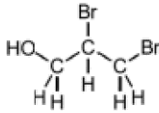
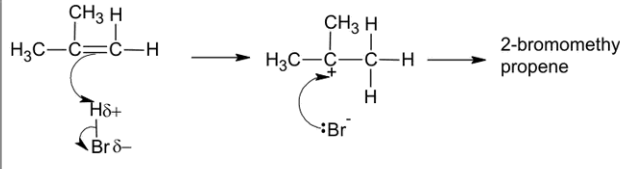


4(b)(ii)	(electrophilic) addition	1
	bromine decolourises / turns colourless / fades (from orange / brown)	1
4(b)(iii)	HOCH ₂ CHBrCH ₂ Br OR 	1

May/June 2017 9701/21 · Q4 (b)(ii), (b)(iii)

2(b)	Produces more useful / more valuable / higher demand substances / alkanes / alkenes	1
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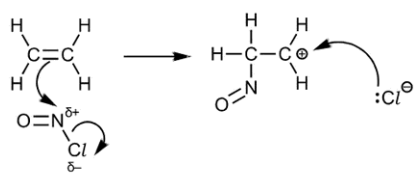
May/June 2018 9701/21 · Q2 (b)

4(d)(i)		
	curly arrow from C=C to H	1
	correct dipole on HBr and curly arrow from bond of HBr to Br	1
	tertiary intermediate cation	1
	Br ⁻ with curly arrow from lone pair	1

May/June 2018 9701/21 · Q4 (d)(i)

4(a)(i)	2-bromobutane	1
4(a)(ii)	ketone	1
4(e)	ethanolic (instead of aqueous)	1
	hotter/higher temperature (heat under) reflux	1

May/June 2018 9701/23 · Q4 (a)(i), (a)(ii), (e)

1(e)	 M1 curly arrow from C=C to N^{δ+} AND curly arrow from N—Cl to Cl^{δ-} M2 intermediate AND curly arrow from lone pair on Cl⁻ to C(+)	2
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Question	Answer	Marks
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March 2019 9701/22 · Q1 (e)

4(b)(i)	ultra-violet (light) / sun(light)	1
4(b)(iii)	free-radical (substitution) reactions are uncontrolled OR further chlorination / substitution occurs	1

March 2019 9701/22 · Q4 (b)(i), (b)(iii)

4(b)(i)	cracking	1
4(d)(i)	unpaired electron(s)	1
4(d)(v)	M1 identify bond types in alkanes and alkenes bonds in alkanes are (all) sigma / σ AND alkenes have (C = C made of) sigma AND pi / σ AND π	1
	M2 electrons in π (of the C = C) are responsible for the reaction electrophiles are attracted to / attack to electrons in pi / π OR electrophiles react with pi / π	1

Question	Answer	Marks
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May/June 2019 9701/22 · Q4 (b)(i), (d)(i), (d)(v)

1(e)(i)	ultra-violet (light) / sunlight	1
1(e)(ii)	$\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$	1

Question	Answer	Marks
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Oct/Nov 2019 9701/21 · Q1 (e)(i), (e)(ii)

1(e)(i)	$\text{Ga}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{GaCl}_3 + 3\text{H}_2\text{O}$	1
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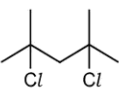
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Question	Answer	Marks
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May/June 2020 9701/22 · Q1 (e)(i)

4(c)(iii)		1
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Oct/Nov 2020 9701/21 · Q4 (c)(iii)

3(c)(iii)		1
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Oct/Nov 2020 9701/22 · Q3 (c)(iii)

6(c)	<table border="1"> <tr> <td></td><td>σ</td><td>π</td></tr> <tr> <td>C_3H_6</td><td>8</td><td>1</td></tr> <tr> <td>$\text{C}_3\text{H}_8\text{O}$</td><td>11</td><td>0</td></tr> </table>		σ	π	C_3H_6	8	1	$\text{C}_3\text{H}_8\text{O}$	11	0	2
	σ	π									
C_3H_6	8	1									
$\text{C}_3\text{H}_8\text{O}$	11	0									
6(d)(i)	M1 more stable = $\text{CH}_3\text{C}^+(\text{H})(\text{CH}_3)$  M2 less stable = $\text{CH}_3\text{CH}_2\text{C}^+(\text{H}_2)$ /  M3 greater (positive) inductive effect of two alkyl groups OR greater electron donation of two alkyl groups owtte	1									
		1									
6(d)(ii)	propan-2-ol	1									

May/June 2021 9701/21 · Q6 (c), (d)(i), (d)(ii)

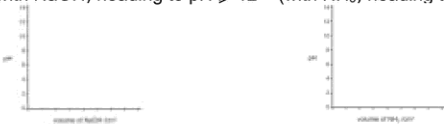
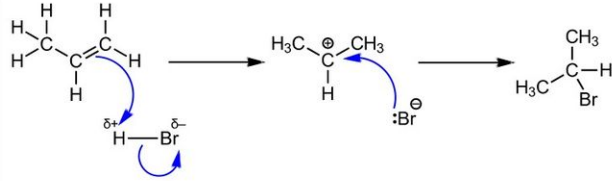
4(b)(i)	A	1
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Question	Answer	Mark
4(c)	dehydrating agent / cause dehydration	1

