

20	(a)		Nonane ✓ (Nonane has) the lowest boiling point as it is the smallest molecule ✓ Links position to Boiling Point / (column) temperature ✓	3	2.1 2 x 1.1	Links Boiling Point to size – even if not nonane IGNORE 'low Boiling Point' unless linked to size 'More carbons and hydrogens' = size
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B)

	(b)	(i)	Ethene ✓	1	1.1	
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C)

		(ii)	C_nH_{2n+2} ✓	1	1.1	ALLOW C_nH_{2n+2}
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D)

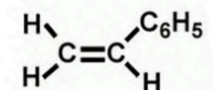
	(c)	(i)	5 (%) ✓	1	2.2	
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E)

		(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) / 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	2.1	
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Q38. (2023) – 23b, 23c

A)

	(b)	 Double bond between C atoms ✓ Rest of structure correct ✓	2	2 x 2.1	DO NOT ALLOW multiple double bonds ALLOW C₆H₅ group in any position ALLOW bond from C to H of C₆H₅ group IGNORE any square brackets / n MP2 is dependent on MP1
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B)

	(c)	Monomer	Polymer	2	2 x 1.1	All 3 correct = 2 marks
		amino acids — DNA nucleotides — proteins sugars — starch ✓✓				1 correct = 1 mark

Q39. (2024)

5	C ✓	1	1.1	
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Q40. (2024)

6	D ✓	1	1.1	
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Q41. (2024)

14	C ✓	1	2.1	
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Q42. (2024)

15	C ✓	1	2.1	
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Q43. (2024)

A)

16	(a)	Ethane ✓	1	1.1	
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B)

	(b)	$\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$ ✓ ✓	2	2 x 2.1	
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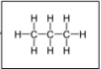
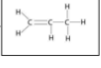
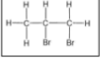
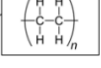
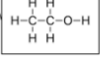
C)

16	(d)	boiling point(s) ✓ stronger ✓ energy ✓	3	3 x 1.1	ALLOW size / mass / intermolecular force ALLOW more/higher/ larger/ strong or AW IGNORE many/ lots of ALLOW heat IGNORE force
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D)

	(e)	Cracking ✓	1	1.1	
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E)

16	(f)	Can be oxidised to a carboxylic acid Has the general formula C_nH_{2n+2} Is decolourised by bromine water Is made in a polymerisation reaction      ✓✓✓✓	4	4 x 2.1	Mark each left-hand box Each box may only have one line
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