

5(a)(i)	(n-)propyl ethanoate	1
5(a)(ii)	NaOH / sodium hydroxide	1
5a(iii)	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O} \\ \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} $	1
5(a)(iv)	perfume / solvent	1

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Question	Answer	Marks						
5(b)(i)	M1 divide by A_r <table> <tr> <td>C</td><td>H</td><td>O</td></tr> <tr> <td>54.5 / 12</td><td>9.1 / 1</td><td>36.4 / 16</td></tr> </table>	C	H	O	54.5 / 12	9.1 / 1	36.4 / 16	1
C	H	O						
54.5 / 12	9.1 / 1	36.4 / 16						
	M2 divide by smallest number <table> <tr> <td>4.54 / 2.275 (= 2 OR 1.99)</td><td>9.1 / 2.275(=4)</td><td>2.275 / 2.275 (=1)</td></tr> </table>	4.54 / 2.275 (= 2 OR 1.99)	9.1 / 2.275(=4)	2.275 / 2.275 (=1)	1			
4.54 / 2.275 (= 2 OR 1.99)	9.1 / 2.275(=4)	2.275 / 2.275 (=1)						
	M3 empirical formula based on correctly rounded values of M2 $\text{C}_2\text{H}_4\text{O}$	1						
5(b)(ii)	(relative) molecular mass / M_r	1						
5(c)(i)	$\text{C}_3\text{H}_6\text{O}_2$	1						
5(c)(ii)	X and Z – no reaction / no (visible) change	1						
	Y – effervesces	1						
5(d)	$2\text{HCO}_2\text{H} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{HCO}_2\text{Na} + \text{CO}_2 + \text{H}_2\text{O}$	1						

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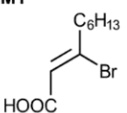
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May/June 2019 9701/22 · Q5 (a)(i), (a)(ii), (a)(iii), (a)(iv), (b)(i), (b)(ii), (c)(i), (c)(ii), (d)

3(a)(i)	M1 acidified / H ⁺ Cr ₂ O ₇ ²⁻ / (potassium / sodium) dichromate OR manganate(VII) / MnO ₄ ⁻ / KMnO ₄ M2 (heat under) reflux	2
3(a)(v)	M1 hydrolysis M2 esterification / condensation	2
3(b)(i)	M1 no. of mol O ₂ = $\frac{1.00 \times 10^5 \times 1.06 \times 10^{-3}}{(8.31 \times 850)}$ M2 no. of mol of nitroglycerine = 4 × 0.0150 = 0.0600 (mol) M3 mass of nitroglycerine = 0.0600 × 227 = 13.6(2) (g)	3
3(c)(i)	C ₅ H ₈ O ₂	1

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Question	Answer	Marks
3(d)(i)	M1  M2 (two) different groups on each C atom in the C=C / end of the C=C double bond M3 no / restricted rotation about C=C	3
3(d)(ii)	H ₂ / hydrogen	1

March 2020 9701/22 · Q3 (a)(i), (a)(v), (b)(i), (c)(i), (d)(i), (d)(ii)

5(a)(iii)	M1 CO ₃ ²⁻ M2 propanoic acid – effervesce. (Propan-1-ol – no reaction)	2
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May/June 2020 9701/21 · Q5 (a)(iii)

6(f)(i)	CH ₃ CH ₂ CO ₂ H + 4[H] → CH ₃ CH ₂ CH ₂ OH + H ₂ O	1
6(g)(i)	<i>Molecular formula of W</i> C ₃ H ₆ O ₂	1

May/June 2020 9701/21 · Q6 (f)(i), (g)(i)

3(c)(iv)	C ₂ H ₅ CH(OH)CN + HCl + 2H₂O → C ₂ H ₅ CH(OH)COOH + NH₄Cl	1
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Oct/Nov 2020 9701/21 · Q3 (c)(iv)

4(b)(i)	M1 (add) group 1 carbonate / group 1 bicarbonate / Na ₂ CO ₃ / NaHCO ₃ etc. M2 effervescence / fizzing / bubbling	2
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May/June 2022 9701/21 · Q4 (b)(i)

5(c)(i)	<i>suggest suitable reagent and conditions for step 1</i> heat AND any dilute named mineral acid e.g. dilute sulfuric acid / dilute hydrochloric acid	1
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May/June 2023 9701/21 · Q5 (c)(i)

4(a)(i)	LiAlH ₄	1
4(a)(ii)	$\text{CH}_3\text{CH}_2\text{CO}_2\text{H} + 4[\text{H}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{H}_2\text{O}$	1
4(b)(ii)	KCN / potassium cyanide in ethanol / C ₂ H ₅ OH AND heat	1
4(b)(iv)	(alkaline) hydrolysis	1
4(d)(ii)	butan-1-ol OR (2) methylpropan-1-ol	1
4(d)(iii)	butan-2-ol OR CH ₃ CH ₂ CH(OH)CH ₃	1

Question	Answer	Marks
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May/June 2025 9701/22 · Q4 (a)(i), (a)(ii), (b)(ii), (b)(iv), (d)(ii), (d)(iii)

4(c)(i)	condensation	1
4(c)(ii)	$\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3 + \text{H}_2\text{O}$	1

May/June 2025 9701/24 · Q4 (c)(i), (c)(ii)

5(d)(i)	oxidising agent	1
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May/June 2025 9701/24 · Q5 (d)(i)

4(d)(i)	condensation	1
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Oct/Nov 2025 9701/22 · Q4 (d)(i)