May/June 2021 9701/22 · Q4 (b)(i), (c)

3(d)(ii)	M1: correct sigmoid shape with vertical section at 25 cm³ for both M2: both curves show initial pH ≤ 2 M3: (with NaOH) heading to pH ≥ 12 (with NH₃) heading to pH 8–12 	3
3(e)(i)	 M1: curly arrow from C=C to H of HBr M2: correct dipole ($\delta^+ \text{H}-\text{Br}^{\delta-}$) AND curly arrow from H—Br to Br M3: curly arrow from lone pair on :Br⁻ to carbocation M4: correct intermediate AND product (2-bromopropane)	4

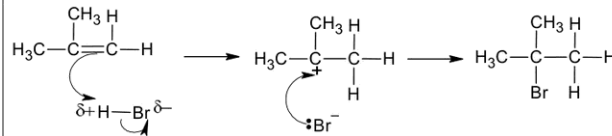
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Question	Answer	Marks
March 2022 9701/22 · Q3 (d)(ii), (e)(i)		
2(b)(i)	reaction 1 = hydrogen / H ₂	1
	reaction 2 = carbon dioxide / CO ₂ AND water / H ₂ O	1
Oct/Nov 2022 9701/23 · Q2 (b)(i)		
5(c)(i)	EITHER (pair of) electrons in π bond are further away from the nuclei so weaker attraction OR (pair of) electrons in σ bond are closer to the two nuclei so stronger attraction	1

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Question	Answer	Marks
5(c)(ii)	 M1 arrow from = of C=C to H of H-Br M2 correct dipole on H-Br AND arrow from H-Br bond to Br M3 correct intermediate AND 2-bromopropane M4 arrow from lone pair on Br⁻ to C⁺ of their intermediate (with +ve or δ^+ charge)	4

Question	Answer	Marks
May/June 2024 9701/21 · Q5 (c)(i), (c)(ii)		
2(b)(i)	a species with one or more unpaired electrons	1
Oct/Nov 2024 9701/21 · Q2 (b)(i)		

3(a)(i)	 Two correct for one mark, all four for two marks: • start at origin • peak sits below the original • peak sits to the right-hand side of the original • new line crosses the original once only AND to the right of the original peak	2
3(a)(iii)	catalyst	1
3(a)(iv)	annotation to show new E_A (nickel / catalyst) further to the left than original E_A	1

May/June 2025 9701/21 · Q3 (a)(i), (a)(iii), (a)(iv)

3(a)(i)	Al_2O_3 / aluminium oxide	1
3(a)(ii)	• unburned hydrocarbons • react with NO / NO₂ • (to) produce PAN (– a component of photochemical smog) Any 2 points = 1 mark, all 3 points = 2 marks	2
3(b)(i)	nickel / platinum	1
3(b)(ii)	minimum energy required for a collision to be effective	1
3(b)(iii)	M1 • area under the curve with energy $\geq E_A$ using a catalyst is larger so • greater proportion of particles with sufficient energy to react M2 rate faster because higher frequency of successful collisions	2

Question	Answer	Marks
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May/June 2025 9701/23 · Q3 (a)(i), (a)(ii), (b)(i), (b)(ii), (b)(iii)

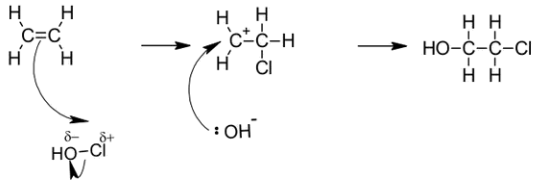
4(a)(iv)	M1 0.001(00) mol sulfur produced M2 $M1 \times 6.02 \times 10^{23}$ $= 6.02 \times 10^{20}$	2
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May/June 2025 9701/23 · Q4 (a)(iv)

6(a)(i)	two or more reactants / molecules react to make (only) one product	1
6(a)(ii)	mix / add Cl_2 into water	1

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Question	Answer	Marks
6(a)(iii)	water purification / killing bacteria or microbes	1
6(b)	 M1 correct arrow for HO-Cl M2 arrow from double bond of C=C to Cl M3 correct intermediate M4 arrow from lone pair on O of :OH- to the appropriate C	4
6(c)(i)	KCN/potassium cyanide in ethanol AND heat	1
6(c)(ii)	(acid) hydrolysis	1

May/June 2025 9701/23 · Q6 (a)(i), (a)(ii), (a)(iii), (b), (c)(i), (c)(ii)

4(c)(i)	2,3-dimethylbut-1-ene	1
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Question	Answer	Marks
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Oct/Nov 2025 9701/21 · Q4 (c)(i)

3(e)(iii)	$\text{C}_6\text{H}_{14} + 9\frac{1}{2}\text{O}_2 \rightarrow 6\text{CO}_2 + 7\text{H}_2\text{O}$	1
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Oct/Nov 2025 9701/22 · Q3 (e)(iii)

4(b)(i)	KCN in ethanol (and heat)	1
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Oct/Nov 2025 9701/24 · Q4 (b)(i)